highways england

M25 Junction 10/A3 Wisley Interchange Combined Modelling & Appraisal Report
Stage 4
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1. Study overview

1.1 Context

In December 2014, the Department for Transport (DfT) published the Road Investment Strategy (RIS) for 2015-2020. The RIS sets out the list of schemes that are to be delivered by Highways England over the period covered by the strategy (2015 – 2020).

The RIS identifies improvements to M25 J10/A3 Wisley Interchange as one of the key investments in the Strategic Road Network (SRN) for the London and South-East region. The proposed improvements being as follows:

"Improvements to the Wisley interchange to allow free-flowing movement, together with improvements to the neighbouring Painshill interchange on the A3 to improve safety and congestion across the two sites"

This commitment to take forward the scheme for delivery in RIS 1 was confirmed within the Highways England Delivery Plan.

Planning and construction of the M25 J10 scheme will include works to convert the intra-junction mainline M25 at J10, from Dual Three Controlled Motorway (D3CM) to Dual 4 All Lane Running (D4ALR). This element was previously considered solely as an element of the M25 J10-J16 Smart Motorway Project (SMP).

Due to the inter-relationship of traffic impacts between the M25 J10 and the conversion of the intra-junction mainline to D4ALR, and the efficiencies provided through constructing them in tandem, the assessment of the M25 J10 scheme through statutory processes will therefore consider the impacts of both elements holistically.

1.2 Statement of scheme objectives

Without the intervention of measures to improve Junction 10, congestion on the approaches to, and through the junction will continue. This will become exacerbated by future traffic growth and would serve to discourage economic growth in the immediate surrounding areas, and along the A3 corridor. It would hinder the aspirations of the Enterprise M3 Local Economic Partnership (LEP) as well as Surrey County Council and Guildford Borough Council. There are no real alternatives to meeting this volume of travel demand via means other than road-based improvements.

The scheme objectives have been defined in line with addressing the problems and their consequences. They align closely with the business strategies for the Highways England, the LEP and for Local Government. The objective, desired outcome from each objective, and measure for success have been considered and are shown in Table 1-1.

In addition to the scheme objectives outlined, the following additional objectives should also be considered to consider optimising value for money and deliverability:

- The scheme, where possible, should make best use of existing infrastructure by providing additional capacity within the existing highway boundary

- The scheme should provide good value for money with an efficiency register as standard
- The scheme should be feasible and deliverable within the RIS timeframe
- The scheme should look to minimise the impact on the surrounding highway network whilst providing the best solution to the issues
- The scheme should consider provision of a viable winter service plan for all complex solutions and liaise with service providers for both Area 5 and Area 3
- The scheme should aim to avoid the need for further capacity interventions for at least ten years post opening (i.e. a mid to long term solution) and accommodate projected traffic demand for this period (to 2032, based on an opening year of 2022)
- The scheme should reflect Operations Directorate ‘fence to fence’ policy to incorporate renewals where foreseeable and commercially acceptable to avoid significant disruption to the public, i.e. ‘no return’ for five years and ideally for ten years for major carriageway interventions (e.g. by incorporating fully resurfaced network within the scheme with funding contributions from Operations Directorate and Service Providers where the cost would be outside of the committed RIS1 funding).

Table 1-1: Scheme objectives

Category	Objective
Route Operation	• Support any projected traffic increases from other committed schemes on the SRN and avoid or mitigate against causing adverse effects elsewhere on the Local Road Network.
Capacity	• Reduce the average delay (time lost per vehicle per mile) on the mainline A3 and on M25 through junction running; and • Smooth the flow of traffic by improving journey time reliability (Planning Time Index) on the mainline A3.
Safety	• Reduce annual collision frequency and severity ratio on the main line A3, slip roads and M25 J10 gyratory.
Social	• Support the projected population and economic growth in the area; • Support walking and cycling by incorporating safe, convenient, accessible and attractive routes for pedestrians, cyclists and equestrians and improving crossing facilities; and • Take account of the concerns of local communities and other key stakeholders raised during consultations.
Environment	• Support compliance with the UK’s legally binding limits and targets on air quality and water quality status and support targets to cut greenhouse gas emissions and objectives for local air quality management areas; • Avoid, mitigate and compensate for adverse effects on the integrity of the Thames Basin Heaths Special Protection Area and other statutory designated nature conservation sites and promote opportunities; • Recognise the significance of designated heritage assets close to the route of the scheme, including at Painshill Park and at Wisley Gardens through incorporating suitable mitigation and/or design measures to avoid or reduce significant harm; • Improve the quality of life for nearby residents, through addressing the effects of noise on people in the declared noise important area’s (IA’s) and ensuring that significant noise effects are mitigated; and • Ensure through good design, that an appropriate balance is achieved between functionality and the scheme’s contribution to the quality of the surrounding environment, addressing existing problems wherever feasible, avoiding, mitigating or compensating for significant adverse impacts and promoting opportunities to deliver positive environmental outcomes.

1.3 Description of scheme

An explanation of the Scheme objectives and a detailed description of the Scheme proposals can be found in the 'Introduction to the Application' (Application document TR010030/APP/1.2). In summary, the Scheme is needed to reduce congestion, improve safety, support planned housing and economic growth and improve walking and cycling provision. The key features of the Scheme include:

- alteration and upgrading of the existing M25 junction 10 roundabout, including elongation and widening of the circulatory carriageway, realignment, lengthening and widening of the junction entry and exit slip roads and demolition of redundant bridge structures
- provision of four new dedicated free-flow slip lanes at M25 junction 10, to enable left-turning traffic to pass through the junction unimpeded by traffic signals
- conversion of the existing hard shoulders on the M25 through junction 10, to provide an additional running lane for traffic in both directions, including emergency refuge areas and associated modifications to M25 gantries, signage and road markings
- widening of the A3 to dual four lanes between the Ockham Park junction and the Painshill junction, except where the A3 crosses over M25 junction 10, which will remain two lanes in each direction as at present
- widening of the A245 Byfleet Road to dual three lanes between the Painshill junction and Seven Hills Road to the west
- provision of two new dedicated slip lanes at the Painshill junction, to enable traffic leaving the A3 northbound carriageway to join the westbound A245 Byfleet Road and traffic on the A245 eastbound carriageway to join the A3 northbound, without having to enter the signalised roundabout
- improvement of the Ockham Park junction, including installation of traffic signals on and at the entries to the junction's gyratory carriageway and new crossing facilities for pedestrians and cyclists
- modification of A3 side road junctions, including improvement of the Old Lane junction, closure of the Wisley Lane junction and construction of a new road, bridging over the A3 to connect Wisley Lane with the A3 at the Ockham Park junction; and closure of the Elm Lane junction and provision of an alternative access to Elm Corner via Old Lane and an improved section of Byway Open to All Traffic
- closure of private accesses from the A3 mainline carriageways and the provision of substitute local access arrangements, including a substitute access for properties between Redhill Road and Seven Hills Road South via a new road running alongside the A3 northbound carriageway and connecting to Seven Hills Road South; a substitute access for properties on the edge of Painshill Park via the A3 southbound on-slip and a substitute access for properties at Wisley Common from Old Lane and crossing the A3 via the replacement Cockcrow Overbridge

- provision of new and improved facilities for pedestrians, cyclists and horse riders, including a new 5.5km long route alongside the A3 between the Ockham Park and Painshill junctions, new and replacement bridges for the benefit of non-motorised users to cross both the M25 and the A3, and new and upgraded public rights of way in the vicinity of the M25 junction 10/A3 Wisley interchange
- extensive areas of habitat creation and enhancement and other environmental mitigation works, including measures to compensate for the impacts of the scheme on the Thames Basin Heaths Special Protection Area and on Bolder Mere, the provision of replacement common land and public open space and the provision of a new wildlife crossing over the A3 as part of a replacement Cockcrow overbridge.

1.4 Details of previous economic assessments

At PCF Stage 0 an initial estimate of the economics for a fully free flow option was prepared as detailed in the Stage 0 report. Benefits were estimated by comparing the potential journey time improvements associated with free flow operation with existing journey times through the signalised roundabout. The estimate of benefits related only to present year flows passing through the junction in an opening year. A 60-year benefit of £763m was estimated, giving a BCR of 3.1 for an assumed construction cost of £250m.

At PCF Stage 1 an initial economic assessment used TUBA and COBA-LT to estimate travel time and vehicle operating cost benefits. The modelling assumed that the M25 J10 to 16 scheme would be provided in the do-minimum and do-something cases. The benefits were masked to only include benefits to traffic using Junction 10 or the network in the immediate vicinity. All assessment processes and values were in line with WebTAG using the December 2015 databook, which has subsequently been superseded.

The analysis showed that all three options had BCRs which provided “very high" Value for Money as follows:

- Option 9 – 8.32
- Option 14 – 7.37
- Option 16 (full grade separation) – 5.23.

Option 16 had all movements grade separated and generally smaller delays on most of the turn movements. However, the additional benefits in Option 16 over Option 9 due to reduction in delays were generally negated by the extra distance that needed to be travelled for most of the right turns. Hence, additional grade separation provided in Option 16 over and above Option 9 was not projected to provide additional benefits. Option 9 and Option 14 were taken forwards for further assessment.

At PCF Stage 2, the economic case and strategic case assessments show that Option 9 and Option 14 had a balance of strengths and weaknesses in terms of outcomes achieved and issues in relation to deliverability. User benefits (travel time and vehicle operating costs) account for the largest proportion of benefits and are 19% higher for Option 9 than Option 14. In addition, accident benefits are 26% higher for Option 9. The total level of benefit was 19% higher in Option 9 than Option 14.

However, the appraisal cost for Option 9 was 29% higher than that of Option 14. This imbalance between cost and benefit differential results in Option 14 showing the highest Benefit Cost Ratio (BCR) of the two options.

Both scheme options were classified as having a High Value for Money. Table 1-2 shows Option 9 has the higher total benefit, but Option 14 can be said to provide significant safety and traffic benefits and results in a higher return on investment in proportion to the cost.

Table 1-2: Summary of PCF Stage 2 PVB, PVC and BCR

Core scenario, £000s (PV)

Category	Op9	Op14
Present Value of Benefits (PVB)	505,670	432,501
Present Value of Cost (PVC)	157,972	122,125
Benefit to Cost Ratio (BCR)	3.20	3.54

The preferred option recommended for taking to PCF Stage 3 was therefore Option 14.

In comparison to the PCF Stage 1 analysis, the BCRs for the scheme options appeared to reduce considerably, and several reasons for this were identified:

- Software changes (TUBA and TEMPRO)
- Parameter changes (Values of Time, Vehicle Operating Costs, PPK and PPM values)
- Comprehensive improvements to the base year calibration of network and flows
- Improved accident analysis
- Demand model changes

At both previous stages an assumption was made regarding the M25 J10-16 scheme which was included in the do minimum and do something scenarios from the opening year. Detailed plans or descriptions were not available for the scheme at PCF Stage 1 or the early stages of PCF Stage 2, therefore an assumed scheme (namely widening to the M25 intra-junction carriageway (J10 becomes D4ALR) and widening between junctions (between J10 and J11 the mainline is widened D5CM) was agreed with Highways England Transport Planning Group.

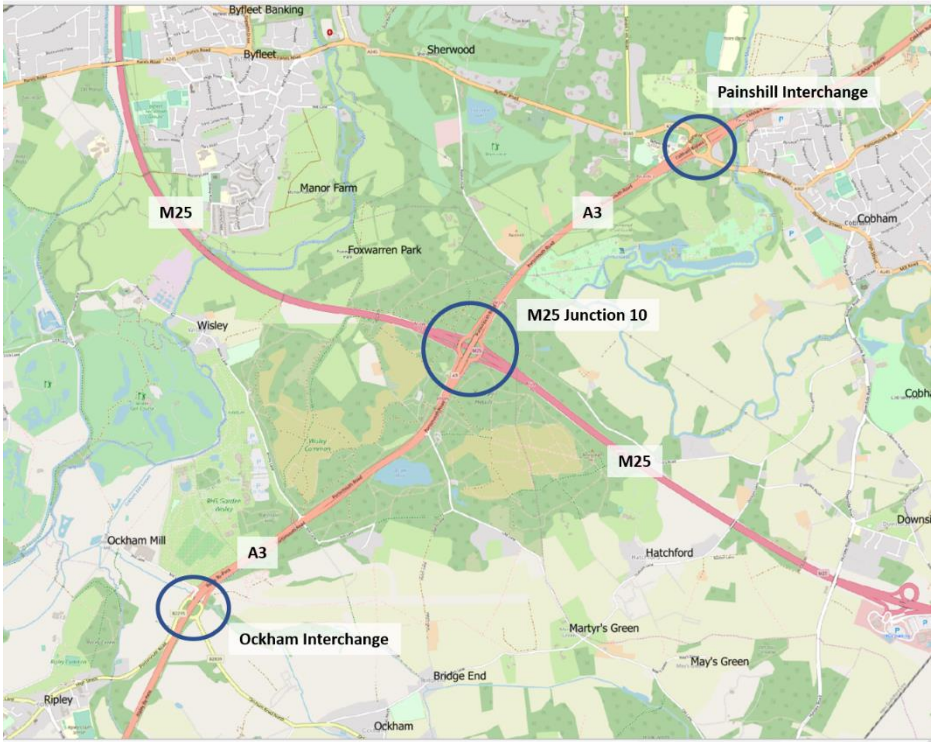
In February 2017, Amey-Arup released a description of the draft recommendation of the M25 J10-16 scheme. A sensitivity test based on the newly provided information was undertaken to understand the impact to the M25 J10 scheme. BCRs were shown to reduce to 2.38 for Option 9, and 2.42 for Option 14, therefore both scheme options were shown to deliver High Value for Money.

2. Local transport situation

2.1 Description of the local transport system

The M25 J10 lies in the south west quadrant of the M25 London Orbital Motorway. At M25 J10 the A3, a key radial route from London to Portsmouth, crosses the M25 motorway. In addition to M25 J10 itself, it has been recognised that the adjacent junction on the A3, Painshill Interchange to the north, is also a pinch-point. Figure 2-1 provides an overview of junctions on the M25 and A3 within the study area.

Figure 2-1: Location of junctions in M25 J10 vicinity



The interchange is situated approximately 30km to the south-west of the City of London and 12km to the north-east of Guildford and forms the confluence of several radial routes between Surrey, Hampshire and Greater London with orbital routes between Kent, East and West Sussex, Surrey, Berkshire and beyond.

The built–up area of Cobham is approximately 3km to the north-east of M25 J10 (and closer to Painshill Interchange), whilst Byfleet and St. George's Hill are just over 2km to the north-west. The villages of Ripley, Send and Burnt Common are situated between 3.5km and 5.5km to the south of the junction. South of the M25, the small hamlets of Elm Corner and Wisley are situated on either side of the A3, with Elm Corner being located just 320m to the east of the A3 and Wisley being approximately 1.4km to the west. The village of Ockham lies to the south east of the A3 Ockham Interchange. The popular visitor attractions of Painshill Park and the Royal Horticultural Society's Garden at Wisley are situated immediately alongside the A3, both to the north and south of M25 J10.

M25 J10 Interchange

The M25 J10 interchange sits on the eastern edge of the Borough of Guildford, and is also near the boroughs of Elmbridge and Woking. Together these boroughs have a population of over 375,000. These boroughs have strong and diverse economies, all containing offices of multi-national companies as well as local retail and business centres.

Putting it in a broader context, the M25 J10/A3 Wisley interchange area is on the eastern side of the Enterprise M3 LEP area which has a population of 1.6 million and sustains 740,000 jobs. High levels of housing and employment growth are planned for this wider area. The M25 is a D4M motorway (dual carriageway with 4 lanes in each direction) either side of M25 J10, although the section of the motorway between the slip-roads through the junction is of D3M standard (3 lanes in each direction). The A3 is a D3 road (dual carriage way with 3 lanes in each direction) either side of the junction, but only D2 between the slip-roads of M25 J10.

The junction itself is a signal controlled roundabout junction with no free-flow left-turn lanes. The roundabout has 3 lanes on the circulatory carriageway. All slip-roads have two lanes; with the A3 northbound off-slip and M25 westbound off-slip having four lanes at the stop-line, and the A3 southbound off-slip and M25 eastbound off-slip having three lanes at the stop-line

There are pedestrian, cycle and equestrian crossings on the roundabout.

Painshill Interchange

Painshill Interchange is approximately 2km to the north of M25 J10 on the A3, where it crosses the A245. This junction is the principle access point to the trunk road network for many surrounding settlements, including Cobham (via A245 east), Byfleet and Brooklands (via A245 west) and the southern parts of Weybridge and Walton-on-Thames via B365 Seven Hills Road. The A3 is a D3 road (dual carriage way with 3 lanes in each direction) either side of, and through, the junction. The A245 has a two-lane approach from the west and a single lane approach from the east. The junction consists of a signalised two-lane roundabout with two lanes at each stop line.

To the west of Painshill, the A245 is a D2 dual carriageway for a short stretch until it crosses Seven Hills Road (Seven Hills Junction). Seven Hills Junction is a signalised junction. West of Seven Hills, both the A245 towards Byfleet and Seven Hills Road towards Weybridge are single carriageways.

Ockham Interchange

Ockham Interchange is approximately 2.5km to the south of M25 J10 where it provides local access from Ripley, Ockham and surrounding areas. It has north facing slips only and the next junction to the south (Clandon) has only south facing slips. This junction is a non-signalised roundabout.

The A3 is a D3AP road (dual carriage way with 3 lanes in each direction) either side of, and through, the Ockham Interchange. Between Ockham and M25 J10 the A3 is a D3 road (dual carriage way with 3 lanes in each direction).

Access Roads

There are several minor junctions along the A3 between M25 J10 and Ockham Interchange. Southbound from M25 J10, there is a junction with Old Lane on the A3 southbound on-slip road. Just before the turn-off into Old Lane is a layby. After the point of merging of the on-slip is the junction with Elm Lane. Elm Lane provides access to a small number of dwellings and is signed as a non-through route. There is access only between Elm Lane and the southbound A3. There is no diverging lane at Elm Lane and turning traffic must slow down on the main carriageway; there is also no merge lane onto the A3 from Elm Lane. Immediately after Elm Lane is a bus stop, presently served by Route 515 between Kingston and Guildford. Buses serving this stop must also decelerate and accelerate on the main carriageway.

On the northbound carriageway between Ockham Interchange and M25 J10 there is the junction with Wisley Lane, which leads to RHS Wisley Gardens. There is no access between Wisley Lane and the southbound A3. There is only a small length of diverging lane off the A3 into Wisley Lane. Traffic coming from Wisley Lane travels some 100m on a ‘slip-road’ before merging. This slip-road is also used as a bus stop and a layby. On the A3 northbound off-slip there is an access road to Park Barn Farm.

Between M25 J10 and Painshill Interchange there are several residential accesses on to the A3 on both north and southbound carriageways in addition to access/egress from the San Domenico site.

2.2 The transport problem

The following problems and issues have been identified:

- There are no real alternatives that cater for the demands of orbital travel via other modes in this corridor
- The southwest quadrant of the M25, where M25 J10 sits, is one of the busiest sections of the motorway network and experiences severe congestion
- Queueing occurs on the mainline A3 daily on the approach to M25 J10, causing knock-on impacts to junctions to the south of M25 J10 and as far back as Ripley to the south and Painshill to the north and even further back during incidents
- Part of the queuing problem is caused by the difficulty accessing the M25 clockwise due to congestion on the M25, but this is being addressed through a separate M25 J10-J16 scheme
- Traffic leaving the A3 at Painshill is often prevented from doing so because of local network congestion tails back from the A245 Seven Hills Road junction that is signal controlled
- The area around M25 J10 has one of the highest recorded collision rate across the M25. Between 2010 and 2015 there were approximately 30 Personal Injury Accidents per year on or around the junction
- The land around M25 J10 and the A3 is of high environmental value and include Special Protection Areas and Sites of Special Scientific Interest

- The facilities for walkers/cyclists along the A3 and at M25 J10 require improvement.

Without appropriate intervention to improve the performance of M25 J10, 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, user satisfaction and environmental impact. Ultimately it will reduce the ability of the junction to perform its role in supporting local and regional aspirations for development and growth.

3. Summary

3.1 Modelling and appraisal approach

In previous PCF Stages the M3/M4 model, developed by Mouchel in 2012, with refinements in the M25 Junction 10 area, was used. It was agreed with Highways England that the South East Regional Transport Model (SERTM) would be used as the basis for PCF Stage 3, as this provides an opportunity for a comprehensive assessment of the wider area and regional impacts of the scheme.

The SERTM was enhanced in the M25 Junction 10 area to include more detailed zoning and network resolution. It was intended that consistency between the SERTM and previous models was retained as far as possible.

A full description of the SERTM is found in the associated reporting documents related to that model.

The economic appraisal included the following elements:

- Scheme construction
- User costs and benefits during construction
- User costs and benefits during operation
- Monetised air quality, noise and greenhouse gas emission impacts
- Accident savings
- Indirect tax effects
- Journey time reliability impacts
- Wider economic impacts

The appraisal results are summarised in the ComMA Summary Template presented in Appendix A.

3.2 Recommended option

Previous option assessment and selection

The current scheme design was selected from a wider range of options during earlier PCF stages.

From the long list of options in PCF Stage 0, three options were taken forwards:

- ‘Option 9’ – a four level free flow in two directions (similar to the current M25 Junction 12)
- ‘Option 14’ – an elongated roundabout with dedicated, free-flow left turn lanes
- ‘Option 16’ – all movements grade separated

The analysis showed that all three options had BCRs which provided ‘Very High’ Value for Money. Additional benefits in Option 16, over Option 9 due to reduction in delays were generally negated by the extra distance that needed to be travelled for most of the right turns. Hence, additional grade separation provided in Option 16 was not projected to provide additional benefits. Option 9 and 14 were taken forward for further assessment.

At PCF Stage 2, the economic case and strategic case assessments showed that Option 9 and Option 14 had a balance of strengths and weaknesses in terms of outcomes achieved and issues in relation to deliverability. User benefits (travel time and vehicle operating costs) account for the largest proportion of benefits and are 19% higher for Option 9 than Option 14. In addition, accident benefits are 26% higher for Option 9. The total level of benefit was 19% higher in Option 9 than Option 14.

However, the appraisal cost for Option 9 was 29% higher than that of Option 14. This imbalance between cost and benefit differential results in Option 14 showing the highest Benefit Cost Ratio (BCR) of the two options.

Both scheme options were classified as having a High Value for Money. Option 9 was shown to have the higher total benefit, but Option 14 can be said to provide significant safety and traffic benefits and results in a higher return on investment in proportion to the cost. Therefore, the preferred option for PCF Stage 3 was Option 14.

Refinement during Stage 3

The scheme currently included the proposed conversion of the through-junction section of the M25 at Junction 10 from three lanes plus hard shoulder to four lanes, known as Junction 10 Through Junction Running (TJR). This element was originally part of the M25 J10-16 RIS scheme but is now included within the M25 J10 scheme due to the opportunity to reduce construction impact on the network by delivering both elements at the same time.

4. Summary & review of existing data

4.1 Introduction

This section will focus on summarising and reviewing existing data which is used in support of the study.

4.2 Review of existing data

As well as additional data, PCF1 and PCF2 data sets used in model development have been reused in the development of the PCF3 highway models.

The data used is categorised into eight groups and summarised below, for more details, including locations of sites, refer to Section 3.2 of the Data Collection Package Report:

- Volumetric data – available data was extracted from the TRADS database, as well as ATC sites used in previous stages
- Demand data – ANPR surveys from PCF2 were used
- Journey time data – Trafficmaster data for the study area, for March 2015, was obtained
- Network data – SERTM was used as a starting point for coding and signal timings
- Mapping data – OS open source tiles, Google Earth and Google Maps were used to check the accuracy of the modelled network
- Operational data – SERTM and the previous S-Paramics model were utilised
- Accident data – detailed accident data provided for PCF2 was used, with additional data supplied for more recent years
- Additional data requirements – additional data was required to update the S-Paramics model, including new flow surveys, journey time data and bus routes and timetables.

More details about the data collated and a summary of that data can be found in the Transport Data Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000004).

5. Data collection

5.1 Introduction

The strategic SATURN model remains as a 2015 base year, however the S-Paramics model has been updated to reflect a 2017 base year and, therefore, required a new data collection exercise. Therefore, this section summarises the data collected to support the PCF3 S-Paramics model.

5.2 Specification of additional data

As part of the data collection process, the following data has been collected:

- ANPR surveys on a defined cordon around M25J10
- MCC surveys to provide more detail of traffic counts by vehicle type
- Wisley event day surveys to understand the impact of increased traffic on the local highway network
- 2017 Trafficmaster to assist with the modelling work undertaken.

Intelligent Data Collection (IDC) were commissioned to undertake the traffic surveys, with the ANPR and MCC surveys completed in May 2017 and the event day survey in April 2017.

Independent checks were undertaken for the mainline counts on the M25 using WebTRIS data from the day of the survey, after an issue was raised with IDC, these showed that recounted data was similar to the WebTRIS counts. There were no reported issues with the event day MCC data and the ATC data from Wisley Lane.

More details about the data collected and a summary of that data can be found in the Transport Data Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000004).

6. Final datasets

6.1 Introduction

The existing data from previous stages, and the new data collected for PCF3, have been used to assist with transport modelling. The data has allowed for more detailed models to be created, and the S-Paramics model to be updated to a 2017 base year. The data allows for robust validation and calibration of the 2017 base model, before using this to test the preferred scheme design.

6.2 Data used

The data used for each of the strategic SATURN model and the operational S-Paramics model is summarised in Table 6-1 below, however more detail can be found in Chapter 5 of the Data Collection Report.

Table 6-1: Data used in highway modelling

Data	Operational S-Paramics Modelling	Strategic SATURN modelling
Volumetric data	WebTRIS data for 2017 has been obtained for the M25 mainline, J10 slip roads and A3 mainline to assist with creating matrices for the model	2017 ANPR data is used to understand trip distribution for the newly added RHS Wisley zone and additional count sites on local roads were utilised for calibration and validation on newly added links
Demand data	2017 ANPR data has been used to assist with creating the demand matrices. MCC data gives known counts which are locked into the matrices. Both the ANPR and MCC data have been used for model validation and calibration.	The prior matrices for PCF3 base model is retained with very minimal changes.
Journey time data	2017 Trafficmaster data has been used for journey time validation and calibration.	2017 Trafficmaster data has been used for journey time validation and calibration.
Network data	SCC provided updated signal plans for Seven Hills Road/Byfleet Road junction. Bus routes and timetables from site visits and SCC websites were used to assist with traffic distribution.	Updated signal plans for Seven Hills/Byfleet Road were used and speed limits from site visits and Google Street View were used to identify locations where speed limits change.
Mapping data	OS open source tiles were used to provide an outline of the highway network, with more detail obtained using satellite imagery and Google Street View.	OS open source tiles were used to provide an outline of the highway network, with more detail obtained using satellite imagery and Google Street View.
Operational data	Operational data was collected on a site visit in June 2017 to help understand driver behavourior. Typical traffic on Google maps was used to see queue length.	Seven Hills Road/Byfleet Road Junction signal timing and staging was updated with the new data set from SCC.
Accident data	Detailed accident data for 2010 to 2015 was available from PCF2, this was updated to include 2016 and 2017 for PCF3	

6.3 Summary of adequacy of the datasets

Although there were some issues with the ANPR data, the analysis and checking procedure of the data allowed for errors to be identified and fixed, where necessary. Additional journey time data is checked against the data received in PCF2, as these are expected to be similar. The site visit undertaken in June 2017 allowed the signal timings and stages to be corroborated with the data received from SCC.

7. Model description & specification

7.1 Introduction

Prior to the beginning of PCF3, there were two existing traffic models available:

- The M3/M4 model developed by AECOM, with a 2009 base year, with model refinements in the M25J10 area for earlier PCF stages
- The South East Regional Traffic Model (SERTM) developed by Highways England, with a 2015 base year.

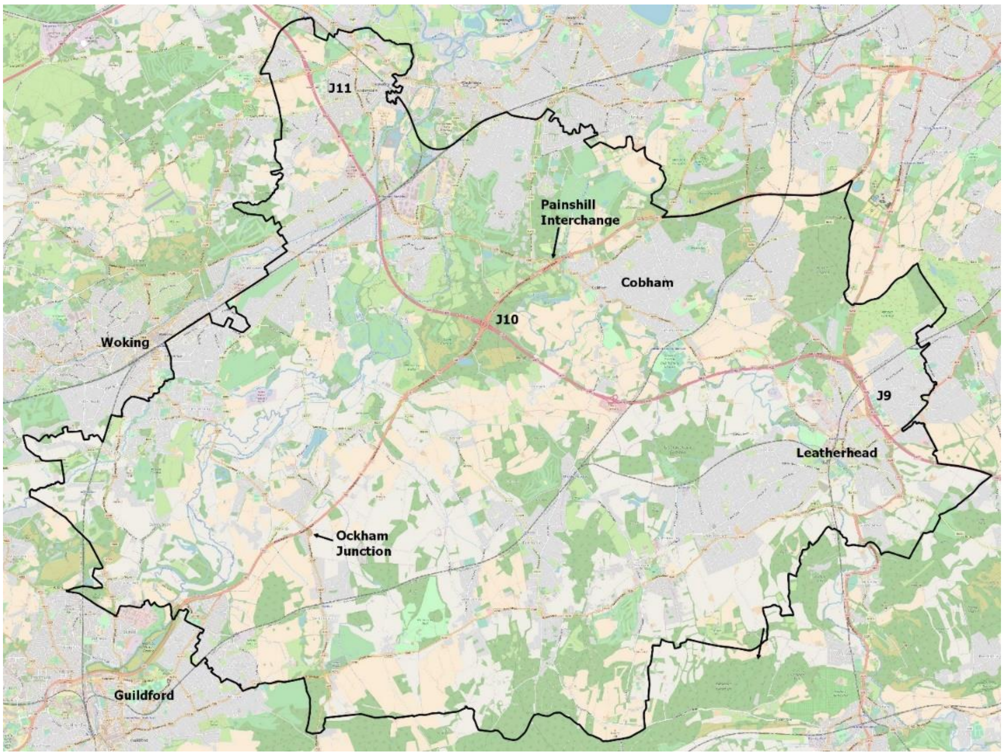
7.2 Description of the overall transport modelling architecture

It was agreed with Highways England that the SERTM would be used in PCF3, with more detailed zoning and network resolution in the M25J10 area as enhancement.

7.3 Modelled area

The Area of Detailed Modelling (AoDM) is shown in Figure 7-1.

Figure 7-1: Area of detailed modelling



7.4 Overview of the model system and standards

The M25J10 study maintains the highway assignment and variable demand modelling (VDM) elements of SERTM. Unless stated, it is assumed that the model processes, demand segmentation, networks and description are consistent with SERTM. Any amendments to the SERTM modelling suite are specifically highlighted in Section 3.4 of the Transport Model Package Report.

Within the AoDM standard WebTAG acceptability guidelines have been utilised, however outside this area, it is assumed that the SERTM model detail and acceptability standards are sufficient.

7.5 Statement of software packages

The model suite includes a VDM using a demand model in DIADEM and a highway assignment model in SATURN, along with a simplified representation of public transport.

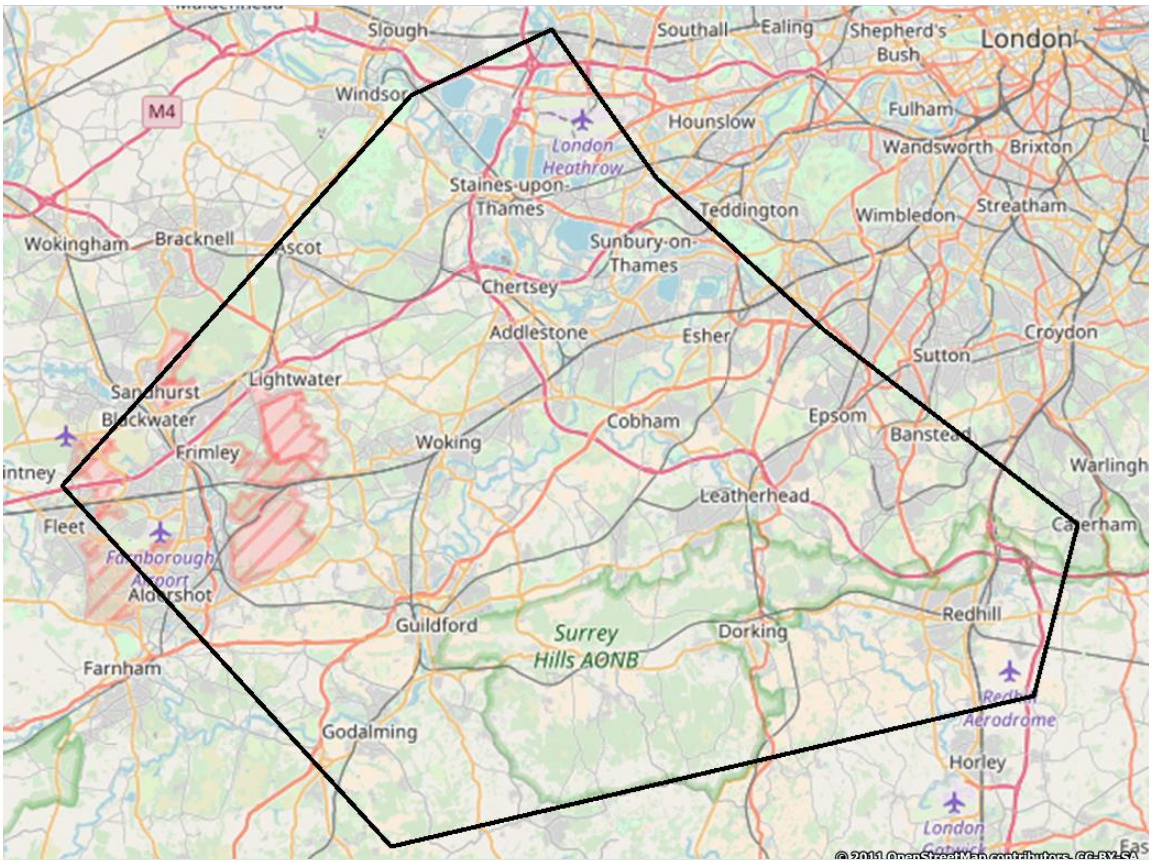
7.6 Model convergence and run times

The fully simulated area of the SERTM is larger than the M3M4 model used in previous PCF stages. Whilst this allows for greater confidence on the assessment of the impact of the scheme over a wider area, it increases the likelihood of issues with model convergence, noise and run times.

In order to retain manageable operational model performance and reduce the impact of model noise and convergence issues, a Fixed Cost Function (FCF) was used. Other cordoning options were considered and can be seen in Section 3.6 of the Transport Model Package Report.

The FCF cordon area is shown in Figure 7-2.

Figure 7-2: Fixed cost function region



For greater detail on the model, including changes made from SERTM and assignment parameters, please refer to Transport Model Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000003).

8. Model development

8.1 Introduction

The SERTM was enhanced in the M25J10 area to allow better representation of the current and future situation in this area.

8.2 Demand model

No changes were made to the demand model.

8.3 Network coding

The network development for PCF3 was limited to the area within the AoDM and comprised of:

- Splitting of zones
- Addition of a lane on the M25CW mainline before off-slip
- Updating the A3 merges/diverges to be in line with motorway merges in the SERTM manual
- Signalisation of junction near Copsem roundabout
- Updating speed flow curves and saturation flows to match observed data
- Addition of local network.

With the addition of new zones, adjustments to trip generation and distribution was required. The SERTM prior matrices were used as a starting point, with distribution at RHS Wisley based on a Transport Assessment and the remainder being based on local existing zones and select link analysis.

For more details on changes from SERTM and model development refer to Transport Model Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000003).

9. Model calibration

9.1 Identification of data

The traffic count data outlined in Section 6 is used in the development of localised screenlines for calibration and validation. Additional ATC locations were used to determine screenlines for trip matrix validation and calibration.

Outside the AoDM and elsewhere, the existing count dataset and screenlines defined and utilised in SERTM are retained.

Generalised cost parameters were derived using a spreadsheet provided for this purpose by Highways England and can be seen in Section 5.3 of the Transport Model Package Report.

9.2 Matrix Estimation

The overall data and processes for matrix estimation were consistent with SERTM. Detailed differences are:

- Counts in the AoDM were replaced with up to date data
- Re-ordering of the data hierarchy in matrix estimation to give local counts highest priority; and
- Utilisation of revised M25J10 prior matrices.

Changes in matrix totals due to matrix estimation can be seen in detail in Section 5.4 of the Transport Model Package Report. In summary, the post matrix estimation matrices retain the trip length distributions of the prior matrices, have very similar totals, however show significant differences at sector level, as was the case with the original SERTM matrix estimation.

9.3 Checks of network characteristics

Networks were checked to ensure consistent coding in accordance with the Network Coding Manual for the RTMs and checks were also performed on key junctions and network connectivity. Some of the changes which were carried from previous stages of the M25J10 model.

For greater detail on the model calibration Transport Model Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000003).

10. Model validation

10.1 Independence of validation data

Validation included:

- Comparison of modelled journey times against independent Trafficmaster data
- Comparison of screenline model flows with traffic count data not used in matrix estimation.

10.2 Convergence and stability

The recommended WebTAG convergence criteria is generally met for all peak periods in terms of both ‘stability’ (%Gap) and ‘proximity’ (P<1%). A table presenting the last six iterations can be seen in Section 6.2 of the Transport Model Package Report.

10.3 Comparison of flows and screenline counts

The post estimation matrices have been calibrated and validated through comparison of observed and modelled flows for screenline and cordon totals and through individual link comparisons.

An all count summary was completed, with the WebTAG criteria being met for at least 85% of the links.

For the AM and IP models, all the calibration and validation screenlines are within 5% of the observed data, for the PM model 90% of the screenlines are within 5% of the observed data. In all cases, the screenline totals are within 10% of the observed flows and meet the overall WebTAG criteria.

The majority of links meet WebTAG link flow criteria. Importantly for scheme assessment, all the turning movements at M25J10 in all time periods meet both criteria. All mainline flows also meet both criteria, with the exception of the A3 SB south of M25J10 which just exceeds the GEH criteria. Modelled flows on the A3 tend to be slightly lower than observed, however all flows meet the criteria. Given that the turning flows at M25J10 are all within the criteria, this is unlikely to have a material effect upon the scheme assessment.

Details, including tables of results, can be found in Section 6.3 of the Transport Model Package Report.

10.4 Comparison of journey times

A SFC analysis was undertaken and showed a very large spread of data indicating a high level of variability in speeds and frequent occurrences of over-saturated flow breakdown conditions.

Speed flow curves are not capable of matching flow breakdown conditions, like those frequently seen on the M25 between junctions 9 and 11. Therefore, it is anticipated that model speeds for this section will tend to be ‘fast’ compared with ‘average’ observed conditions. A sensitivity test will be undertaken to demonstrate the difference between a default and fitted SFC for the base and forecast assignments.

The SERTM network is generally faster than the mean observed journey time, in particular on the M25, due to the SFC being unable to represent speeds and journey times in flow breakdown conditions. However, the analysis of variability has shown that the modelled journey times lie within the range of observed journey times.

10.5 Realism tests

The methodology, reasoning and detailed results for the realism tests are given in Section 6.5 of the Transport Model Package Report.

The overall changes in elasticity due to car fuel increase is -0.32, which is within the plausible range recommended in WebTAG. Business trips are more sensitive to changes in fuel costs than the expected values. It is recommended that the implications of this irregularity are included in subsequent forecasting analysis.

10.6 Summary of validation performance

The outputs presented discussing model development, calibration and validation show that the model is considered suitable for the purpose of developing traffic forecasts used to inform economic, environmental and operational appraisal of highway infrastructure schemes around the M25J10.

For greater detail on the model validation refer to the Transport Model Package Report (HE551522-ATK-GEN-XX_Z-RP-TR-000003).

11. Forecast assumptions

11.1 Introduction

This section details the assumptions and inputs into the development of the forecast year traffic model. The forecasting approach applied draws on guidance from WebTAG, in particular: TAG unit M2, March 2017; and TAG unit M4, July 2017.

For details on the forecasting approach refer to Section 3.1 of the Traffic Forecasting Package Report.

Forecast matrices were produced with National Trip End Model (NTEM 7.2) data, making any necessary adjustments to account for the local developments to be included. DfT Road Traffic Forecasts (2015 RTF) were used for the growth of freight traffic.

Details of the planned network and developments are categorised in an uncertainty log in line with WebTAG. High and low growth scenarios, based on uncertainty in national growth in demand, are included in addition to the core scenario. Treatment of local uncertainty with regard to planning is not included in the alternative scenarios.

11.2 Description and justification of the forecast years

For PCF3, traffic forecasts were required for the following years:

- 2022 (year of opening)
- 2037 (design year)

The forecast years are consistent with those used in previous PCF stages

11.3 Uncertainty log

For this model, the core scenario was developed based on:

- NTEM 7.2 forecasts on travel demand growth in the south east
- Sources of local uncertainty that are more likely to occur than not
- Appropriate modelling assumptions

The management of the uncertainties in formulating the core scenario follows relevant guidance in WebTAG, which recommends the establishment of an uncertainty log, and subsequently forming a core scenario based on the level of uncertainty identified.

National uncertainty involves national projections such as demographic data, GDP growth and fuel price trends. In the core scenario, the impact of changes in demographic data is assumed to be based on the NTEM dataset, while growth in other parameters is taken from the TAG Data book. As is the case with most models, the SERTM will not be able to reflect the uncertainty of national trends, therefore, high and low growth scenarios are used.

For more details on national uncertainty and local uncertainty, including the land use developments included in the core scenario refer to Section 3.3 of the Traffic Forecasting Package Report.

11.4 Reference case forecast demand

The Reference Case matrices reflect the changes in demand from the base year, attributable to demographic variations such as the changes in number of jobs and residents in an area and the number of cars owned. They represent the travel demand that would arise if there were no changes in travel costs from the base year model.

The demand model then creates forecast assignments using the Reference Case matrices to extract travel costs which are pivoted off the base year assignment. Using this methodology, the do-minimum forecast matrices are created accounting for:

- Changes in value of time resulting from changes in income (based on WebTAG values)
- Changes in fuel efficiency and operating costs which change the cost of car travel
- Transport interventions between the base and the forecast year
- Changes in levels of congestion arising from changes in car usage.

The basis for developing the future year trip matrices was a combination of the NTEM 7.2 database for private trips and the National Transport Model (NTM) for freight vehicles.

NTEM 7.2 forecasts have been used inside the local council areas, to act as a control on the overall growth after applying the increases from local developments. Within the South-East region, growth has been constrained at NTEM county level. Outside this area, growth has been controlled to balance to regional target values. The process to develop the growth accounts for car ownership.

For details on the method used to apply growth to car and freight trips and the overall impact of applying growth refer to Section 3.4 in the Traffic Forecasting Package Report.

11.5 Forecast year networks

Outside the AoDM, the do-minimum highway network infrastructure changes are consistent with SERTM, with each of the committed schemes included on top of the validated base year network. For a list of the committed infrastructure assumptions included in the forecast years, see the associated Traffic Forecasting Package Report and uncertainty log.

The do-minimum network comprises of the validated base network with the addition of the SERTM schemes outside the AoDM.

During the project, it was found that there were various network issues, therefore, convergence fixes and signal optimisation was undertaken.

The coding of the do-something network is consistent with the do-minimum network, allowing for transfer of data to the environmental team and for checks of operational and economic performance.

Prior to running the VDM, traffic signal information and operational timings were derived from previously issued models. To ensure the most efficient operation at the junction, further optimisation and refinement was utilised and an additional assignment of the highway models was undertaken.

11.6 VDM and post VDM highway adjustments

During the modelling analysis, it was found that the highway assignment and the VDM had issues regarding convergence, noise and model run times.

It was agreed, due to time constraints, that the VDM process would terminate after ten loops for each scenario. In the fully modelled area, the VDM achieves the recommended demand/supply gap for both scenarios in the forecast years. The level of convergence outside this area, whilst above the recommended values, was deemed acceptable.

Due to the long run rimes of DIADEM, it was agreed that a stable VDM platform would be established and subsequent model improvements would be undertaken with highway only assignment.

Post VDM adjustments

The following changes were made and a highway only assignment was undertaken:

- Network adjustments including signal optimisation, network and capacity fixes and refinement of template coding outside the AoDM
- Highway demand matrix changes to Wisley Gardens and Wisley Airfield
- Use of refined Fixed Cost Function area.

For details of these changes refer to Section 3.6 of the Traffic Forecasting Package Report (HE551522-ATK-GEN-XX-RP-TR-000002).

12. Forecast results

12.1 Introduction

The results presented are based on the outputs from the highway only assignment (post VDM) with the changes made to the network, localised demand adjustments and utilising the Fixed Cost Function.

12.2 Model convergence

The highway assignment model converges to WebTAG recommendations in both 2022 and 2037.

12.3 Core scenario forecast outputs

The historical trends and projected changes in the do-minimum scenario are compared on the M25 mainline to the west of J10 and on the A3 through J10. The results (presented in Section 4.3 of the Traffic Forecasting Package Report) show a growth in traffic in both locations, with network improvements on the A3 allowing an increased capacity. The do-minimum forecasts are considered sufficiently robust to test the effects of the proposed M25J10 scheme.

When looking at a cordoned area, constrained to that used for operational modelling, there is an increase in trip demand of approximately 600-1000 PCUs in 2022 and 800-1200 PCUs in 2037 due to implementing the scheme. This demand response is consistent with the effects of operational benefits, with a localised average travel time saving of up to 100 seconds.

Throughput and delay

The throughput of M25J10 is expected to decrease in the do-minimum, compared to the base, in 2022 and increase in 2037. Delay is expected to increase in both forecast years due to the way that signal timings have been optimised in the future year do-minimum scenario. The introduction of the scheme is expected to result in a reduction in delay relative to the base.

Journey Times

Journey time comparisons show that the scheme provides significant journey time savings throughout the local area, with increases in travel time isolated to: Old Lane; Painshill A3 SB off-slip in the AM; the A307 in Cobham; and Ripley village.

Whilst there are expected to be increases through Ripley village, particularly on the approach to Ockham roundabout, the overall change in journey time between Ripley and Painshill decreases in all scenarios.

Traffic Flow

There are significant increases in capacity of turning flows at M25J10, hence an increase in flow is seen. There is a decrease in flow going through J10 in both directions, which can be attributed to an increase in vehicles using the A3 to join the M25 at J10, as opposed to joining at J9. An increase in flow on some local roads is expected, however in the scheme proximity an overall decrease of up to 0.5% is expected, with travel times decreasing by almost 1%.

More details, including tables of results and figures, on throughput, journey times and traffic flows can be found in Section 4.3 of the Traffic Forecasting Package Report.

12.4 Sensitivity Tests

The core scenario is intended to be the best basis for decision-making given current evidence, however there is no guarantee that the outturn will match the assumptions. Therefore, sensitivity testing is undertaken to provide evidence that intervention is still effective under high growth assumptions and that the intervention is economically viable during low growth assumptions.

In accordance with WebTAG Unit M4, the low and high growth traffic forecasts should be based on a proportion of base year demand added to, or taken away from, the demand for the core scenario. For this scheme, forecasts were required at the opening year (2022) and design year (2037), therefore, appropriate low and high growth factors were required for each modelled year. These are presented in Table 4-8 of the Traffic Forecasting Package Report.

High and low growth was run for all years and time periods with a consistent pattern seen where the lowest growth scenario still provides travel time benefits and the highest growth scenario is still effective in reducing congestion.

An additional sensitivity test to present the impact of no through junction running at J10 was run and can be found in Appendix B.1 of the Traffic Forecasting Package Report (HE551522-ATK-GEN-XX-RP-TR-000002).

13. Economic appraisal approach

13.1 Introduction

The Economic Assessment has been carried out using standard procedures and economic parameters as defined in TAG Unit A1, with efforts made to quantify and monetise costs and other impacts where appropriate. The Value for Money (VfM) assessment is carried out as a staged process to ensure that a complete and robust analysis is undertaken.

At Stage 4, key elements of the Stage 3 Economic Assessment have been updated to include an additional forecast year, 2051, and to consider an updated scheme cost estimate. The key elements that have been reassessed are outlined as follows.

- Changes in travel time and vehicle operating costs;
- Accident savings;
- Monetisation of wider economic impacts; and
- Consideration of an updated scheme cost estimate.

These elements are all reported in the Stage 4 EAR Addendum. All other aspects of the Stage 3 assessments remain unchanged.

13.2 Economic appraisal processes

The impacts of the M25J10 scheme have been estimated using outputs from the SATURN model in conjunction with industry standard appraisal software, focusing on three areas of impact: impacts on travel times and vehicle operating costs; impacts on road accidents; and assessment of delays during construction.

Software used in economic appraisal

The appraisal of the identified impacts was undertaken using TUBA v1.9.10 and COBA-LT software packages (for user benefits and accident benefits respectively).

All benefits and costs were assessed over a 60-year project post opening appraisal period (2022 to 2081), before being discounted to a common base year of 2010.

13.3 Scheme costs

The preparation of the scheme costs has been carried out following principles set out in TAG Unit A1.2.

Scheme costs at Stage 3 have been derived from information provided by the Highways England Commercial Services team and the revised costs have been derived from a total capital baseline cost provided by the Regional Delivery Partner.

Table 13-1 summarises the outturn costs for the scheme estimated at Stage 3 and the revised costs at Stage 4. It should be noted that for the core Stage 4 economic assessments, the revised baseline capital cost estimates are considered, as agreed with Highways England. The capital cost estimates at

Stage 3 are presented to provide context for sensitivity tests for high and low growth and for M25 Junction 10 Through Junction Running discussed in Section 14.13.

Table 13-1: Cost forecasts, £million

	Stage 3 Capital baseline cost	Revised Capital baseline cost
Scheme	282.4	272.6

These costs have been rebased to 2010 calendar year profiles for economic calculations, using the GDP-deflator series as published in the latest TAG Data book. All costs are in factor cost unit of account and exclude VAT, both recoverable and non-recoverable. Table 13-2 summarises the economic costs for the Scheme.

Table 13-2: Discounted scheme costs – investment, PV, £million

	Stage 3 Cost, £million PV	Revised Cost, £million PV
Preparation	11.0	10.6
Supervision	6.5	6.3
Works	162.0	156.4
Land	18.3	17.7
Total	197.8	190.9

The costs presented include allowances for risks in the construction and programme, however, as advised by Highways England, no allowance is made for optimism bias.

13.4 Changes in travel time and vehicle operating cost

The impacts of the scheme on travel times and vehicle operating costs were assessed using the DfT's TUBA programme.

The scheme related parameters in the TUBA scheme file were largely determined by the parameters used in the forecasting model, namely: the first year, 2022; the last year, 2081 (60 years from opening year); and the modelled years, 2022, 2037 and 2051.

No further growth in traffic or benefits was assumed beyond 2051 (apart from an allowance from continued growth in real value of time, in line with WebTAG).

The TUBA assessment was based on four time slices: AM; IP; PM; and weekend. Annualisation factors were used to convert estimates of costs and benefits during the modelled hours into estimates for 12 hour working week days for each modelled year. The time slices and annualisation factors used are detailed in Section 3.4 of the Economic Assessment Package Report, while the updated assessment is reported in Section 3.2 of the Stage 4 EAR Addendum.

13.5 Accident savings

The DfT's COBA-LT spreadsheet has been used to provide a simple assessment of the impact of the scheme on accident costs.

Links within the Affected Road Network (ARN) which saw a traffic flow change of more than 5% were included in the calculation of accident benefits.

Accident rates in the vicinity of M25J10 were calculated using observed data from 2012 to 2016, with links with no data using COBA-LT default accident rates.

Consistent with TUBA, the COBA-LT assessment considered impacts over a 60-year appraisal period, drawing on traffic flow information from the SATURN models for 2022, 2037 and 2051, and assuming no further growth in traffic or benefits beyond 2051 (apart from an allowance from continued growth in the real value of accidents, in line with WebTAG).

The accident analysis report included as Appendix B of the Economic Assessment Package Report details the observed accidents, while the updated assessment of the impact of the scheme on accidents is documented in Section 3.3 of Stage 4 EAR Addendum.

13.6 Journey reliability benefits

The scheme is expected to reduce queuing and delays at and around M25J10, which will improve travel time reliability for road users. Furthermore, widening the A3 between the Ockham and Painshill interchanges is anticipated to allow for a smoother flow in traffic past Junction 10.

Highways England’s MyRIAD tool has been developed to measure the effects of changes in incident related journey time variability on motorways but is only able to capture reliability variations in relation to motorway widening schemes and technology improvements on links, therefore a classification of D4AM has been adopted for the A3 in the Do-Something scenario. A report detailing the methodology used in the MyRIAD assessment is included in Appendix B of the Economic Assessment Package Report.

The monetised benefits from MyRIAD have been included in the adjusted BCR as Level 2 benefits.

WebTAG does not provide a specific approach for assessing reliability impacts on non-urban junction improvement schemes.

TRIS data from Highways England has been analysed for investigating the reliability of J10 turning movements, as well as M25 and A3 mainline movements. This analysis has been used to determine the Planning Time Index (PTI) for several movements around J10.

13.7 Impacts of construction and maintenance

Construction of the scheme would involve a complex programme of traffic management on the live highways, including: reduced speed limits; narrow lanes; lane closures; and overnight closure of the road with diversions.

Construction delays were determined by reducing speed limits to 50mph on the M25 and A3 mainline in the immediate vicinity of M25 J10. In addition, two seconds of intergreen time were added to each signal phase at J10 to account for delays due to construction vehicles.

The construction dis-benefit has been estimated by undertaking a TUBA assessment for the two years of the construction period.

Full details of the buildability of the scheme were considered in terms of construction phases and are presented in the March 2017 M25J10/A3 Improvements Buildability Review, Skansa.

At present, there is no allowance for the dis-benefits that will be experienced after opening during maintenance periods due to the increase in available capacity.

13.8 Monetisation of environmental impacts

Air quality and greenhouse gases

The approach to assessing local air quality for a scheme is set out in TAG Unit A3 (the Air Quality Sub-Objective) and is based on a quantification of the change in exposure at properties in the opening year.

Further details are provided in the PCF3 Environmental Statement.

Noise

The approach for assessment of traffic-related noise is set out in TAG Unit A3 (the Noise Sub-Objective) and similar to the air quality assessment is assessed by the change in noise levels at residential property frontages in the opening year.

Further details are provided in the PCF3 Environmental Statement.

13.9 Monetisation of wider economic impacts

Whilst no specific modelling of Wider Economic Impacts has been undertaken, for the purposes of this assessment the following was proposed:

- Benefits associated with increased output in imperfectly competitive markets were quantified in line with WebTAG Unit A2.2 and the DfT's Wider Economic Benefits and Transport Appraisals: A Guidance Framework. The benefit is estimated by applying a 10% uplift factor to the business and freight transport user benefits
- New methodology for agglomeration once agreed.

The monetised benefits assessed from the above process are Level 2 benefits and are therefore included in the adjusted BCR when considering overall Value for Money.

13.10 Social and Distributional impacts

Social impacts cover the human experience of the transport system and its impact on social factors, where not considered as part of economic or environmental impacts. The WebTAG appraisal has been carried out in accordance with TAG Unit A4.1 Social Impact Appraisal.

Distributional impacts consider the variance of impacts across different social groups and are assessed as part of the appraisal and entered into the Appraisal Summary Table (AST).

The purpose of the Distribution Impacts analysis is to attempt to identify those who would gain or lose from the Scheme, with particular emphasis on the potential impact upon equality through identifying the effects upon those who are disadvantage compared to the majority of the population.

A distributional impact report for the Scheme can be found in Appendix C of the Economic Assessment Package Report (HE551522-ATK-GEN-XX-RP-TR-000003).

14. Economic appraisal results

14.1 Introduction

This section presents the results of the economic assessment for the Do-Something scenario compared against the Do-Minimum scenario.

14.2 Travel time and vehicle operating benefits

Table 14-1 presents the Present Value of Benefits (PVB) of the scheme after opening from TUBA. The travel time benefits account for the majority of the scheme benefits, with negative vehicle operating benefits due to increased travel distance.

Table 14-1: TEE table summary of 60-year travel time and vehicle operation costs

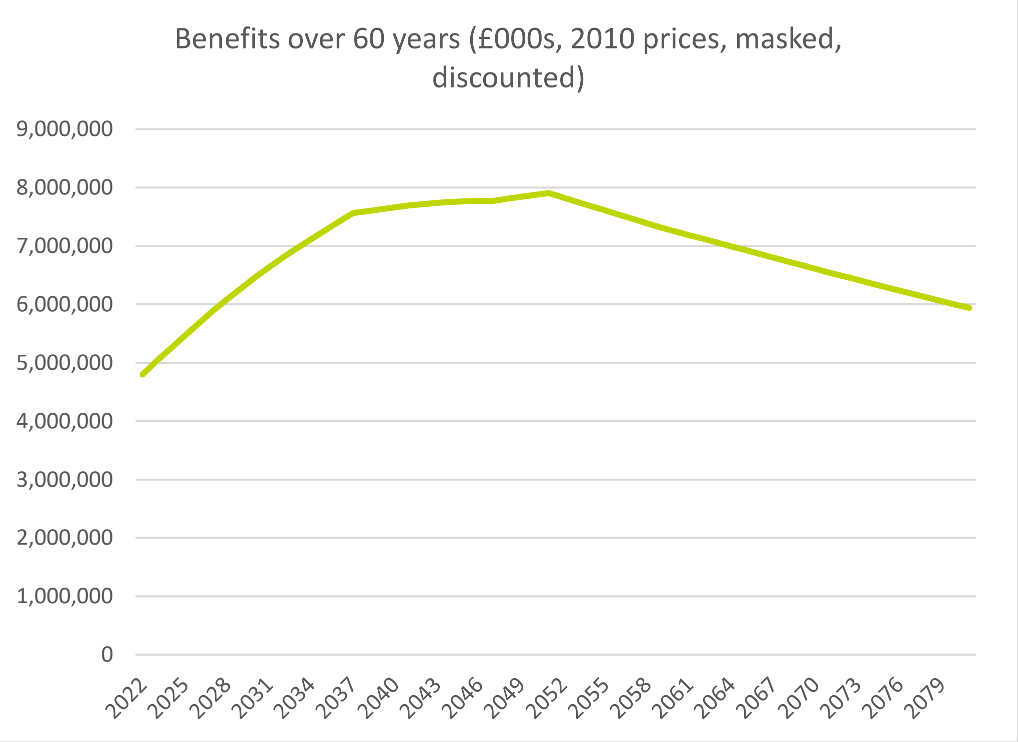
	PV, £million (2010 prices and values)
Travel Time	420,375
Vehicle Operating Cost	-31,556
Total	388,818

Disaggregating the TUBA TEE benefits by time period, it can be seen that although there are benefits in all time period, the AM period accounts for around 40% of the total benefits. Disaggregating the benefits by journey purpose shows that most benefits, approximately 57% are accrued by business users.

The travel time benefits have also been disaggregated by size of time saving. This shows the greatest contribution to the time saving benefits are derived from time savings of 0 to +2 minutes, but these are substantially offset by journey time disbenefits in the 0 to -2 minutes time band. In net terms, the greatest journey time benefits arise within the +/-2 to +/-5 minutes time bands.

Figure 14-1 shows the benefits over the 60-year period. This shows that benefits rise between 2022 to 2037 and then again between 2037 to 2051 as congestion in the do minimum worsens. After 2051, the benefits are held level, and the diagram shows a tail as they are discounted through time.

Figure 14-1: Benefits of 60 years



14.3 Accident benefits

The COBA-LT analysis gives the monetary value of accident savings as £73.2 million PV over the appraisal period. This results from an average reduction of 24.7 accidents per year over the 60-year appraisal period.

At the M25J10 roundabout there is expected to be a 31% reduction in the number of accidents, a significantly greater reduction than on the network around M25J10 within the detailed study area, which sees a reduction of approximately 9% from the do-minimum scenario. This is due to the improvements being concentrated here. Accidents are also reduced on the A3 mainline between Ockham and Painshill due to widening and the closure of side roads.

. For further analysis on accidents saved refer to Section 3.3 of the Stage 4 EAR Addendum and the accident analysis report included as Appendix B of the Economic Assessment Package Report

14.4 Monetisation of environmental impacts

Table 14-2 shows the monetary impact of environmental impacts. There are savings from improvements to noise, however there are costs associated with increases in greenhouse gases and deterioration in air quality. For details on the monetisation of environmental impacts refer to the Environmental Assessment Report.

Table 14-2: Monetary value of environmental impacts

	PV, £000s (2010 prices and values)
Greenhouse gases	-9,319
Air quality	-344
Noise	711
Total	-8,952

14.5 Impact of construction and maintenance

Table 14-3 presents the expected dis-benefits of traffic delays for road users during the construction of the scheme.

Table 14-3: TEE table summary for construction and maintenance impact

	PV, £million (2010 prices and values)
Travel Time	-11,963
Vehicle Operating Cost	1,194
Total	-10,768

14.6 Transport Economic Efficiency (TEE) table

The TEE table is summarised in Table 14-4 below and in Section 3.6 of the Stage 4 EAR Addendum.

Table 14-4: TEE table summary

Category		PV, £000s (2010 prices and values)
Business	Travel time	212,638
	Operating cost	8,876
	During construction	-5,126
	Total	216,389
Commuting	Travel time	63,383
	Operating cost	-8,047
	During construction	-1,626
	Total	53,710
Other	Travel time	144,353
	Operating cost	-32,385
	During construction	-4,017
	Total	107,951
Present Value TEE Benefit		378,049

14.7 Public accounts

Public accounts details are summarised in Table 14-5 below and presented in full in Appendix C of the Economic Assessment Package Report. The scheme investment costs are from the last Highways England Commercial cost estimate, which was provided in Stage 4. Indirect tax impacts have been updated as per Section 3.7 of the Stage 4 EAR Addendum.

Table 14-5: PA table summary, PV £000s

Central Government Funding	PV, £000s (2010 prices and values)
Present Value of Costs (PVC)	190,936
Wider Public Finances	-25,778

14.8 Level 1 Analysis of Monetised Costs and Benefits (AMCB) table

Table 14-6 summarises the Level 1 economic assessment results for the core scenario.

Table 14-6: AMCB summary table, £000s (PV)

Category	Core Scenario
Greenhouse gases	-9,319
Air quality	-344
Noise	711
Accidents	73,159
TEE: Commuting	53,710
TEE: Other	107,951
TEE: Business	216,389
Wider public finances	25,778
PVB	468,035
PVC	190,936
NPV	277,098
BCR	2.45

14.9 Level 2 journey reliability benefits

To estimate a monetised impact associated with the widening of the A3, the DfT’s MyRIAD tool has been utilised. The core run models the A3 as a three-lane-all-purpose road in the Do-Minimum scenario, however, as MyRIAD does not provide a four-lane-all-purpose road option, the improved section of the A3 is modelled as four-lane motorway in the Do-Something. A sensitivity test has been undertaken to estimate the impact of selecting three-lane motorway as the existing road type in the Do-Minimum.

Table 14-7 presents the results of the two tests. Given the limitations of the assessment, the core scenario may represent an overestimate of benefit.

Therefore, the sensitivity assessment is selected, as this offers a conservative estimate of the benefits.

Table 14-7: MyRIAD scenarios and results, PV £000s

Run	Do-Minimum	Do-Something	PVB, £000s
Core	D3AP with MIDAS without CCTV, with VMS	D4M with MIDAS, without CCTV, with VMS	102,900
Sensitivity	D3M with MIDAS, without CCTV, with VMS	D4M with MIDAS, without CCTV, with VMS	35,400

14.10 Level 2 wider economic impacts

An estimate of increased output in imperfectly competitive markets has been derived directly from the business user benefits present in the TEE (in line with WebTAG Unit A2.2). The monetised impact is estimated to be £21.6 million.

14.11 Level 2 Analysis of Monetised Costs and Benefits (AMCB) table

Table 14-8 summarises the Level 1 and 2 economic assessment results for the core scenario.

Table 14-8: AMCB summary table, £000s (PV)

Category	Core Scenario
Greenhouse gases	-9,319
Air quality	-344
Noise	711
Accidents	73,159
TEE: Commuting	53,710
TEE: Other	107,951
TEE: Business	216,389
Wider public finances	25,778
Reliability	35,400
Imperfect markets	21,639
PVB	525,073
PVC	190,936
NPV	334,137
BCR	2.75

14.12 Non-monetised benefits

Environmental impacts

The non-monetised environmental impacts have been assessed using WebTAG criteria and are detailed in the Appraisal Summary Table.

In summary:

- The impact on landscape has been assessed as Moderate Adverse
- The impact on Historic Environment has been assessed as Neutral
- A Large Adverse impact has been assessed for Biodiversity
- The impact on Water Environment has been assessed as Moderate Beneficial.

Social and distributional impacts

The full Distributional Impacts assessment can be found in Appendix C of the Economic Assessment Package Report and is summarised as:

- The appraisal considers there to be a moderate beneficial impact on accidents for the M25 J10 scheme

  Overall, the impact on Air Quality due to the Scheme is considered to be Slight Beneficial
- The overall assessment of Affordability for the M25 J10 scheme is Moderate Adverse
- A Slight Beneficial impact has been assessed for Journey Quality
- Overall a Slight Adverse effect on Noise is noted for the M25 J10 scheme
- Personal Security for the M25 J10 scheme has been scored as Neutral
- The Severance impacts due to the scheme are assessed as Slight Beneficial
- The assessment of User Benefits for the M25 J10 scheme is a Slight Beneficial impact.

14.13 Sensitivity Tests

High and Low Growth

The high and low growth sensitivity tests have been based only on TUBA assessments of user benefits carried out at Stage 3, including two forecast years 2022 and 2037.

Table 14-9 summarises the economic assessment results for the Low and High growth scenarios against the Stage 3 Core Scenario (which was based on two forecast years only). The comparison may indicate the direction and scale of change with high and low growth, but the results should not be directly compared against the Stage 4 Core Scenario impacts reported elsewhere in this report.

Table 14-9: Benefit summary table for Low and High scenarios, £000s (PV)

Category	Low Growth	Stage 3 Core Scenario	High Growth
TEE: Commuting	83,327	65,947	120,521
TEE: Other	146,412	97,504	234,784
TEE: Business	198,901	159,453	282,259
Total	428,640	**322,904**	637,564

The low growth has higher overall benefits than seen in the core scenario. Whilst there is less benefit at Junction 10 itself, there is also reduced disbenefit at certain locations (e.g M25 Junctions 9 and 11 and the A3 in Guildford), caused by redistribution of traffic due to the scheme. The high growth scenario increases the scale of benefits significantly, as in this scenario, the Do-Minimum is heavily congested and therefore the scale of the impact is higher. The variation between scenarios indicates that the scheme is still economically viable in all growth scenarios.

Table 14-10. summarises the estimated BCRs for the low and high growth scenarios. These have been estimated by applying a proportionate approach that combines the user benefits presented in Table 14-9 (and the related increased productivity in imperfectly competitive markets) to the core scenario benefits for all other impacts.

Table 14-10: Cost benefit analysis for high and low growth scenarios, £000s (PV)

Category	Low Growth	Stage 3 Core Scenario	High Growth
Greenhouse gases	-9,319		
Air quality	-344		
Noise	711		
Accidents	45,354		
TEE: Commuting	83,327	65,947	120,521
TEE: Other	146,412	97,504	234,784
TEE: Business	198,901	159,453	282,259
Wider public finances	29,235		
Reliability benefits	35,400		
Imperfect markets	19,890	15,945	28,226
PVB	**549,567**	**439,885**	**766,827**
PVC	197,828	197,828	197,828
Adjusted BCR	**2.78**	**2.22**	**3.88**

Cost sensitivity tests

To understand the impact of how a variation in scheme cost would affect the Value for Money classification, a High-Cost Variation (assumes appraisal costs are 20% higher) and a Low-Cost Variation (assumes appraisal costs are 20% lower) sensitivity tests have been conducted. The economic results are presented in Table 14-11.

Table 14-11: Cost benefit analysis for high and low cost scenarios, £000s (PV)

Category	Low cost (-20%)	High cost (+20%)
Present Value of Benefits (PVB)	525,073	525,073
Present Value of Costs	158,262	237,393

Benefit Cost Ratio (BCR)	3.32	2.21

M25 Junction 10 Through Junction Running

The Scheme currently includes the proposed conversion of the through-lane section of the M25 at Junction 10 to four lanes. This element was originally part of the M25 J10-16 RIS scheme and therefore this sensitivity test seeks to determine the impact on the Through Junction Running (TJR) element being removed.

Model runs have been undertaken to compare the network operation, without the TJR element, in both Do-Minimum and Do-Something scenarios. A separate accident assessment has also been conducted, however no other scheme specific assessments have been undertaken. The No-TJR test has not been updated at Stage 4 so the assessments summarised below are based on two model years of 2022 and 2037, and are not directly comparable with the results above which are based on three forecast years. The cost of the scheme with the TJR element removed has also been estimated, resulting in a reduction in appraisal cost of approximately £30m.

Table 14-12 summarises the economic results of the no TJR sensitivity test in comparison to the core scenario as assessed at Stage 3.

Table 14-12: Cost benefit analysis for no J10 TJR test, £000s (PV)

Category	Core	No J10 TJR
Present Value of Benefits (PVB)	439,885	414,255
Present Value of Costs	197,828	165,915
Benefit Cost Ratio (BCR)	2.22	2.50

Appendices

Appendix A. ComMA Summary

High level benefits and costs

Present Value of Benefits (initial)	£468.03m
Present Value of Benefits (adjusted)	£525.07m
Present Value of Costs	£190.94m
Initial BCR	2.45
Adjusted BCR	2.75

Sources of Costs

Costs have been derived from information provided by the Highways England Regional Delivery Partner. The Present Value of Costs (PVC) is based on the 'most likely' cost, considering an average level of risk. As advised by Highways England Commercial Unit, optimism bias is not required on Highways England figures.

The PVC is presented in 2010 factor prices and values after the application of inflation and rebasing. Construction costs make up 82% of the total cost, with land, preparation and supervision making up the remaining 18%.

Sources of Benefits

All figures here are in Present Value (2010 prices and values) and over the 60-year appraisal period.

As usual for this type of scheme, the benefits are dominated by the user benefits after the scheme is completed. There are forecast to be £420.4m of travel time savings and a dis-benefit of £31.6m of vehicle operating costs, mainly due to increased journey distances. Set against this, disbenefits during construction are estimated as £10.8m. Drawing these factors together, there is a net £378.0m of user benefits. This is the Present Value of Transport Economic Efficiency (TEE) as seen in the TEE table. This £378.0m is split among commuters (£53.7m), other consumers (£108.0m) and business users (£216.4m).

Accident cost savings are estimated as £73.2m. Environmental impacts are estimated as £9.0m of disbenefits, primarily through greenhouse gas disbenefits which are partly offset by small noise benefits. Finally, the increased fuel consumption is reflected in an impact on the wider public finances (indirect revenue from fuel taxation) of £25.8m. Drawing these factors together with the user benefits, the net benefits are £468.0m which is the Present Value of Benefits (PVB) as seen in the AMCB table.

Journey time reliability benefits are conservatively estimated at £35.4m.

The impact of increased output in imperfectly competitive markets (reflecting the additional margin that firms can make on each additional unit of output they can produce as a result of travel cost savings) is estimated at £21.6m.

Drawing these factors together, the £468.0m described earlier, plus the £35.4m of journey time reliability benefits and £21.6m of wider economic impacts, produce a final benefits total of £525.1m.

Demand Growth along the Route (Do Minimum)

Link	AADT (opening year)	AADT (design year)	AADT change (%)
M25 through junction			
East bound – between Junctions 9 and 10	81,805	92,746	13.37%
East bound – between Junctions 10 and 11	96,872	108,623	12.13%
West bound – between Junctions 9 and 10	83,529	100,013	19.73%
West bound – between Junctions 10 and 11	94,399	111,980	18.62%
Distance-weighted Average	Not quantified		
A3 through junction			
North bound – between Junction 10 and Painshill	55,611	66,164	18.98%
North bound – between Junction 10 and Ockham	67,176	80,012	19.11%
South bound – between Junction 10 and Painshill	50,175	59,763	19.11%
South bound – between Junction 10 and Ockham	61,970	70,504	13.77%
Distance-weighted Average	Not quantified		

Demand Growth along the Route (Do Something)

Link	AADT (opening year)	AADT (design year)	AADT change (%)
M25 through junction			
East bound – between Junctions 9 and 10	82,398	93,338	13.28%
East bound – between Junctions 10 and 11	97,817	110,671	13.14%
West bound – between Junctions 9 and 10	84,015	99,466	18.39%
West bound – between Junctions 10 and 11	97,145	114,514	17.88%
Distance-weighted Average			Not quantified
A3 through junction			
North bound – between Junction 10 and Painshill	55,820	67,253	20.48%
North bound – between Junction 10 and Ockham	67,301	81,725	21.43%
South bound – between Junction 10 and Painshill	53,979	64,302	19.12%
South bound – between Junction 10 and Ockham	65,170	77,591	19.06%
Distance-weighted Average			Not quantified

Key Monetised Benefits and Costs

Category	Benefits and costs in £'000 (PV)
Business Users	
Journey Time Savings	£212,638
Vehicle Operating Costs	£8,876
Non-Business users	
Journey Time Savings	£207,736
Vehicle Operating Costs	-£40,432
Reliability	
Business Reliability	£17,906
Non-business Reliability	£17,494
Safety	
Safety	£73,159
Environmental Impacts	
Noise	£711
Local Air Quality	-£344
Greenhouse Gases	-£9,319
Landscape	Not quantified
Wider Economic Impacts	
Agglomeration	Not quantified
Market Competition	£21,639
Dependent Development	Not quantified
Labour Supply	Not quantified
Customer Impact	
Traffic delays due to Construction	-£10,768
Traffic impacts due to Maintenance	Not quantified
Journey Quality	Not quantified
Developer contributions	
Developer contributions	n/a
Other Impacts	
Indirect tax Revenues	£25,778
[Other - please specify]	n/a
Costs	
Cost to Broad Transport Budget	£190,936
Cost savings(where relevant)*	n/a

*The cost savings row should only be completed where the option being considered will deliver financial savings to Highways England'

Key quantified benefits / costs

Category	Quantified impacts	*Units*
Journey times		
Journey Time Savings		*(average saving per journey on scheme sections in minutes)**
Safety		
Accidents	1484	*(total number saved)*
Fatalities	27	*(total number saved)*
Seriously injured	196	*(total number saved)*
Slightly injured	2213	*(total number saved)*
Environmental Impacts		
Number of Noise important areas affected	None	*(number)*
Names of AQMAs	Esher AQMA; M25 AQMA; AQMA No. 1 M25; Kingston upon Thames AQMA	*(names)*
Change in NOx emissions	655	*(tonnes)*
Change in PM10 emissions	35	*(tonnes)*
Change in greenhouse gas emissions	3,425	*(tonnes CO2e)*
Customer Impact: Totals		
Traffic delays due to Construction		*(total loss on scheme sections in hours)*
Traffic impacts due to Maintenance	Not quantified	*(total impact on scheme sections in hours)*
Customer Impact: Per journey		
Traffic delays due to Construction (cars)		*(average loss per journey on scheme sections in minutes) **
Traffic delays due to Construction (LGVs)		*(average loss per journey on scheme sections in minutes) **
Traffic delays due to Construction (HGVs)		*(average loss per journey on scheme sections in minutes) **
Traffic impacts due to Maintenance (cars)	Not quantified	*(average impact per journey on scheme sections in minutes) **
Traffic impacts due to Maintenance (LGVs)	Not quantified	*(average impact per journey on scheme sections in minutes) **
Traffic impacts due to Maintenance (HGVs)	Not quantified	*(average impact per journey on scheme sections in minutes) **

**Defined as total saving or loss on all scheme sections per day divided by distance-weighted AADT on scheme sections*

Strategic Outcome	KPI	Scheme Contribution – Qualitative	Scheme Contribution - Quantitative
Making the network safer	The number of KSIs on the SRN.	The introduction of free-flowing left turns reduces conflict points and hence results in a reduction in accidents. Also, the closure of the current Wisley Gardens access removes safety issues in this area.	Reduction of 1484 accidents, including 27 fatalities
Delivery of better environmental outcomes	Noise: Number of Noise Important Areas mitigated. Biodiversity: Delivery of improved biodiversity, as set out in the Company's Biodiversity Action Plan	No significant effects from road traffic noise that are directly attribute to the Scheme were predicted. The net present value is positive due to noise mitigation measures proposed by the Scheme (low noise surfacing, barriers)	Households experiencing reduced daytime noise in forecast year: 102
Helping cyclists / walkers and other vulnerable users	The number of new and upgraded crossings	The Scheme is generally anticipated to provide significant benefits to NMU with increased bridleway routes available for equestrian users than at present. The A3 pedestrian and cycle route will see significant improvements in its new location and be upgraded to a restricted byway that is set back from the A3 and the scheme will provide overbridges across the A3 and M25 negating the need for at grade crossings. Large beneficial effects once the Scheme is operational are also anticipated at the new pedestrian crossings at Painshill Junction and Ockham junctions and new or improved footways and bridleways elsewhere.	6 new or improved crossings

Appendix B. ComMA Data Annex

B.1 Scheme Cost

Table 1: Scheme investment cost profile in 2010 prices (£m)

Year	2010 factor prices (not discounted)	2010 market prices
2018	£1.20	£1.09
2019	£10.14	£8.85
2020	£32.77	£27.64
2021	£105.00	£85.58
2022	£78.58	£61.88
2023	£6.54	£4.98
2024	£0.91	£0.67
2025	£0.13	£0.09
2026	£0.09	£0.06
2027	£0.09	£0.06
2028	£0.03	£0.02
2029	£0.01	£0.00
Total	£235.49	£190.94

Table 2: Scheme O&M cost profile in 2010 prices

Operational and maintenance costs have not been provided by Highways England and therefore not included at this stage as they will be minor in comparison to the main scheme implementation costs. They will be considered further in subsequent PCF stages.

B.2 Scheme benefits / disbenefits

Journey times

Table 3: Average journey times during construction period along route by phase (minutes)

	Phase 1	*Phase 2 (if relevant)*	*Phase 3 (if relevant)*
Without scheme	Not currently calculated	Not currently calculated	Not currently calculated
With scheme	Not currently calculated	Not currently calculated	Not currently calculated

Table 4: Average journey times along route (minutes:seconds)

M25 between Junctions 9 and 11 (seconds)

	Opening year	Design year	Change (%)
AM Peak			
Clockwise			
Without scheme	227	239	5.29%
With scheme	226	236	4.42%
Anti-clockwise			
Without scheme	683	732	7.17%
With scheme	670	715	6.72%
Inter-Peak			
Clockwise			
Without scheme	224	238	6.25%
With scheme	224	237	5.80%
Anti-clockwise			
Without scheme	678	751	10.77%
With scheme	660	726	10.00%
PM Peak			
Clockwise			
Without scheme	220	230	4.55%
With scheme	222	231	4.05%
Anti-clockwise			
Without scheme	810	842	3.95%
With scheme	771	795	3.11%

A3 between Ripley Crossroads and Painshill (seconds)

	Opening year	Design year	Change (%)
AM Peak			
North bound			
Without scheme	383	588	53.52%
With scheme	351	391	11.40%
South bound			
Without scheme	332	432	30.12%
With scheme	338	393	16.27%
Inter-Peak			
North bound			
Without scheme	263	316	20.15%
With scheme	265	291	9,81%
South bound			
Without scheme	282	363	28.72%
With scheme	290	339	16.90%
PM Peak			
North bound			
Without scheme	299	373	24.75%
With scheme	270	304	12.59%
South bound			
Without scheme	330	405	22.73%
With scheme	332	392	18.07%

Source: *Traffic Forecasting Package Report*

Safety

Table 5: Number of accidents by year

Year	Without scheme	With scheme	Difference (With-Without Scheme)
Year 1	220.3	203.6	-16.7
Year 2	219.1	202.3	-16.8
Year 3	217.8	200.9	-16.9
Year 4	216.5	199.6	-16.9
Year 5	215.2	198.2	-17
Year 6	213.9	196.9	-17
Year 7	212.7	195.5	-17.2
Year 8	211.5	194.1	-17.4
Year 9	212.3	194.5	-17.8
Year 10	213.2	195	-18.2
Year 11	214	195.5	-18.5
Year 12	214.8	195.9	-18.9
Year 13	215.6	196.4	-19.2
Year 14	216.3	196.8	-19.5
Year 15	217.1	197.2	-19.9
Year 16	217.8	197.5	-20.3
Year 17	217	196.2	-20.8
Year 18	216.2	194.9	-21.3
Year 19	217.3	195.5	-21.8
Year 20	218.4	196	-22.4
Year 21	219.6	196.5	-23.1
Year 22	220.7	197	-23.7
Year 23	221.8	197.5	-24.3
Year 24	222.9	198.1	-24.8
Year 25	224	198.6	-25.4
Year 26	225.2	199.1	-26.1
Year 27	226.3	199.6	-26.7
Year 28	227.4	200.1	-27.3
Year 29	228.5	200.6	-27.9
Year 30	229.6	201.2	-28.4
Year 31	229.6	201.2	-28.4
Year 32	229.6	201.2	-28.4
Year 33	229.6	201.2	-28.4
Year 34	229.6	201.2	-28.4
Year 35	229.6	201.2	-28.4
Year 36	229.6	201.2	-28.4
Year 37	229.6	201.2	-28.4
Year 38	229.6	201.2	-28.4
Year 39	229.6	201.2	-28.4
Year 40	229.6	201.2	-28.4
Year 41	229.6	201.2	-28.4
Year 42	229.6	201.2	-28.4
Year 43	229.6	201.2	-28.4
Year 44	229.6	201.2	-28.4
Year 45	229.6	201.2	-28.4
Year 46	229.6	201.2	-28.4
Year 47	229.6	201.2	-28.4
Year 48	229.6	201.2	-28.4
Year 49	229.6	201.2	-28.4
Year 50	229.6	201.2	-28.4
Year 51	229.6	201.2	-28.4
Year 52	229.6	201.2	-28.4
Year 53	229.6	201.2	-28.4
Year 54	229.6	201.2	-28.4
Year 55	229.6	201.2	-28.4
Year 56	229.6	201.2	-28.4
Year 57	229.6	201.2	-28.4
Year 58	229.6	201.2	-28.4
Year 59	229.6	201.2	-28.4
Year 60	229.6	201.2	-28.4

Table 6: Number of Fatal casualties by year

Year	Without scheme	With scheme	Difference (With-Without Scheme)
Year 1	3.6	3.3	-0.3
Year 2	3.6	3.3	-0.3
Year 3	3.6	3.2	-0.4
Year 4	3.5	3.2	-0.3
Year 5	3.5	3.2	-0.3
Year 6	3.5	3.1	-0.4
Year 7	3.5	3.1	-0.4
Year 8	3.4	3.1	-0.3
Year 9	3.4	3.1	-0.3
Year 10	3.4	3.1	-0.3
Year 11	3.4	3.1	-0.3
Year 12	3.5	3.1	-0.4
Year 13	3.5	3.1	-0.4
Year 14	3.5	3.1	-0.4
Year 15	3.5	3.1	-0.4
Year 16	3.5	3.1	-0.4
Year 17	3.4	3.1	-0.3
Year 18	3.4	3.1	-0.3
Year 19	3.4	3.1	-0.3
Year 20	3.5	3.1	-0.4
Year 21	3.5	3.1	-0.4
Year 22	3.5	3.1	-0.4
Year 23	3.5	3.1	-0.4
Year 24	3.5	3.1	-0.4
Year 25	3.5	3.1	-0.4
Year 26	3.6	3.1	-0.5
Year 27	3.6	3.1	-0.5
Year 28	3.6	3.1	-0.5
Year 29	3.6	3.1	-0.5
Year 30	3.6	3.1	-0.5
Year 31	3.6	3.1	-0.5
Year 32	3.6	3.1	-0.5
Year 33	3.6	3.1	-0.5
Year 34	3.6	3.1	-0.5
Year 35	3.6	3.1	-0.5
Year 36	3.6	3.1	-0.5
Year 37	3.6	3.1	-0.5
Year 38	3.6	3.1	-0.5
Year 39	3.6	3.1	-0.5
Year 40	3.6	3.1	-0.5
Year 41	3.6	3.1	-0.5
Year 42	3.6	3.1	-0.5
Year 43	3.6	3.1	-0.5
Year 44	3.6	3.1	-0.5
Year 45	3.6	3.1	-0.5
Year 46	3.6	3.1	-0.5
Year 47	3.6	3.1	-0.5
Year 48	3.6	3.1	-0.5
Year 49	3.6	3.1	-0.5
Year 50	3.6	3.1	-0.5
Year 51	3.6	3.1	-0.5
Year 52	3.6	3.1	-0.5
Year 53	3.6	3.1	-0.5
Year 54	3.6	3.1	-0.5
Year 55	3.6	3.1	-0.5
Year 56	3.6	3.1	-0.5
Year 57	3.6	3.1	-0.5
Year 58	3.6	3.1	-0.5
Year 59	3.6	3.1	-0.5
Year 60	3.6	3.1	-0.5

Table 7: Number of Serious casualties by year

Year	Without scheme	With scheme	Difference (With-Without Scheme)
Year 1	26.2	23.8	-2.4
Year 2	26	23.6	-2.4
Year 3	25.9	23.5	-2.4
Year 4	25.7	23.3	-2.4
Year 5	25.6	23.2	-2.4
Year 6	25.4	23	-2.4
Year 7	25.3	22.8	-2.5
Year 8	25.1	22.7	-2.4
Year 9	25.2	22.7	-2.5
Year 10	25.3	22.8	-2.5
Year 11	25.4	22.9	-2.5
Year 12	25.5	22.9	-2.6
Year 13	25.6	23	-2.6
Year 14	25.7	23	-2.7
Year 15	25.8	23.1	-2.7
Year 16	25.8	23.1	-2.7
Year 17	25.7	23	-2.7
Year 18	25.7	22.8	-2.9
Year 19	25.8	22.9	-2.9
Year 20	25.9	22.9	-3
Year 21	26.1	23	-3.1
Year 22	26.2	23.1	-3.1
Year 23	26.3	23.1	-3.2
Year 24	26.5	23.2	-3.3
Year 25	26.6	23.3	-3.3
Year 26	26.7	23.3	-3.4
Year 27	26.9	23.4	-3.5
Year 28	27	23.5	-3.5
Year 29	27.1	23.5	-3.6
Year 30	27.3	23.6	-3.7
Year 31	27.3	23.6	-3.7
Year 32	27.3	23.6	-3.7
Year 33	27.3	23.6	-3.7
Year 34	27.3	23.6	-3.7
Year 35	27.3	23.6	-3.7
Year 36	27.3	23.6	-3.7
Year 37	27.3	23.6	-3.7
Year 38	27.3	23.6	-3.7
Year 39	27.3	23.6	-3.7
Year 40	27.3	23.6	-3.7
Year 41	27.3	23.6	-3.7
Year 42	27.3	23.6	-3.7
Year 43	27.3	23.6	-3.7
Year 44	27.3	23.6	-3.7
Year 45	27.3	23.6	-3.7
Year 46	27.3	23.6	-3.7
Year 47	27.3	23.6	-3.7
Year 48	27.3	23.6	-3.7
Year 49	27.3	23.6	-3.7
Year 50	27.3	23.6	-3.7
Year 51	27.3	23.6	-3.7
Year 52	27.3	23.6	-3.7
Year 53	27.3	23.6	-3.7
Year 54	27.3	23.6	-3.7
Year 55	27.3	23.6	-3.7
Year 56	27.3	23.6	-3.7
Year 57	27.3	23.6	-3.7
Year 58	27.3	23.6	-3.7
Year 59	27.3	23.6	-3.7
Year 60	27.3	23.6	-3.7

Table 8: Number of Slight casualties by year

Year	Without scheme	With scheme	Difference (With-Without Scheme)
Year 1	314.3	289.3	-25
Year 2	312.5	287.3	-25.2
Year 3	310.6	285.4	-25.2
Year 4	308.7	283.4	-25.3
Year 5	306.7	281.4	-25.3
Year 6	304.8	279.3	-25.5
Year 7	303	277.3	-25.7
Year 8	301.2	275.2	-26
Year 9	302.3	275.7	-26.6
Year 10	303.4	276.4	-27
Year 11	304.5	277	-27.5
Year 12	305.6	277.6	-28
Year 13	306.6	278.1	-28.5
Year 14	307.6	278.6	-29
Year 15	308.6	279.1	-29.5
Year 16	309.6	279.6	-30
Year 17	308.4	277.6	-30.8
Year 18	307.2	275.7	-31.5
Year 19	308.7	276.3	-32.4
Year 20	310.3	276.9	-33.4
Year 21	311.9	277.6	-34.3
Year 22	313.4	278.2	-35.2
Year 23	314.9	278.8	-36.1
Year 24	316.5	279.5	-37
Year 25	318	280.1	-37.9
Year 26	319.5	280.7	-38.8
Year 27	321.1	281.3	-39.8
Year 28	322.6	282	-40.6
Year 29	324.1	282.6	-41.5
Year 30	325.6	283.2	-42.4
Year 31	325.6	283.2	-42.4
Year 32	325.6	283.2	-42.4
Year 33	325.6	283.2	-42.4
Year 34	325.6	283.2	-42.4
Year 35	325.6	283.2	-42.4
Year 36	325.6	283.2	-42.4
Year 37	325.6	283.2	-42.4
Year 38	325.6	283.2	-42.4
Year 39	325.6	283.2	-42.4
Year 40	325.6	283.2	-42.4
Year 41	325.6	283.2	-42.4
Year 42	325.6	283.2	-42.4
Year 43	325.6	283.2	-42.4
Year 44	325.6	283.2	-42.4
Year 45	325.6	283.2	-42.4
Year 46	325.6	283.2	-42.4
Year 47	325.6	283.2	-42.4
Year 48	325.6	283.2	-42.4
Year 49	325.6	283.2	-42.4
Year 50	325.6	283.2	-42.4
Year 51	325.6	283.2	-42.4
Year 52	325.6	283.2	-42.4
Year 53	325.6	283.2	-42.4
Year 54	325.6	283.2	-42.4
Year 55	325.6	283.2	-42.4
Year 56	325.6	283.2	-42.4
Year 57	325.6	283.2	-42.4
Year 58	325.6	283.2	-42.4
Year 59	325.6	283.2	-42.4
Year 60	325.6	283.2	-42.4

Environment

Table 9: NOx emissions (tonnes)

Year	Without scheme	With scheme	Difference
Opening year	2453	2457	4
Year 2	2397	2402	5
Year 3	2341	2347	5
Year 4	2286	2292	6
Year 5	2230	2236	6
Year 6	2174	2181	7
Year 7	2119	2126	7
Year 8	2063	2071	8
Year 9	2007	2016	8
Year 10	1951	1960	9
Year 11	1896	1905	9
Year 12	1840	1850	10
Year 13	1784	1795	10
Year 14	1729	1740	11
Year 15	1673	1684	11
Year 16	1617	1629	12
Year 17	1617	1629	12
Year 18	1617	1629	12
Year 19	1617	1629	12
Year 20	1617	1629	12
Year 21	1617	1629	12
Year 22	1617	1629	12
Year 23	1617	1629	12
Year 24	1617	1629	12
Year 25	1617	1629	12
Year 26	1617	1629	12
Year 27	1617	1629	12
Year 28	1617	1629	12
Year 29	1617	1629	12
Year 30	1617	1629	12
Year 31	1617	1629	12
Year 32	1617	1629	12
Year 33	1617	1629	12
Year 34	1617	1629	12
Year 35	1617	1629	12
Year 36	1617	1629	12
Year 37	1617	1629	12
Year 38	1617	1629	12
Year 39	1617	1629	12
Year 40	1617	1629	12
Year 41	1617	1629	12
Year 42	1617	1629	12
Year 43	1617	1629	12
Year 44	1617	1629	12
Year 45	1617	1629	12
Year 46	1617	1629	12
Year 47	1617	1629	12
Year 48	1617	1629	12
Year 49	1617	1629	12
Year 50	1617	1629	12
Year 51	1617	1629	12
Year 52	1617	1629	12
Year 53	1617	1629	12
Year 54	1617	1629	12
Year 55	1617	1629	12
Year 56	1617	1629	12
Year 57	1617	1629	12
Year 58	1617	1629	12
Year 59	1617	1629	12
Year 60	1617	1629	12

Table 10:PM10 emissions (tonnes)

Year	Without scheme	With scheme	Difference
Opening year	208698	208733	35
Year 2	208647	208680	33
Year 3	208596	208628	32
Year 4	208545	208575	30
Year 5	208494	208522	29
Year 6	208443	208470	27
Year 7	208392	208417	25
Year 8	208341	208365	24
Year 9	208290	208312	22
Year 10	208239	208259	21
Year 11	208188	208207	19
Year 12	208137	208154	18
Year 13	208086	208102	16
Year 14	208035	208049	14
Year 15	207983	207996	13
Year 16	207932	207944	11
Year 17	207932	207944	11
Year 18	207932	207944	11
Year 19	207932	207944	11
Year 20	207932	207944	11
Year 21	207932	207944	11
Year 22	207932	207944	11
Year 23	207932	207944	11
Year 24	207932	207944	11
Year 25	207932	207944	11
Year 26	207932	207944	11
Year 27	207932	207944	11
Year 28	207932	207944	11
Year 29	207932	207944	11
Year 30	207932	207944	11
Year 31	207932	207944	11
Year 32	207932	207944	11
Year 33	207932	207944	11
Year 34	207932	207944	11
Year 35	207932	207944	11
Year 36	207932	207944	11
Year 37	207932	207944	11
Year 38	207932	207944	11
Year 39	207932	207944	11
Year 40	207932	207944	11
Year 41	207932	207944	11
Year 42	207932	207944	11
Year 43	207932	207944	11
Year 44	207932	207944	11
Year 45	207932	207944	11
Year 46	207932	207944	11
Year 47	207932	207944	11
Year 48	207932	207944	11
Year 49	207932	207944	11
Year 50	207932	207944	11
Year 51	207932	207944	11
Year 52	207932	207944	11
Year 53	207932	207944	11
Year 54	207932	207944	11
Year 55	207932	207944	11
Year 56	207932	207944	11
Year 57	207932	207944	11
Year 58	207932	207944	11
Year 59	207932	207944	11
Year 60	207932	207944	11

Table 11: Greenhouse gas emissions (tonnes CO2e)

Year	Without scheme	With scheme	Difference
Opening year	1802301	1805726	3425
Year 2	1823668	1827097	3429
Year 3	1845036	1848468	3433
Year 4	1866403	1869840	3437
Year 5	1887770	1891211	3441
Year 6	1909137	1912582	3445
Year 7	1930505	1933954	3449
Year 8	1951872	1955325	3453
Year 9	1973239	1976696	3457
Year 10	1994606	1998067	3461
Year 11	2015974	2019439	3465
Year 12	2037341	2040810	3469
Year 13	2058708	2062181	3473
Year 14	2080075	2083552	3477
Year 15	2101443	2104924	3481
Year 16	2122810	2126295	3485
Year 17	2122810	2126295	3485
Year 18	2122810	2126295	3485
Year 19	2122810	2126295	3485
Year 20	2122810	2126295	3485
Year 21	2122810	2126295	3485
Year 22	2122810	2126295	3485
Year 23	2122810	2126295	3485
Year 24	2122810	2126295	3485
Year 25	2122810	2126295	3485
Year 26	2122810	2126295	3485
Year 27	2122810	2126295	3485
Year 28	2122810	2126295	3485
Year 29	2122810	2126295	3485
Year 30	2122810	2126295	3485
Year 31	2122810	2126295	3485
Year 32	2122810	2126295	3485
Year 33	2122810	2126295	3485
Year 34	2122810	2126295	3485
Year 35	2122810	2126295	3485
Year 36	2122810	2126295	3485
Year 37	2122810	2126295	3485
Year 38	2122810	2126295	3485
Year 39	2122810	2126295	3485
Year 40	2122810	2126295	3485
Year 41	2122810	2126295	3485
Year 42	2122810	2126295	3485
Year 43	2122810	2126295	3485
Year 44	2122810	2126295	3485
Year 45	2122810	2126295	3485
Year 46	2122810	2126295	3485
Year 47	2122810	2126295	3485
Year 48	2122810	2126295	3485
Year 49	2122810	2126295	3485
Year 50	2122810	2126295	3485
Year 51	2122810	2126295	3485
Year 52	2122810	2126295	3485
Year 53	2122810	2126295	3485
Year 54	2122810	2126295	3485
Year 55	2122810	2126295	3485
Year 56	2122810	2126295	3485
Year 57	2122810	2126295	3485
Year 58	2122810	2126295	3485
Year 59	2122810	2126295	3485
Year 60	2122810	2126295	3485

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