highways england

Lower Thames Crossing

Post-Consultation Scheme Assessment Report

Volume 5: Traffic and Economics Appraisal

Volume 5

Lower Thames Crossing | 2017

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The designs shown and described in this Post-Consultation Scheme Assessment Report have been developed for the detailed appraisal of options as part of the options phase, and may be subject to change in later stages of the scheme development.

1 Introduction

1.1 Structure of Post-Consultation Scheme Assessment Report

1.1.1 The Post-Consultation Scheme Assessment Report (SAR):

- Reports on the appraisal of the route options for a new Lower Thames Crossing (LTC), including the engineering, safety, operational, traffic, economic, social and environmental appraisals.
- Reports on the public consultation of options.
- Presents a Recommended Preferred Route.

1.1.2 Highways England is making a recommendation to the Secretary of State (SoS), following consideration and analysis of the consultation feedback, on which route option Highways England considers should be selected as the Preferred Route. The SoS will consider the recommendation and then decide which route option will form the Preferred Route. That decision will be published in a 'preferred route announcement'. The Preferred Route will then be developed in more detail, with further consultation, before an application is made for a Development Consent Order (DCO).

1.1.3 A Pre-Consultation SAR was published in January 2016 and was made available at public consultation; the Pre-Consultation SAR was made up of seven volumes. Each volume has been updated in the Post-Consultation SAR to include revised and additional information where required. The Post-Consultation SAR also reports on the consultation, response to consultation findings and the Recommended Preferred Route.

1.1.4 An outline of what is included in each volume of the Post-Consultation SAR is set out below:

- Volume 1 – provides an Executive Summary of the SAR.
- Volume 2 – describes the scheme background, including previous studies undertaken, existing traffic, physical and environmental conditions, the future conditions without an improvement, the need for improvement and the scheme objectives.
- Volume 3 – describes the option identification and selection process. It summarises the consultation process, the consultation findings and the Highways England response to those findings. It describes the routes reported in the Post-Consultation SAR (the Post-Consultation Appraisal Routes).
- Volume 4 – describes the engineering, safety and cost appraisal of the Post-Consultation Appraisal Routes.
- **Volume 5 (this volume)** – describes the traffic and economic appraisal of the Post-Consultation Appraisal Routes.
- Volume 6 – describes the environmental appraisal of the Post-Consultation Appraisal Routes.

- Volume 7 – summarises the appraisal of the Post-Consultation Appraisal Routes against the scheme objectives and describes the Recommended Preferred Route. It also describes the next steps including further work that will be undertaken in the development of the scheme.

1.2 Structure of this Volume

1.2.1 The structure of this volume is as follows:

- Section 2 briefly describes the Lower Thames Crossing (LTC) options which have been assessed. More detail is provided in Volume 3.
- Section 3 provides an overview of the traffic, economic and social appraisal of these LTC options.
- Section 4 presents the traffic appraisal results of the options based on Version 2.1 of the LTC strategic traffic model (LTC v2.1).
- Section 5 describes the economic appraisal results of the options. This includes the consideration of Wider Impact benefits and Journey Time Reliability to give a broader view of the economic impacts of the options.
- Section 6 presents the Social Impact appraisal results.
- Section 7 presents Benefit Cost Ratios (BCRs) which provide summary measures of those economic, social and environmental impacts that can be expressed in monetary terms.
- Section 8 describes sensitivity testing undertaken for high and low traffic growth.
- Section 9 sets out the conclusions about the traffic, economic and social impact appraisal.
- Section 10 lists other documentation referred to in this report.

2 Post-Consultation Appraisal Routes

2.1 Introduction

2.1.1 This section provides a brief summary of the post-consultation appraisal routes that have been subject to detailed appraisal. A comprehensive description of the option development process is set out in Volume 3 of the Post-Consultation SAR. This summary is provided to set the context for the route options that have been appraised.

2.1.2 Traffic and economic modelling has been undertaken for the following five routes listed below and shown in **Figure 2.1**.

- Route 1 with a bridge crossing
- Route 3 with Western Southern Link
- Route 3 with Eastern Southern Link
- Route 4 with Western Southern Link
- Route 4 with Eastern Southern Link.

Routes 3 and 4 include twin bored tunnels which would each be large enough to contain an 11m wide three lane carriageway but would be arranged initially with a 7.3m wide two lane carriageway.

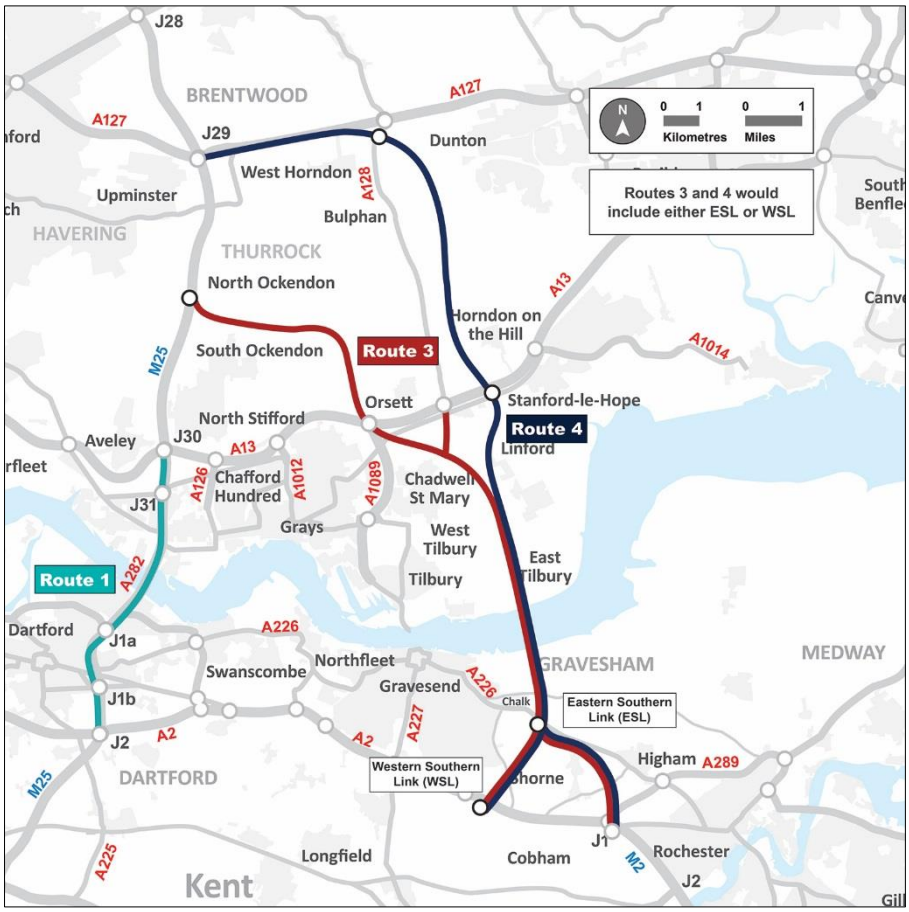


FIGURE 2.1 - POST-CONSULTATION APPRAISAL ROUTES

3 Overview of Appraisal Approach

3.1 Introduction

3.1.1 This section provides an overview of the traffic, economic and social impact appraisal of the LTC options. The appraisal of all impacts has been based on DfT's WebTAG guidance and includes the monetary valuation of two environmental impacts – greenhouse gas emissions and noise. The calculation and valuation of noise impacts is described in Volume 6.

3.1.2 The costs and benefits for the LTC options have been calculated over a 60 year appraisal period from the assumed scheme opening year of 2025 by measuring how the impacts change compared to a scenario in which LTC is not constructed, referred to as the 'Without Scheme' option (refer to Volume 2 for more details of this option). In line with HM Treasury's Green Book appraisal requirements, the impacts considered include those that can be expressed in monetary terms and those which can only be expressed in qualitative terms.

3.1.3 Key assumptions upon which the appraisal was based are:

- Dual two lane, all purpose, provision for the LTC options.
- For Route 3 and Route 4 it has been assumed that a tunnel is provided which can accommodate a dual-three lane road, but in assessing the benefits, it is only assumed that a dual two-lane road is operational throughout the 60 year appraisal period.
- Core DfT economic growth and development planning assumptions based on National Trip End Model (NTEM) version 6.2.
- The values of time issued by the DfT in October 2015 – the consultation values.
- User charges for different vehicle categories that replicate those at Dartford Crossing today and remain constant in real terms in future years for all route options.
- Most likely scheme costs (refer to Volume 4 of Post-Consultation SAR).

3.2 Traffic appraisal

3.2.1 A strategic level traffic model has been used to analyse the impact of the LTC options on traffic flows and journey times. Changes in traffic also result in other impacts, such as changes in noise and air quality. The model has a focus on the area immediately affected by the LTC but, in outline, covers the whole of Great Britain. It includes a representation of the road network and a demand matrix of origin and destination trips split into six user classes, each with a separate value of time. The model has a 2009 base year and produces traffic forecasts for two modelled years – the 2025 opening year and a 2041 design year.

3.2.2 For the appraisal of the longlist of options, the model was essentially the same traffic model as that used in DfT's 2013 *Review of Lower Thames*

Crossing Options: Final Review Report and is referred to as the LTC version 1 model (LTC v1). As the project progressed, this LTC v1 model was further refined and developed to create the LTC Version 2.0 model (LTC v2.0) which was used to appraise the options in advance of the non-statutory consultation which took place in early 2016. The changes which were made to the LTC v1 model to create the LTC v2.0 model included:

- Incorporating the latest development planning and highway scheme information, including refining of zoning.
- Incorporating the network coding from Transport for London's (TfL) Highway Assignment Model (LOHAM).
- Coding enhancements, to improve the representation of the highway network.
- Use of the latest version of the SATURN assignment model software.
- Controlling of trip forecasts to the National Trip End Model v6.2 forecasts.

3.2.3 During 2016, the LTC v2.0 model was further enhanced for the appraisal of options post consultation with a new model version 2.1 (LTC v2.1). The changes to the model which were made in this further enhancement included:

- Further coding enhancements to improve highway network representation.
- Incorporation of the impact of the Dart Charge network changes, with the removal of the toll barriers, including its effect on traffic capacities.
- Amendment to the application of the national trip end model forecasts to better reflect anticipated patterns of local development in Kent and Essex.
- Use of the revised values of time issued by the DfT in their October 2015 consultation.

3.2.4 The LTC v2.1 model is based on 2001 demand data although it has been updated to better reflect trip patterns from 2009. It is proposed that a Version 3 model (LTC v3) will be used for the Development Consent Order (DCO) phase of the LTC project which will include more recent demand data for full WebTAG compliance. However, the use of the LTC v2.1 model for the appraisal of the Post-Consultation Appraisal Routes is considered proportionate and appropriate, given that the model was revalidated in 2009. The modelling is based on user charges that replicate those at Dartford Crossing today and remain constant in real terms in future years i.e. they rise in line with inflation.

3.2.5 The model comprises a demand model and an assignment model. The demand model forecasts trip matrices for the required future model years based on trip ends, travel costs and assumptions about travellers' behavioural response to travel costs. The assignment model splits the trips according to the route they take through the network and then calculates the cost of travelling via each route. These forecast cost calculations are needed

not only for the assignment model, but also (in matrix form) for the demand model. Forecasts of vehicle flows on links from the highway assignment model, also inform the analysis of some social and environmental impacts. The demand model starts with a set of base trip matrices (by purpose and user class) and incorporates incremental changes in demand from the base year to the forecast years. Variation in demand due to the changes in costs in the future is also incorporated within the forecasting process.

3.2.6 WebTAG requires the appraisal of alternative economic growth scenarios. The Core scenario is the scenario based on central economic growth and the most unbiased and realistic set of development planning assumptions appropriate for the appraisal of LTC options. This is the basis for the results presented in this Volume. The results of alternative growth scenarios, testing the impact of low and high growth are presented as sensitivity tests in Section 8.

3.3 Economic appraisal

3.3.1 The economic appraisal of the options consists of the following elements:

- Forecasting the direct economic impacts of the options– these are the economic effects arising directly out of the changes in travel behaviour and traffic conditions associated with each option, as well as some of the associated impacts such as accidents and greenhouse gas emissions.
- Forecasting the Wider Impacts – an assessment of those economic impacts which arise beyond those traditionally included in highway scheme appraisals.
- Forecasting Journey Time Reliability – economic benefits associated with improving journey time reliability.

3.3.2 For each route option the forecasts from the LTC v2.1 traffic model, such as traffic flows and generalised costs, provide inputs into DfT's economic appraisal tools in order to estimate the economic impacts, such as changes in journey times, vehicle operating costs, user charges and accidents, which are calculated in monetary terms and expressed as Present Values (PV) in 2010 prices as required by DfT. In carrying out this analysis, use has been made of the revised values of time, issued in October 2015 by DfT, as part of their consultation.

3.3.3 The ratio of the present value of benefits (PVB) to the present value of scheme costs (PVC) constitutes the Benefit Cost Ratio (BCR). Two BCRs, an Initial BCR (which excludes wider economic impacts and journey time reliability benefits) and an Adjusted BCR (which includes wider economic impacts and journey time reliability benefits), are calculated for each option.

Direct Economic Impacts

3.3.4 Direct economic impacts include the following elements:

- Travel time savings
- Vehicle operating cost savings
- User charges

3.3.5 DfT's Transport User Benefit Appraisal (TUBA) tool has been used to calculate these economic benefits and express them in present value terms. The benefits have been split between business users, commuters, and other non-business users.

3.3.6 Delays to users caused by the construction of Route 1 and Route 3 with ESL have also been calculated using specially designed runs of TUBA. Such impacts for other options have not been appraised but are expected to be similar to the relatively small impacts estimated for Route 3 with ESL. Delays to users from maintenance works have not been appraised, but are not expected to be significant and, therefore, would not influence the choice between the options.

Wider Impacts benefits

3.3.7 Wider Impacts benefits have been calculated and are included in the Adjusted BCR for the LTC options.

3.3.8 Wider Impacts benefits refer to those benefits that arise beyond those traditionally included in highway scheme appraisals. These are impacts of the LTC options on:

- The productivity of existing workers from changes in the concentration of economic activity, referred to as agglomeration.
- Increased output from firms due to lower business costs.
- Additional taxation revenues as more people are incentivised to work.

3.3.9 These impacts have been calculated using the LTC Wider Impacts model which is an updated version of the Wider Impacts model used in the DfT's *Review of Lower Thames Crossing Options: Final Review Report, AECOM, April 2013* described in paragraphs 4.6.6 to 4.6.14 and Appendix D of that report.

Journey Time Reliability

3.3.10 A further additional economic benefit which is included in the Adjusted BCR calculation is an assessment of the Journey Time Reliability impacts of each option. The approach adopted is based on the methodology set out in WebTAG.

3.4 Monetised Environmental Impacts

3.4.1 The impact of the LTC options on two environmental impacts, noise and greenhouse gas emissions, has also been estimated and valued in monetary present value terms based on WebTAG guidance. A detailed description of this environmental appraisal and its monetisation is contained in Volume 6 but the appraisal approach can be summarised as follows:

- Noise – monetisation based on the health impacts.
- Greenhouse Gas Emissions – based on traffic impacts combined using the Workbook approach set out in WebTAG, to determine the scale of carbon emissions which are expected and then appraised by using carbon values to monetise these emissions.

3.5 Social appraisal

3.5.1 The appraisal of social impacts follows WebTAG guidance and includes an assessment of the LTC options on:

- Accidents – these impacts have been calculated and valued using DfT's COBALT appraisal tool.
- Physical activity i.e. impacts on pedestrians and cyclists.
- Severance of public rights of way.[1]
- Journey quality of road users.
- Personal security of road users.
- Personal affordability of road users.

3.5.2 The impact of LTC options on people's accessibility to the transport system and non-use value of retaining transport services have not been appraised for LTC because WebTAG guidance states these criteria relate to public transport schemes.

3.6 Public accounts

3.6.1 The public accounts impacts associated with each option, include the scheme costs which would be incurred for that option, less any increases in operational revenues and indirect tax revenues, resulting from that option.

3.6.2 The calculation of the scheme costs for the Post Consultation Appraisal options, including both construction costs and operational expenditure, are described in Volume 4.

3.6.3 For the purposes of undertaking cost-benefit analysis for each of the Route options, use has been made of the DfT TUBA software which converts the scheme cost estimates (construction and operating costs) to a standard price base (2010) and applies appropriate standard discounting, depending on the year in which the costs are expected to be incurred to a discount base of 2010. This converts the forecast expenditure profile to a present value of costs.

3.6.4 In addition to determining the present value of scheme costs, the TUBA software is also used to forecast changes in indirect taxation revenues, principally VAT and fuel duty, which are linked to changes in traffic volumes and distances travelled for each option.

[1] DfT's WebTAG guidance (Volume 4.1) defines severance as the impact of a traffic intervention on separating residents from community facilities and services. This volume reports the severance impacts of the LTC route options on public rights of way. Volume 6 reports the severance impacts on community facilities.

4 Traffic Appraisal

4.1 Introduction

4.1.1 This section summarises the traffic appraisal results using the LTC v2.1 traffic model for Route 1 and Routes 3 and 4 with the Western Southern Link (WSL) and Eastern Southern Link (ESL). The results for each route include assessments of forecast traffic flows, the predicted users of the crossings and journey times. Impacts are assessed for the modelled years 2025 and 2041 and have been assessed against the 'Without Scheme' option. The section also presents an example of the impact of the poor operational resilience of the existing Dartford Crossing on the road network and the modelled impact of LTC in improving operational resilience.

4.1.2 The traffic forecasts which have been prepared to appraise the LTC route options, are based on a number of factors. Most importantly, they consider the traffic capacities of both the existing Dartford Crossing and the proposed LTC crossing options. These capacities when combined with the forecast traffic demand, provide an indication of the likely traffic conditions in the future and the associated journey times through the road network.

4.1.3 This section begins by explaining the crossing capacities and the development planning assumptions included in the core growth scenario. The forecasts provide estimates of how the additional capacity across the River Thames would affect total traffic flows at Dartford and the way these could change between the existing and new crossings as a result of the LTC options, taking into account their location and that of the existing crossing.

4.1.4 This section also presents the forecast impact on congestion that would result from the LTC options by reporting the change in journey times for a number of frequently used journeys that currently use the existing crossing.

4.1.5 The forecasts indicate that the traffic flows and journey times across the River Thames are not influenced significantly by the LTC crossing type, either bridge, bored tunnel or immersed tunnel. Therefore, the traffic analysis presented here is applicable to any of the crossing types and this section focuses on assessing the five Post Consultation route options – Route 1, Route 3 ESL, Route 3 WSL, Route 4 ESL and Route 4 WSL.

4.2 Crossing Capacities

4.2.1 The existing and future traffic capacities of the crossings (existing Dartford Crossing and new LTC crossing) have a direct impact on the volumes of traffic which are predicted to make use of the crossing in the future, as well as heavily influence traffic conditions at the crossings.

4.2.2 Existing traffic flows at the Dartford Crossing are constrained by the traffic capacities of the existing tunnels and bridge, as well as the capacities of the approach roads to the Crossing which control the throughput of traffic. These two factors limit the volume of traffic which can currently use the Dartford Crossing at peak times and this will constrain future traffic growth, as traffic volumes reach capacity over extended periods of the day.

4.2.3 **Table 4.1** presents the hourly capacity of the existing crossing and the new LTC crossing route options in terms of passenger car units (pcu). The term pcu is a traffic engineering term used to quantify road capacity and is used to convert the traffic capacity impacts of different vehicle types to a single standard unit. For example, heavy good vehicles are generally assessed to have a pcu value between 2.0 and 3.0, depending on the precise vehicle type, indicating that they take up 2 to 3 times the road capacity of a standard passenger car.

TABLE 4.1 - HOURLY LOWER THAMES CROSSING CAPACITY FOR EACH OF THE APPRAISED OPTIONS

Capacity (pcus)	Without Scheme (Existing Dartford Crossing only)	Route 1: Existing crossing plus 4 lane bridge	Routes 3 & 4: existing crossing plus Dual 2 lane bored Tunnel
Capacity at crossing Southbound	6,400	6,400 + 3,100* = 9,500 (existing east tunnel reversed to provide capacity south bound)	6,400 + 4,660 = 11,060
Capacity at crossing Northbound	3,100* West Tunnel + 3,100* East Tunnel = 6,200	3,100* + 6,700 = 9,800 (West Tunnel and new bridge)	6,200* + 4,660 = 10,860
Total capacity across River Thames	12,600	Total 19,300 (+53% over existing crossing)	Total 21,920 (+74% over existing crossing)

* Tunnel capacities not adjusted to reflect potential capacity reductions due to Dangerous Goods Vehicle (DGV) management requirements.

4.2.4 **Table 4.1** shows the existing hourly capacity for the Without Scheme scenario is around 12,600 pcus per hour, with slightly higher capacity being provided in the southbound direction by the QEII Bridge, than the northbound capacity provided by the tunnels.

4.2.5 With Route 1, the additional new bridge (4 lanes northbound) would provide additional capacity of 6,700 pcus per hour, slightly greater than the existing QEII Bridge, which has a capacity of 6,400 pcus per hour. With Route 1, the Thames crossing capacity would be increased by 53% to around 19,300 pcus per hour compared to the current capacity of 12,600 pcus per hour.

4.2.6 With Routes 3 & 4, the crossing capacity would increase to around 21,920 pcus per hour, 74% higher than that provided today. The additional capacity created with Routes 3 & 4 is significantly higher than that with Route 1 due to the provision of the new tunnels and approach roads, as well as the location and design of the associated junctions.

4.2.7 These traffic capacities have been included in the traffic modelling used to forecast the future usage of the road network affected by the LTC crossings.

4.3 Future Development

4.3.1 Travel demand in the Core growth scenario has been forecast based on a central estimate of national economic growth and an assessment of anticipated future land use developments in the areas around the LTC crossing. In accordance with, DfT guidance, all identified future developments have been categorised into three categories based on the assessed likelihood that the development will proceed:

- 'Near Certain' – The development will occur or this a high probability that it will occur
- 'More than Likely' – The development is likely but there is some uncertainty
- 'Reasonably Foreseeable' – The development may happen but there is significant uncertainty

4.3.2 In some cases a further fourth category has been adopted where the likelihood of development is even lower than that considered under the 'Reasonably Foreseeable' category.

4.3.3 For the Core growth scenario forecast, account has been taken of those developments in the 'Near Certain' and 'More than Likely' categories. Taking account of all of the identified development in these categories for the Core growth scenario to 2041, it is forecast that there will be approximately 100,000 new jobs and 60,000 new homes in the vicinity of the LTC crossing.

4.3.4 **Figure 4.1** shows the percentage growth in 24 hour travel demand in the Core growth scenario for cars, LGVs and HGVs in the LTC traffic model between 2009 and 2041. For all three vehicle categories, demand in the LTC model falls within the low and high range of DfT's latest road traffic forecasts for the period 2010 to 2040.[2] This indicates that the level of travel demand in the LTC traffic model is realistic, in relation to DfT forecasts.

[2] Department for Transport (2015): Road traffic forecasts 2015 https://www.gov.uk/government/publications/road-traffic-forecasts-2015

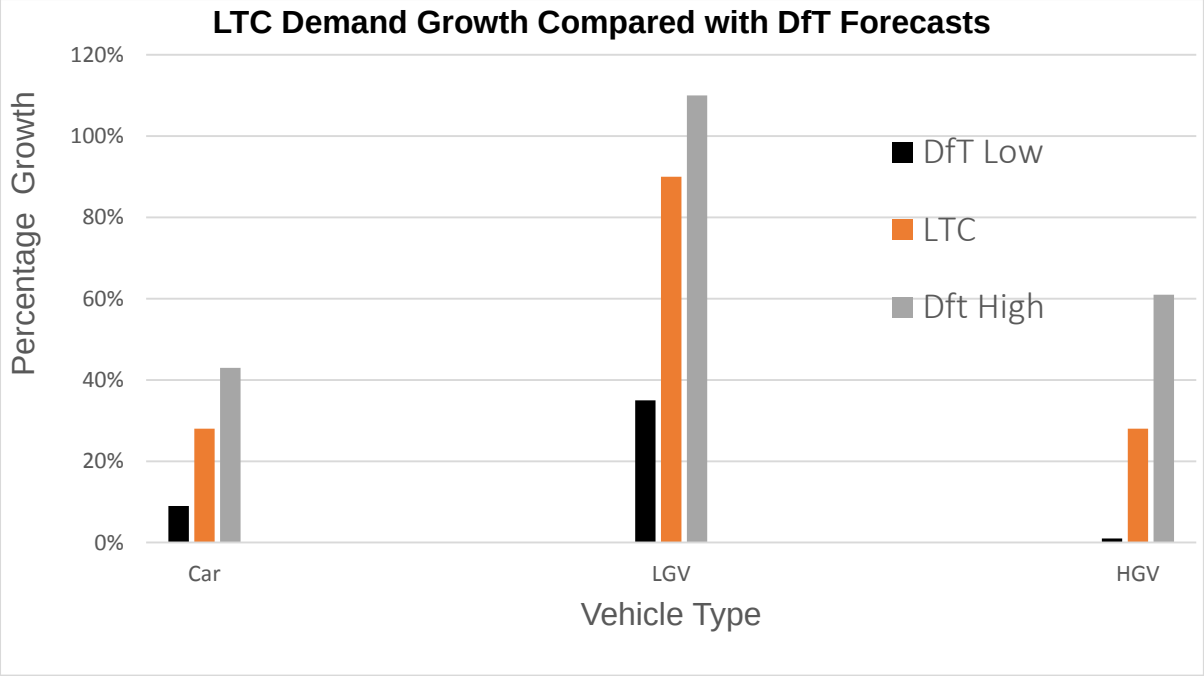


FIGURE 4.1 - LTC DEMAND GROWTH COMPARED WITH DFT FORECASTS

4.4 Traffic flows

4.4.1 Modelling has been undertaken to forecast traffic volumes for three separate average hourly time periods (morning peak, inter-peak and afternoon peak) to examine the impact of the LTC route options. The results have been combined using annualisation factors to produce Annual Average Daily Traffic (AADT) forecasts for light and heavy goods vehicles (HGVs) on a number of road sections affected by the route options. These forecasts are set out in **Tables 4.2** to **4.9**.

4.4.2 The forecasts are described in terms of:

- The growth of total traffic across the river, the split of traffic between Dartford Crossing and LTC as a result of the different crossing options and the main predicted users.
- Changes to traffic volumes on selected sections of the wider road network.
- Changes in travel times and congestion on sections of the road network.
- The growth of HGV traffic across the river with the different crossing options and the different shares of HGV traffic and the balance between this and the level of car traffic.
- The differential impact of the Western Southern Link and Eastern Southern Link on traffic flows for Routes 3 and 4.

4.5 Traffic using existing Dartford Crossing and LTC Options

4.5.1 The total traffic flows across the River Thames using the existing Dartford Crossing, Route 1 and Routes 3 and 4 with the Western and Eastern Southern Links compared to the Without Scheme scenario in 2009, 2025 and 2041 are shown in **Tables 4.2** and **4.3**:

TABLE 4.2 - LTC V2.1 ANNUAL AVERAGE DAILY TRAFFIC FORECASTS 2009 AND 2025

Year	Option		AADT All Vehicles	AADT Light Vehicles	AADT Heavy Goods Vehicles (HGVs)	AADT %HGVs
2009	Without Scheme		140,000	116,000	24,000	17%
2025	Without Scheme		172,000	144,000	28,000	16%
	Route 1		214,000	182,000	32,000	15%
	Route 3/WSL	LTC	84,000	71,000	13,000	15%
		DC	154,000	134,000	20,000	13%
		Total	238,000	205,000	33,000	14%
	Route 4/WSL	LTC	82,000	70,000	12,000	15%
		DC	156,000	136,000	20,000	13%
		Total	238,000	206,000	32,000	13%
	Route 3/ESL	LTC	83,000	70,000	13,000	16%
		DC	155,000	135,000	20,000	13%
		Total	238,000	205,000	33,000	14%
	Route 4/ESL	LTC	81,000	68,000	13,000	16%
		DC	156,000	136,000	20,000	13%
		Total	237,000	204,000	33,000	14%

* DC = Dartford Crossing

TABLE 4.3 - LTC V2.1 ANNUAL AVERAGE DAILY TRAFFIC FORECASTS 2041

Year	Option		AADT All Vehicles	AADT Light Vehicles	AADT Heavy Goods Vehicles (HGVs)	AADT %HGVs
2041	Without Scheme		171,000	142,000	29,000	17%
	Route 1		239,000	202,000	37,000	15%
	Route 3/WSL	LTC	96,000	81,000	15,000	16%
		DC	169,000	146,000	23,000	14%
		Total	265,000	227,000	38,000	14%
	Route 4/WSL	LTC	95,000	81,000	14,000	15%
		DC	170,000	147,000	23,000	14%
		Total	265,000	228,000	37,000	14%
	Route 3/ESL	LTC	94,000	79,000	15,000	16%
		DC	169,000	146,000	23,000	14%
		Total	263,000	225,000	38,000	14%
	Route 4/ESL	LTC	93,000	78,000	15,000	16%
		DC	171,000	148,000	23,000	13%
		Total	264,000	226,000	38,000	14%

* DC = Dartford Crossing

4.5.2 Daily traffic volumes for the Without Scheme scenario are predicted to increase between 2009 and 2025 by 23% to 172,000 AADT. Some of this growth is due to the implementation of Dart Charge and some is related to future economic growth.

4.5.3 Route 1 would provide additional capacity alongside the existing crossing and reduce the bottleneck caused by the northbound tunnels and traffic management cell. At present, there is a level of suppressed demand for travel across the River Thames at Dartford, which is not satisfied due to the current operating conditions on the crossing and the lack of capacity at many times in the day. Over time, this level of suppressed demand is forecast to increase and hence, with the additional capacity provided by Route 1, a significant number of additional vehicles are forecast to cross the River Thames at this location, in particular additional light vehicle trips.

4.5.4 Compared to the Without Scheme case forecast, Route 1 AADT flows are estimated to increase by 24% to 214,000 in 2025 and by 40% to 239,000 in 2041. As discussed later in this section, heavy traffic flows, and a lack of capacity on the wider road network, mean that not all of the new crossing capacity associated with Route 1 could be fully utilised. In particular traffic capacity constraints on the existing corridor and associated junctions on the M25/ A282 approaches to the Dartford Crossing, would limit the volumes of traffic that could make use of the enhanced crossing with Route 1.

4.5.5 Forecast traffic volumes on Route 3 and 4 (with WSL and ESL) river crossings are broadly similar, at around 81,000 - 84,000 vehicles (AADT) in 2025 rising to around 93,000 - 96,000 vehicles (AADT) in 2041. At the

existing Dartford Crossing, total traffic volumes in 2025 are predicted to be around 9% lower than the Without Scheme scenario with heavy goods vehicle flows forecast to reduce by 29%. This significant reduction in heavy goods vehicle traffic continues through to 2041, where heavy goods vehicle flows at the Dartford Crossing are 21% lower than those in the Without Scheme situation. This reduction is due to heavy goods vehicle traffic to and from the Kent ports and the Channel Tunnel which would transfer to the new Lower Thames Crossing at Location C, with Routes 3 or 4.

4.5.6 **Figure 4.2** presents the forecast total traffic crossing the River Thames including the existing Dartford Crossing and the new Lower Thames Crossing for Routes 1, 3 and 4 for 2009, 2025 and 2041. It shows that Route 1 would accommodate significantly more traffic than the existing Dartford Crossing. However, Routes 3 and 4 would attract even higher volumes of crossing traffic reflecting the greater capacity offered by the new crossing and improved connectivity they create between the road network north and south of the River Thames.

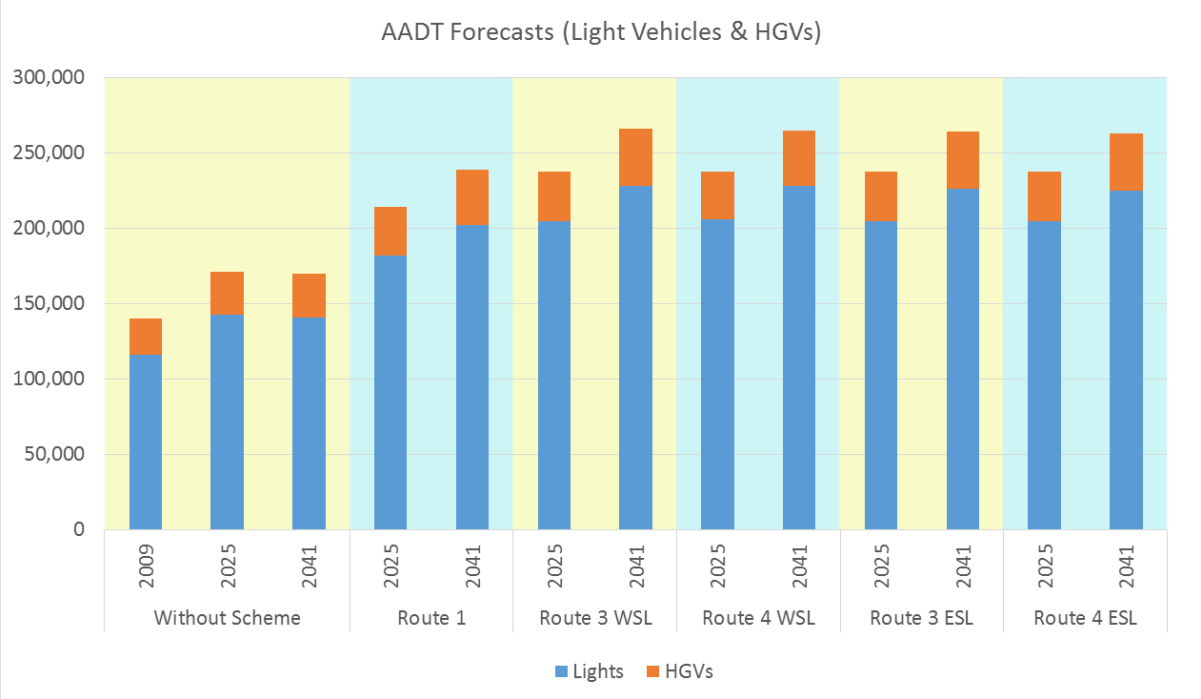
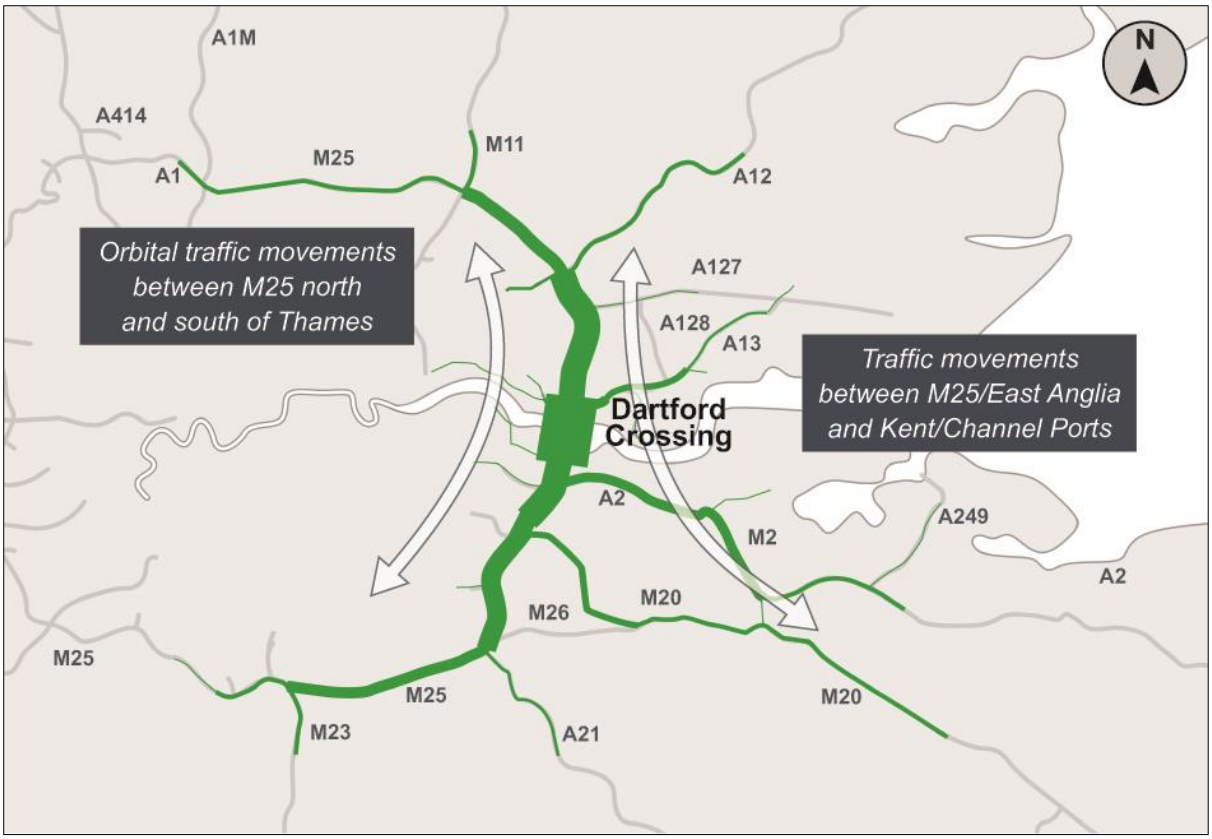


FIGURE 4.2 - ANNUAL AVERAGE DAILY TRAFFIC (AADT) FORECASTS CROSSING THE RIVER THAMES

4.5.7 In terms of the predicted users of the crossings, the green lines in **Figure 4.3** represent the origins and destinations of traffic that would use the Route 1 LTC crossing option in the AM peak in 2041. This shows that:

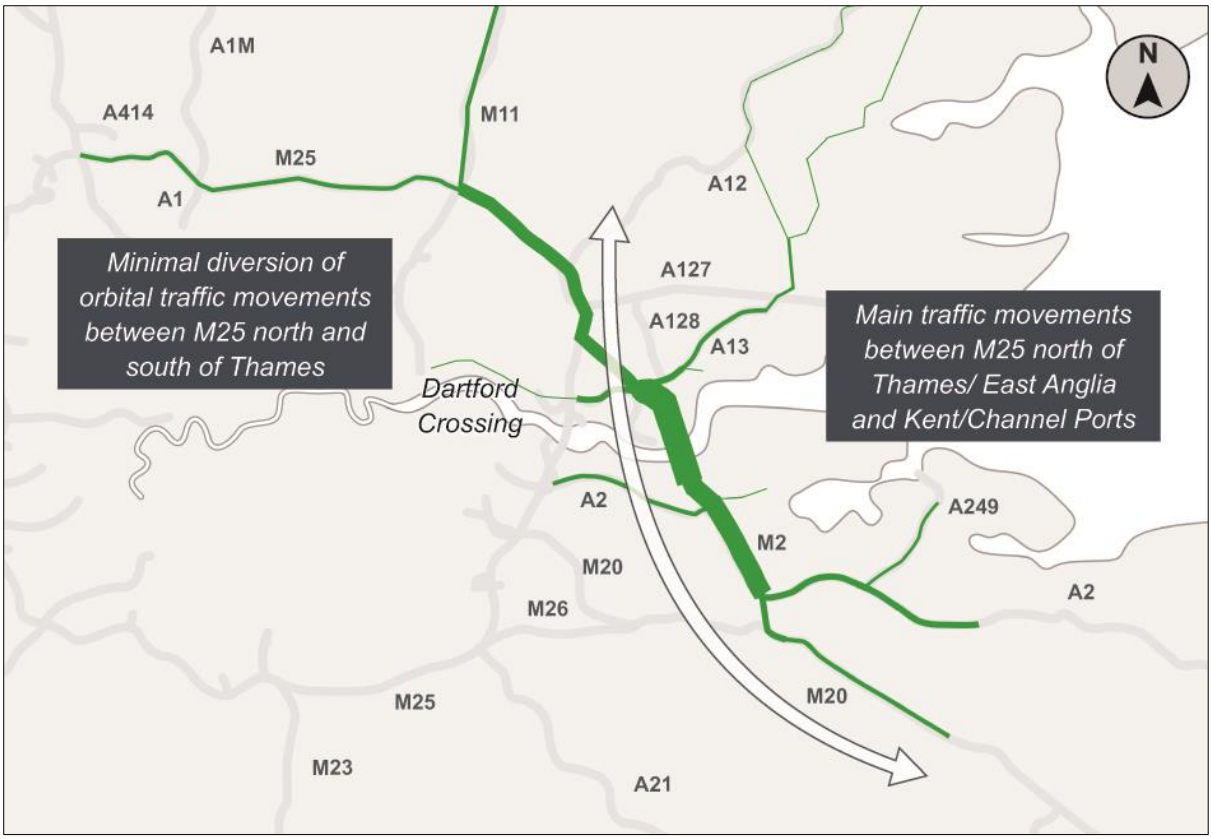
- The main users of Route 1 would be those travelling north and south on the eastern section of the M25 and those travelling between Kent/ Channel Ports and the M25/ East Anglia.
- The main users of Route 1 would be the same as those people using the Dartford Crossing today, but in greater volumes.



The green lines illustrate the pattern of forecast origins and destinations of traffic using the Dartford Crossing AM peak 2041. The thickness of the green line illustrates the volume of Dartford Crossing users making use of each approach route and exit route to/from the Crossing

FIGURE 4.3 - PREDICTED USERS OF ROUTE 1

4.5.8 **Figure 4.4** shows that the main users of Routes 3 and 4 would be people travelling between Kent/ Channel Ports and the M25/ East Anglia and that there would be minimal diversion of M25 orbital traffic movements to the new crossing.



The green lines illustrate the pattern of forecast origins and destinations of traffic using the LTC new crossing in the AM peak 2041. The thickness of the green line illustrates the volume of LTC users making use of each approach route and exit route to/from the Crossing

FIGURE 4.4 - PREDICTED USERS OF ROUTE 3 AND 4

4.5.9 The following key points can be concluded about the forecast traffic flows and the predicted users of, the crossings:

- Route 1 would accommodate significantly more traffic than the existing Dartford Crossing. However Routes 3 and 4 would attract even higher traffic volumes across the River Thames.
- Routes 3 and 4 would result in significant reductions in heavy goods vehicle traffic on the existing Dartford Crossing, volumes would be reduced by 29% in 2025, and by 21% in 2041.
- The choice of Eastern or Western Southern Link would not significantly alter the traffic volumes using the river crossings.
- Similarly, for Routes 3 and 4, the forecast volume of traffic using the proposed river crossings is similar for each option.
- The main users of Route 1 would be those making orbital movements on the M25 - those travelling north and south on the eastern sections of the M25 and those travelling between Kent/ Channel Ports and the M25(north of the River Thames)/ East Anglia. The users of Route 1 would be those people making the same trips movements as those people using the Dartford Crossing today, but in greater volumes.

- The main users of Routes 3 and 4 would be people travelling between Kent/ Channel Ports and the M25 (north of the River Thames)/ Essex/East Anglia and that there would be minimal diversion of M25 orbital movements (those travelling north and south on the eastern sections of the M25) to the new crossing from the M25.

4.6 Traffic impacts across the network

4.6.1 **Tables 4.4** and **4.5** present traffic forecasts for selected key sections of the road network in the Without Scheme situation and for each of the With Scheme LTC route options in 2025 and 2041. The location of the road network sections are shown in **Figure 4.5**. Forecast increases in traffic flows compared to the Without Scheme are shown as positive value and reductions as negative values

TABLE 4.4 - FORECAST TRAFFIC CHANGES WITH OPTIONS COMPARED TO WITHOUT SCHEME IN 2025 (AADT)

Road	Location (refer to Fig 4.5)	Without Scheme	Changes with Route 1	Changes with Route 3 WSL	Changes with Route 3 ESL	Changes with Route 4 WSL	Changes with Route 4 ESL
A2	West of A227 (1)	154,000	+2,000	-7,000	-14,000	-5,000	-12,000
M2	A228-A2/ A289 (2)	102,000	+1,000	+23,000	+34,000	+22,000	+33,000
M20	A228-M26 (3)	122,000	+3,000	-8,000	-10,000	-7,000	-9,000
A13	West of A1089 (4)	105,000	+3,000	-3,000	-2,000	0	+1,000
A127	West of A128 (5)	83,000	0	-9,000	-9,000	+34,000	+35,000
A12	West of A1023 (6)	90,000	0	-2,000	-2,000	-3,000	-2,000
A226	East of Gravesend (7)	5,000	0	+10,000	+10,000	+10,000	+9,000
M25	South of J2 (8)	180,000	+13,000	+3,000	+1,000	+4,000	+2,000
M25	North of J29 (9)	182,000	+6,000	+15,000	+16,000	+21,000	+22,000

Note: Forecast Increases in traffic flows on the roads for each route option compared to the Without Scheme are shown as positive values.

TABLE 4.5 - FORECAST TRAFFIC CHANGES WITH OPTIONS COMPARED TO WITHOUT SCHEME IN 2041 (AADT)

Road	Location (refer to Fig 4.5)	Without Scheme	Change with Route 1	Change with Route 3 WSL	Change with Route 3 ESL	Change with Route 4 WSL	Change with Route 4 ESL
A2	West of A227 (1)	161,000	+2,000	-2,000	-11,000	-1000	-9,000
M2	A228-A2/ A289 (2)	106,000	+2,000	+25,000	+37,000	+24,000	+36,000
M20	A228-M26 (3)	134,000	+4,000	-9,000	-11,000	-9,000	-10,000
A13	West of A1089 (4)	113,000	+4,000	-2,000	-1,000	-2,000	0
A127	West of A128 (5)	84,000	0	-9,000	-9,000	+40,000	+41,000
A12	West of A1023 (6)	91,000	0	-1,000	-1,000	-1,000	-1,000
A226	East of Gravesend (7)	5,000	0	+12,000	+12,000	+12,000	+12,000
M25	South of J2 (8)	182,000	+16,000	+3,000	+2,000	+4,000	+2,000
M25	North of J29 (9)	189,000	+9,000	+19,000	+20,000	+22,000	+23,000

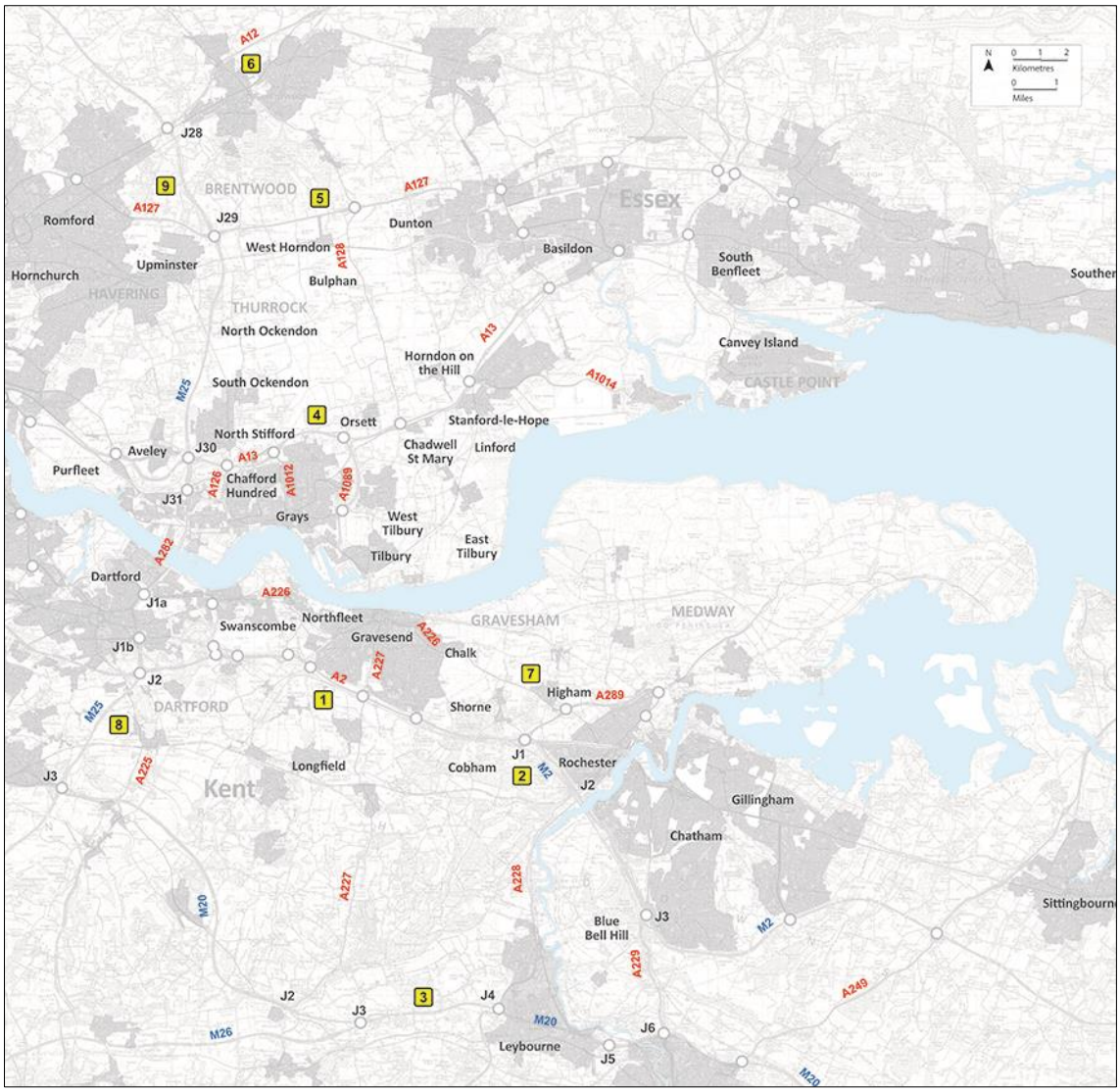
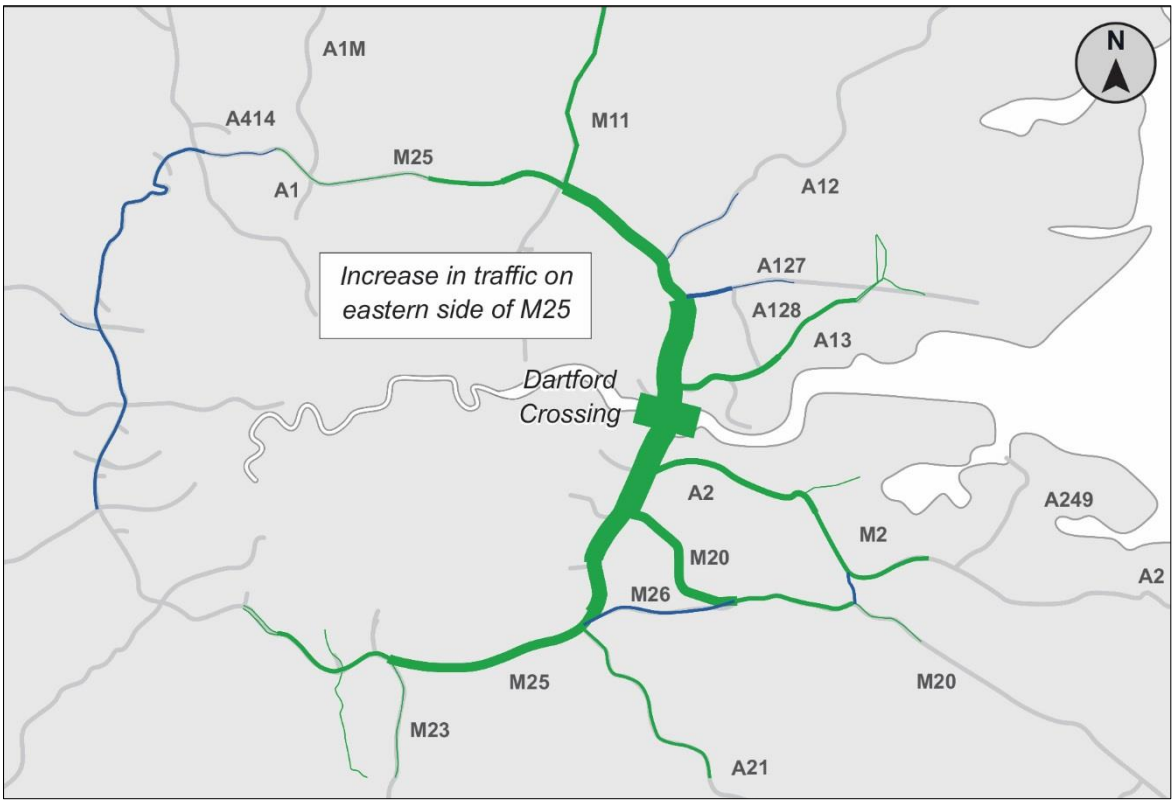


FIGURE 4.5 - LOCATION OF ROAD NETWORK SECTIONS

4.6.2 **Figure 4.6** shows that the most significant impact of Route 1 would be to attract additional traffic onto the existing Dartford crossing and into the M25 eastern corridor. Other effects would include increasing traffic volumes between M25 (north of the River Thames)/ East Anglia and Kent/ Channel Ports due to the additional capacity provided at the Dartford Crossing.

4.6.3 The forecasts also show that Route 1 would increase traffic levels on the M25 and a number of the traffic corridors that feed the Dartford Crossing including the M20 and A13, compared to the Without Scheme situation. These traffic increases would further exacerbate congestion problems on these corridors, which are already forecast in the Without Scheme situation.



Green shows increases in traffic and blue decreases in traffic compared with the Without Scheme AM peak 2041

FIGURE 4.6 - NETWORK IMPACTS OF ROUTE 1

4.6.4 **Tables 4.4** and **4.5** show that Routes 3 and 4 would result in the following:

- Relief to the existing Dartford Crossing corridor.
- Relief to the A2 between Gravesend and Dartford (5,000 to14,000 vehicles per day reduction in 2025) as crossing traffic is drawn away from the A2 to use LTC but is replaced by some traffic with origins within the M25 corridor (South) using LTC to reach its destination in Essex/East Anglia and vice versa. The ESL options provides greater relief than the WSL options.
- Additional traffic being attracted to the M2 at Chatham (22,000 to 34,000 additional vehicles per day in 2025), which originates from, or is destined for, Kent and the Channel Tunnel. The ESL options would lead to higher flows on the M2 than the WSL options.
- Some traffic relief to the M20 between the A228 and M26 (7,000 to 10,000 vehicles per day reduction in 2025).
- Additional traffic attracted to the M25 to the north of Junction 29 (15,000 to 22,000 additional vehicles per day in 2025), as the provision of additional capacity across the River Thames releases suppressed trips and induces trips, many of which would travel on the M25 north of the river.
- Higher traffic volumes on the M25 south of Junction 2 (1,000 to 4,000 additional vehicles per day in 2025) as traffic diverting to the new

crossing releases capacity at the existing crossing, and would release suppressed demand.

- Additional traffic volumes attracted to the A226 east of Gravesend (9,000 to 10,000 additional vehicles per day in 2025) as a result of the local junction with the A226.
- With Route 3, relief to the A127 west of the A128 (9,000 vehicles per day reduction in 2025).

4.6.5 Heavy goods vehicles (HGVs) form a key component of the traffic crossing the River Thames at Dartford at present and will continue to be a significant component of river crossing traffic in the future. Details of forecast HGV movements are reported in **Tables 4.2** and **4.3**. The provision of additional river crossing capacity with each Route option enable additional HGV trips to be made compared to the Without Scheme situation. The forecast combined volumes of HGV traffic on the existing crossing and forecasts on the new crossings are set out in **Table 4.6**.

TABLE 4.6 - FORECAST TOTAL HGV RIVER CROSSING TRAFFIC – AADT (COMBINED FLOW FOR DARTFORD CROSSING AND LTC CROSSING)

Year	Without Scheme	Route 1	Route 3 WSL + Dartford Crossing	Route 3 ESL + Dartford Crossing	Route 4 WSL + Dartford Crossing	Route 4 ESL+ Dartford Crossing
2009	24,000					
2025	28,000	32,000	33,000	33,000	32,000	33,000
2041	29,000	37,000	38,000	38,000	37,000	38,000

4.6.6 In the Without Scheme case, HGV traffic is predicted to increase by 17% between 2009 and 2025 but only by 4% between 2025 and 2041 as growth would be severely constrained by the capacity available.

4.6.7 The provision of additional highway capacity with the construction of Routes 1, 3 or 4 would enable HGV volumes to increase by around 14-18% in 2025 compared to the Without Scheme scenario and by 2041 this would increase to 28-31%. Overall the Eastern Southern Link options for Routes 3 and 4 would attract marginally more HGVs than the Western Southern Link options but the differences would be small.

4.6.8 HGV flows provide support for economic activity and growth. Limitations on the free movement of these vehicles may have repercussions for future levels of economic activity. Although the levels of HGV traffic are forecast to grow in the Without Scheme scenario, they would be very limited beyond 2025, due to the capacity constraints at the Dartford Crossing. With a new crossing, these capacity constraints would be removed and further growth of HGV traffic is forecast. Such growth indicates that the capacity constraints of the existing crossing would inhibit the growth of this traffic, which impacts economic activity in the areas served by the crossing.

4.7 Travel Times and Congestion Relief

Journey Times: Crossings

4.7.1 **Table 4.7** shows forecast average journey times for the existing crossing, a new crossing at location A (Route 1) and a new crossing at Location C (Routes 3 and 4). This is presented for three periods; the present, 2025 when a new crossing is forecast to be open, and 15 years after opening.

4.7.2 The average journey times and speeds are based on northbound morning peak hour journeys between Junctions 1B and 31 on the M25.

TABLE 4.7 - FORECAST JOURNEY TIMES AND SPEEDS AT THAMES CROSSINGS – MORNING PEAK

	Scenarios			
	Without Scheme	Route 1	Routes 3 &4	
	Journey Time (mins) Average Speed (mph)	Journey Time (saving) Average Speed (mph)	Journey Time (mins) Average Speed (mph)	
			Dartford	Equivalent distance at New Crossing (3.2 miles)
Present (2016)	9 mins 22 mph	*Not applicable*		
2025	11 mins 18 mph	6 mins (-5) 34 mph	7½ mins (-3½) 26 mph	3½ mins (-7½) 54 mph
2041	13½ mins 15 mph	8 mins (-5½) 25 mph	10 mins (-3½) 20 mph	4 mins (-9½) 50 mph

Current/ Without Scheme Scenario

4.7.3 At present, journey times across the Dartford Crossing vary significantly due to congestion resulting from incidents. In the evening weekday peak (4pm to 7pm), over 60% of current journeys are below 30 mph.

4.7.4 Under the Without Scheme scenario, this situation will continue to deteriorate and will be compounded by the reduction in reliability described below. It is difficult to accurately forecast the combination of increased traffic and reducing reliability on journey times but both will deteriorate if nothing were to be done.

Route 1

4.7.5 Route 1 would provide additional highway capacity, to allow 40% more traffic flow by 2041. On opening of a new crossing at Dartford (Route 1), peak journey times would improve compared to those at present but, by 2041, this would reduce with journey times forecast to be similar to those now in 2016.

Route 3 and 4

4.7.6 Routes 3 and 4 would provide additional highway capacity, to allow around 54% more traffic flow across the River Thames by 2041. On opening of the new crossing, journey times at the existing crossing would also see improvements, similar to those achieved by Route 1. Like Route 1, these would reduce with time.

Journey Times: Strategic Network

4.7.7 Forecast morning peak travel times with each of the LTC options have been extracted from the model for a selection of illustrative journeys on the strategic road network which would make use of the existing or proposed river crossings.

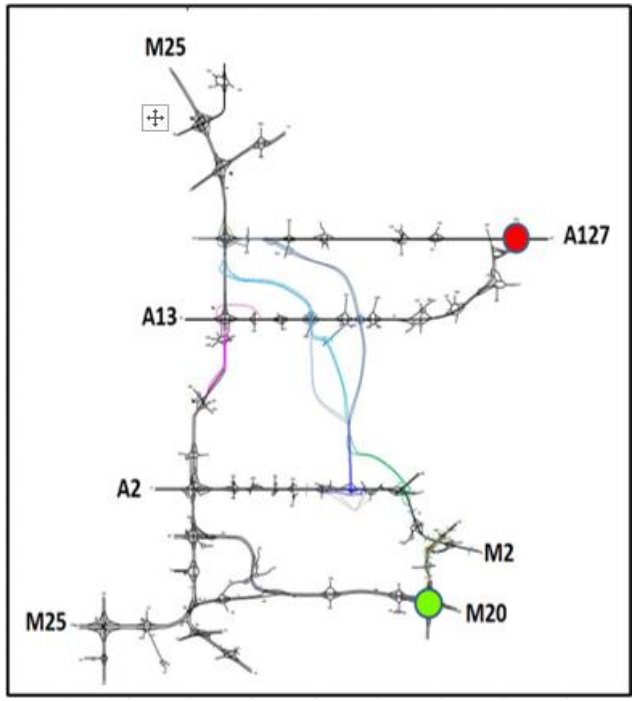
4.7.8 The forecast morning peak journey times and speeds are shown in **Figures 4.7 to 4.10**. The start and end points for these journeys are illustrated in these figures - green dots represent the start points and the red dots the end points for these journeys.

4.7.9 **Figure 4.7** shows that in the absence of additional crossing capacity, the forecast travel time for a trip between M20 Junction 6 and the A127 to the east would increase from about 47 minutes to 52 minutes by 2025 due to increased congestion over time. With the provision of additional on-line capacity (Route 1) the travel time in 2025 would fall by about 5 minutes back to the 2009 level. With additional traffic growth to 2041, in the Without Scheme situation journey times are forecast to increase to 56 minutes but with Route 1 this would reduce to 50 minutes – a 6 minute time saving in 2041.

4.7.10 The crossing options further east would, however, offer the largest and more sustained savings in travel times. The saving for Route 3 and 4 would be between 16 and 22 minutes respectively in 2025, reducing the forecast travel time to just over 30 minutes. Over the period to 2041 travel times would increase but the savings with Routes 3 and 4 would continue to be in the range of 19 to 24 minutes compared to the Without Scheme scenario in 2041. Compared to Route 1, the additional savings of Routes 3 and 4 would amount to about 15 minutes in both 2025 and 2041.

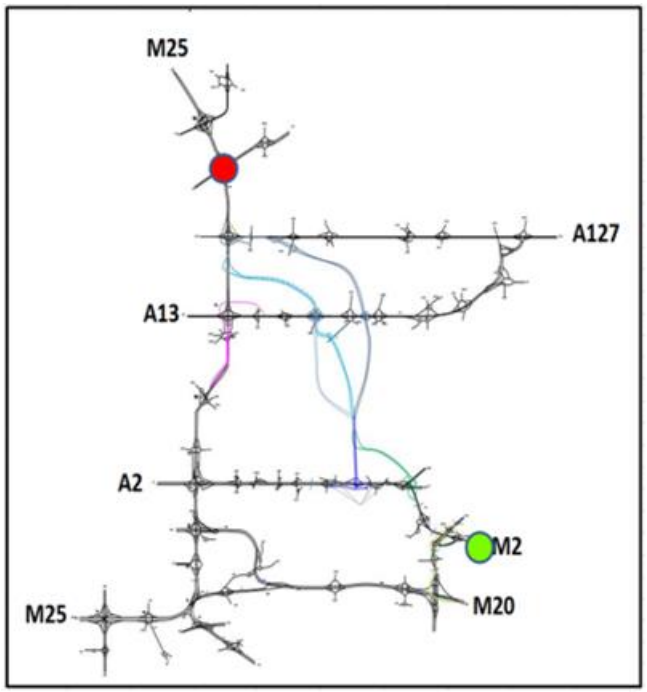
4.7.11 **Figure 4.8** shows a similar pattern of savings for users travelling between M2 Junction 4 to M25 Junction 28 northbound via Dartford and LTC, although the savings using both routes would be less at 8 to 12 minutes for Routes 3 and 4 in 2025 and 2041.

4.7.12 **Figure 4.9** shows that the travel times for traffic using the M25 northbound between Junctions 3 and 28 are forecast to be between 3 and 4 minutes shorter than the Without Scheme scenario, due to the additional capacity provided by Route 1, in 2025. The time savings offered by Routes 3 and 4 would be similar to those for Route 1, reflecting the congestion relief that would be achieved within the M25 Eastern Corridor by transferring traffic to the new LTC with these route options. **Figure 4.10** shows a similar, but slightly lower, level of savings would be achieved for southbound traffic on the M25 corridor.



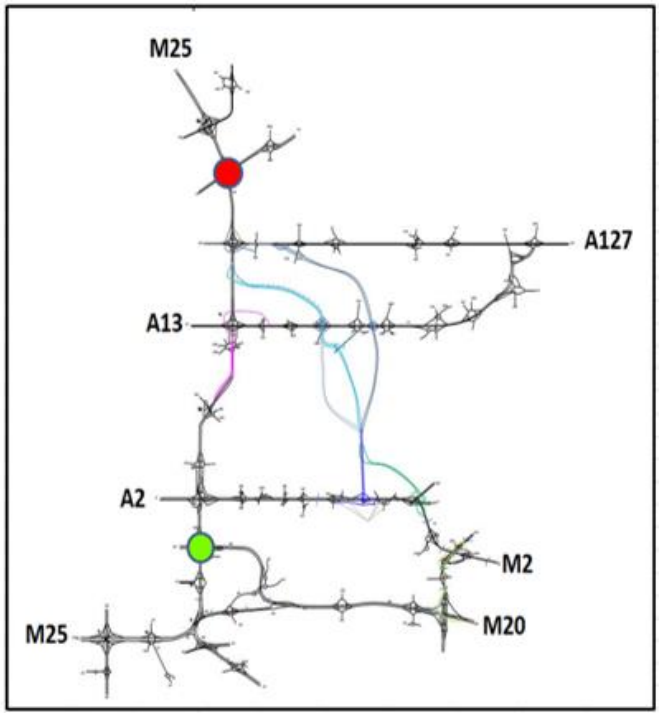
AM Peak	Without Scheme	Route 1	Route 3 ESL	Route 3 WSL	Route 4 ESL	Route 4 WSL
Distance (miles)	38.6	38.8	27.8	29.3	26.3	27.7
Year	Time (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)
2009	47					
2025	52	5	18	16	22	20
2041	56	6	21	19	24	22
Year	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)
2009	50					
2025	45	49	50	50	52	52
2041	42	47	48	48	50	49

FIGURE 4.7 - FORECAST TRAVEL TIMES AND SPEEDS IN THE MORNING PEAK
M20 J6 TO A127/ A1245 NORTHBOUND VIA DARTFORD/LTC



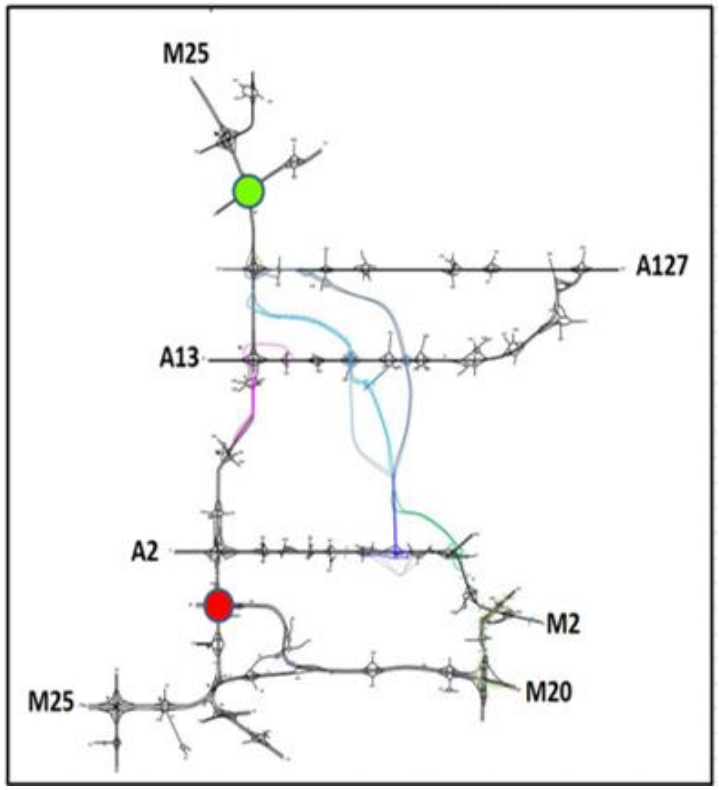
AM Peak	Without Scheme	Route 1	Route 3 ESL	Route 3 WSL	Route 4 ESL	Route 4 WSL
Distance (miles)	31.7	31.7	28.2	29.7	28.9	30.3
Year	Time (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)
2009	36					
2025	40	3	10	8	10	8
2041	44	3	12	10	12	10
Year	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)
2009	53					
2025	47	51	57	56	57	56
2041	44	47	54	53	55	54

FIGURE 4.8 - FORECAST TRAVEL TIMES AND SPEEDS IN THE MORNING PEAK
M2 J4 TO M25 J28 NORTHBOUND VIA DARTFORD/LTC



AM Peak	Without Scheme	Route 1	Route 3 ESL	Route 3 WSL	Route 4 ESL	Route 4 WSL
Distance (miles)	16.4	16.4	16.4	16.4	16.4	16.4
Year	Time (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)
2009	20					
2025	23	3	3	3	4	4
2041	25	4	4	4	5	5
Year	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)
2009	49					
2025	44	50	51	51	52	52
2041	39	47	47	47	49	49

FIGURE 4.9 - FORECAST TRAVEL TIMES AND SPEEDS IN THE MORNING PEAK
M25 J3 TO M25 J28 NORTHBOUND VIA DARTFORD



AM Peak	Without Scheme	Route 1	Route 3 ESL	Route 3 WSL	Route 4 ESL	Route 4 WSL
Distance (miles)	16.7	16.7	16.7	16.7	16.7	16.7
Year	Time (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)	Time saving (mins)
2009	20					
2025	25	4	3	3	3	3
2041	28	5	3	3	4	4
Year	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)	Speed (mph)
2009	50					
2025	41	49	46	47	47	47
2041	36	43	41	41	42	42

FIGURE 4.10 - FORECAST TRAVEL TIMES AND SPEEDS IN THE MORNING PEAK
M25 J28 TO M25 J3 SOUTHBOUND VIA DARTFORD

4.8 Comparison of Western Southern Link with Eastern Southern Link

4.8.1 The Western Southern Link (WSL) would join the A2 at a new junction east of Gravesend in the proximity of Thong; the Eastern Southern Link (ESL) would join the A2/M2 with a modified junction at M2 Junction 1. This section compares the traffic forecasts for Routes 3 and 4, with the WSL and ESL options. **Figure 4.11** shows the WSL and ESL.

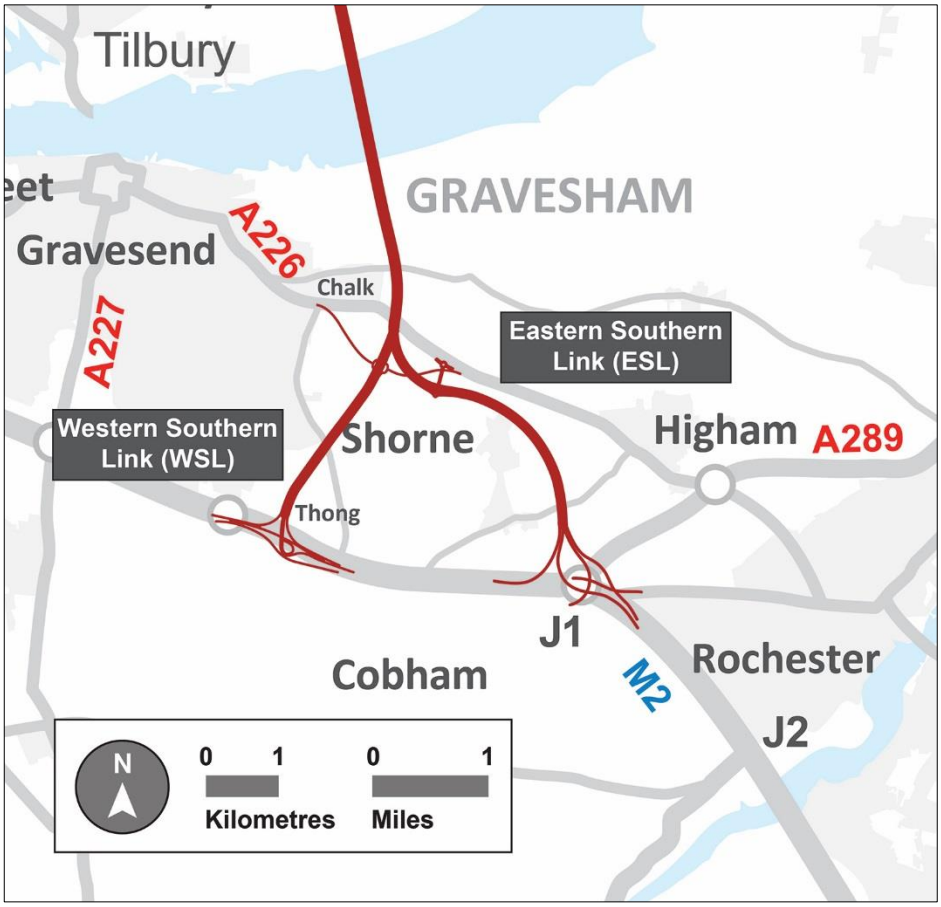


FIGURE 4.11 - WSL AND ESL

4.8.2 Forecast traffic flows (AADT) across the Dartford Crossing and Routes 3 and 4 with the Western and Eastern Southern Links were previously shown as part of the total crossing volumes for all options in **Tables 4.2 and 4.3**. A summary comparison for Routes 3 and 4 with Western and Eastern Southern Links is reproduced in **Table 4.8**.

TABLE 4.8 - COMPARISON OF FORECAST TRAFFIC FLOWS (AADT) FOR WESTERN AND EASTERN SOUTHERN LINKS IN 2025

	Without Scheme	Route 3 WSL	Route 3 ESL	Route 4 WSL	Route 4 ESL
Existing Crossing	172,000	154,000	155,000	156,000	156,000
New Crossing (Tunnel)		84,000	83,000	82,000	81,000

4.8.3 **Table 4.8** shows that in 2025, the traffic forecasts for Route 3 and Route 4 ESL and WSL options are similar. The forecasts for the Existing Crossing indicate that these options will result in a reduction of approximately 16,000 - 18,000 vehicles per day compared with the Without Scheme situation.

4.8.4 **Table 4.9** shows that the same patterns continue in 2041 with all four options forecast to perform in a similar fashion but there are slightly higher forecast volumes of traffic on the WSL river crossings compared to the ESL river crossings for each Route option but differences continue to be small. By 2041 the relief to the Existing Crossing compared to the Without Scheme scenario is forecast to be very small.

TABLE 4.9 - COMPARISON OF TRAFFIC FLOWS (AADT) FOR WESTERN AND EASTERN SOUTHERN LINKS IN 2041

	Without Scheme	Route 3 WSL	Route 3 ESL	Route 4 WSL	Route 4 ESL
Existing Crossing	171,000	169,000	169,000	170,000	171,000
New Crossing (Tunnel)	-	96,000	94,000	95,000	93,000

4.8.5 Considering traffic impacts away from the river crossings, the forecast impact of the ESL options compared to the WSL options in 2025 can be summarised as follows:

- Significantly more vehicles would be attracted away from the A2 between Gravesend and the M25 (around -7,000 vehicles AADT).
- Significantly more vehicles would be attracted to the M2 (+11,000 vehicles AADT).
- Slightly more relief would be offered to the M20 (around -2,000 vehicles AADT).
- Slightly fewer vehicles would be attracted to the M25 south of Junction 2 (difference of 2,000 vehicles AADT).
- The impacts of ESL on the A127, A12, A226 would be broadly similar for the ESL as the WSL.

4.8.6 The pattern of the impact of ESL compared to WSL in 2041 would be similar to that in 2025.

4.8.7 **Figure 4.12** shows that traffic on Routes 3 and 4 using the Western Southern Link to get to the M2 Junction 1 would have a 1.6 miles longer journey than traffic using the Eastern Southern Link.

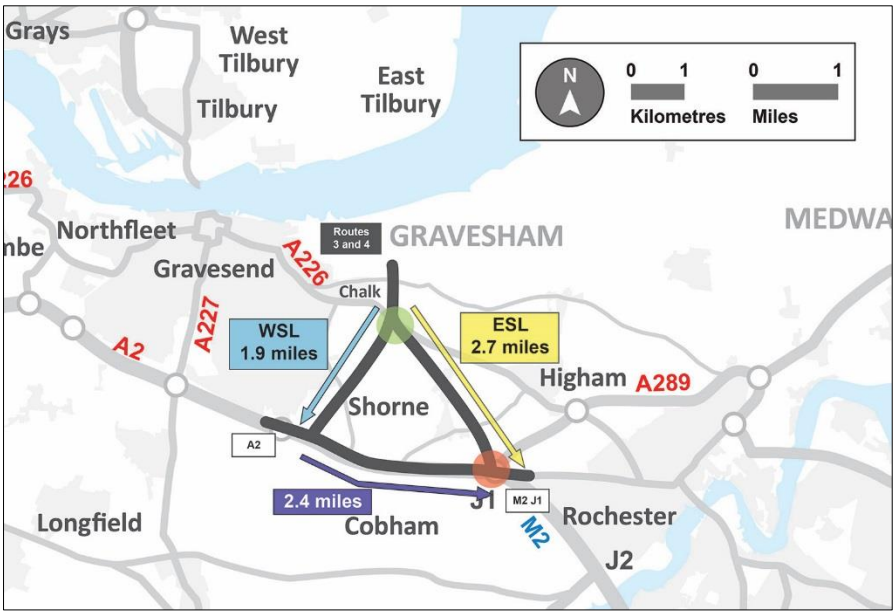


FIGURE 4.12 - COMPARISON OF DISTANCES FOR TRAFFIC USING WESTERN SOUTHERN LINK AND EASTERN SOUTHERN LINK

4.8.8 As the ESL would be shorter and provide a more direct route from the M2/ M20, travel times are expected to be 2 minutes shorter between the M20 Junction 6 and A127/ A1245 and between M2 Junction 4 and M5 Junction 28 compared to the WSL.

4.8.9 **Figure 4.12** also shows that traffic on Routes 3 and 4 using the Eastern Southern Link to get to the A2 (west) would have a 3.2 mile longer journey compared to the WSL.

4.9 Operational resilience

4.9.1 Whilst the fundamental problem at the crossing is that the traffic demand at certain periods of the day exceeds the crossing capacity, the incremental way that the adjacent network and crossing capacity has evolved over more than 50 years has led to a road configuration that exacerbates the capacity problem and increases the likelihood of incidents. Forecasts predict that the period when traffic is congested will increase, resulting in a greater chance of incidents.

4.9.2 Resilience refers to the ability of a road, or road network, to maintain an acceptable level of service for users following an incident. A range of incidents may arise that disrupt the normal operation of traffic on the road such as traffic accidents, weather events, and non-vehicular encroachment on to the road. A large number of incidents occur on the existing Dartford Crossing and the crossing provides poor levels of resilience to these incidents.

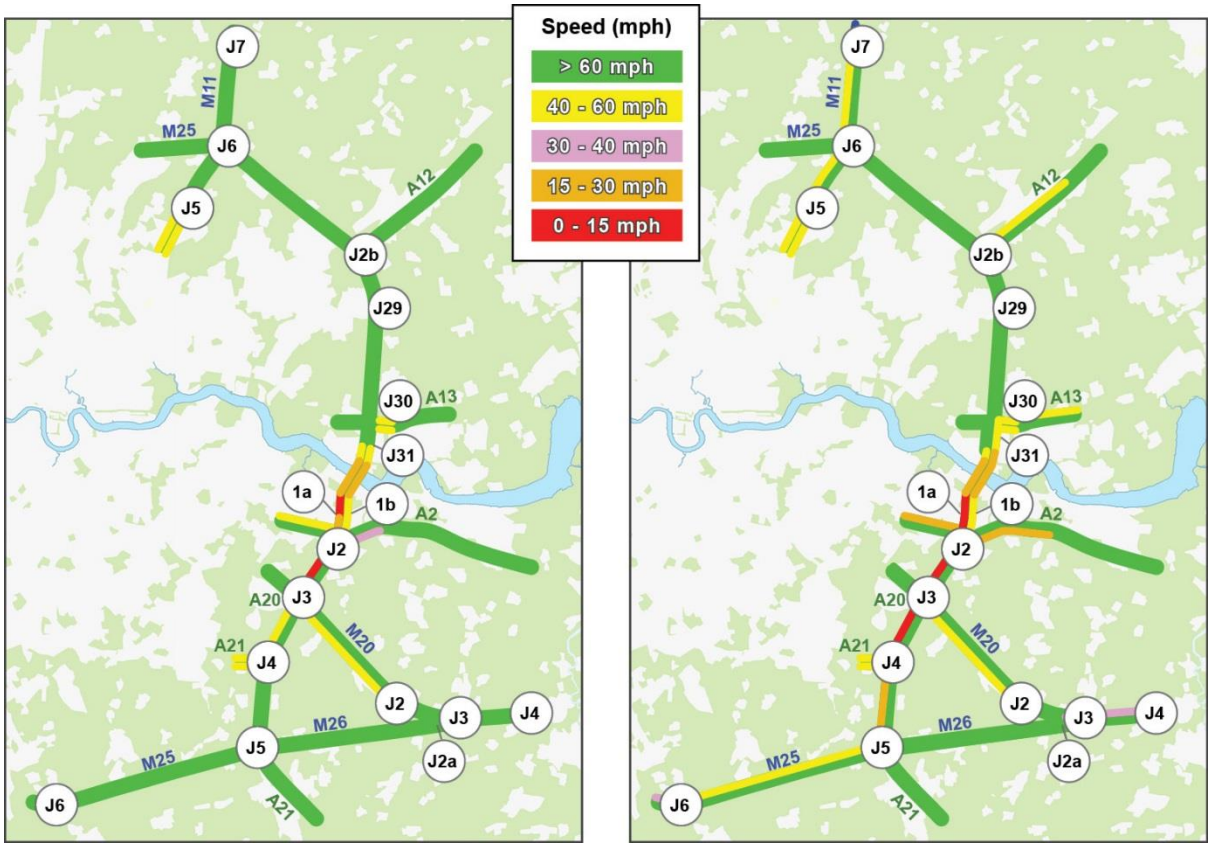
4.9.3 The road network near the crossing results in incidents occurring at a greater frequency in this location than other parts of the Strategic Road Network. A main cause of the incidents is the complex road layout close to the crossing with junctions closely spaced, resulting in traffic weaving over relatively short distances.

4.9.4 In the second half of 2015 there were over 950 unplanned closures of a single lane or more at the crossing. On average, there are over 5 closure incidents a day, with an average 18 minute duration. In the event of significant closures, the local network is badly affected and users have no real alternative routes, resulting in congestion and delay.

4.9.5 In the event of partial or full closure, traffic has to be re-routed through the unaffected sections or in the worst case, via the Blackwall Tunnel (approximately a 30 mile detour and minimum additional travel time of 40 minutes). The Blackwall Tunnel is only accessible to vehicles under 4m in height and hazardous loads are not permitted, which forces many heavy goods vehicles to drive around the M25, equivalent to up to an additional 100 miles, with an additional travel time of at least 2 hours.

Example of poor operational resilience today

4.9.6 The congestion and incidents do not only affect the crossing users. The strategic location and importance of the crossing means that any disruption at the crossing has a ripple effect on the surrounding network. This can be demonstrated by reference to an incident in July 2014, when the northbound tunnels were closed at about 12.30pm because of an accident. **Figure 4.13** shows the resulting congestion on the network at 1pm and 5pm on the day of the accident. By 1pm, the queues were already spreading back from Junction 2 on the M25. Even at 5pm, the queues had reached their largest extent and had reached back to Junction 5, with journey speeds below 15mph between Junction 1a and Junction 4 of the M25, down the A2 and along the M20 in Kent. An area of some 425 square kilometres was affected by the resultant congestion. It was almost midnight before congestion was relieved, as the capacity of the single open tunnel was sufficient for the overnight traffic volumes. The closed tunnel was reopened at 5.30am the following morning before the morning peak traffic period.



Average Speeds between 1pm and 2pm **Average Speeds between 5pm and 6pm**

FIGURE 4.13 - ILLUSTRATION OF AVERAGE TRAVEL SPEEDS ON CROSSING AND SURROUNDING ROAD NETWORK AFTER INCIDENT IN JULY 2014

4.9.7 It is estimated that approximately 40,000 vehicles were delayed for more than 30 minutes, resulting in 20,000 lost hours on a single afternoon.

4.9.8 The existing corridor will continue to be prone to incidents in the future because of the poor alignment and junction configuration, as described in SAR Volume 2, Section 3.2. Operationally, Routes 3 and 4 would provide considerably greater flexibility in the event of a major incident on the M25/ A282 corridor than Route 1, because they would provide an entirely new river crossing, and an alternative route that could be used as a diversion route for traffic. The new scheme at Routes 3 and 4 would incorporate technology which would be integrated with the wider strategic network and the existing Dartford Crossing. Incident detection and variable message signing would enable effective management of traffic during incidents, and provide road users with information on diversion routes.

4.9.9 In the next stage of scheme development further, testing and modelling of network resilience will be undertaken to support the operational and economic appraisal work.

4.10 Conclusions

4.10.1 This section summarises the findings of the traffic appraisal which has been carried out for each of the route options. (Details of other elements of the appraisal – economic and social impacts are described in Sections 5 & 6).

The results of the traffic appraisal of route options can be summarised by considering the 3 key components of the LTC:

- The location of the Thames River Crossing - comparison of Location A (Route 1) and Location C (Routes 3 and 4).
- The form of the southern link for route options at Location C - comparison of WSL and ESL route options.
- The selection of the route option north of the river for route options at Location C - comparison of Route 3 and Route 4 options.

4.10.2 To compare these route options, **Tables 4.10**, **4.11** and **4.12** present a summary of the traffic appraisal results in terms of traffic volumes, predicted users, journey times and crossing capacity. From these appraisal results, the following conclusions can be drawn.

The Location of the Thames River Crossing

4.10.3 A new river crossing at Location C would improve the overall connectivity of the road network, allowing significantly greater number of trips to be made across the River Thames than a crossing at Location A. A crossing at Location C would be effective at supporting new development and the associated traffic movements to the east of the existing A282 corridor.

4.10.4 Location C (Routes 3&4) would provide the most traffic congestion relief to the existing crossing, by reducing heavy goods vehicle traffic, a key objective of LTC, as well as providing relief on the A2 and M20 corridors.

4.10.5 Whilst a new crossing at Location A (Route 1) would allow more traffic to access the existing crossing corridor compared to the current situation, other pinch-points on the M25 and its feeder routes would become congested over time and constrain the amount of traffic that could reach the upgraded crossing (Route 1). In other words, increasing the capacity of the crossing structure and the immediate approach roads would not ease congestion on the approach roads, local roads and arterial roads.

4.10.6 Overall, a new crossing at Location A (Route 1) would not meet the objective to relieve the congested Dartford Crossing and approach roads and improve their performance by providing free flowing north-south capacity for the following reasons:

- Whilst providing some improvements in congestion at the existing crossing and providing journey time savings for M25 traffic between J3 and J28, it would not provide wider network journey time improvements. There would be increased congestion on key radial routes - M20, A2 and A13.
- The crossing and approaches would be restricted to a 50mph speed limit, due to constraints imposed by the layout of the crossing structures, junctions and existing development along the route; the route could not be transformed into a free-flowing 70mph solution.
- Construction of Route 1 would take approximately 6.5 years. During this time traffic would be restricted to a 40mph speed limit, with complex traffic management arrangements. The capacity at the

existing crossing would be reduced during construction, imposing delays on existing users and increased unreliability of journey times.

4.10.7 In terms of operational resilience, a crossing at Location C would provide considerably greater flexibility in the event of a major incident on the M25/ A282 corridor than a crossing at Location A.

4.10.8 Route 1 would not meet the objective to improve resilience of the Thames crossings and Strategic Road Network. Whilst it provides additional crossing resilience, it would not improve the resilience of the wider road network, for the following reasons:

- Traffic would still be funnelled through the existing M25/ A282 corridor between Junction 2 and Junction 30.
- There would be more traffic along the route; by 2041, there would be a 40% increase in traffic at the crossing, with a 28% increase in the number of HGVs.
- Route 1 would not provide an independent alternative route for traffic to use. Incidents along the corridor and approach routes would still lead to long delays and severe congestion.

4.10.9 Predicted future travel times across the existing crossing would be broadly similar whichever location is chosen as the existing Dartford tunnels would continue to limit speeds and traffic volumes due to their capacity constraints. As expected, the catchment area for a crossing at Location A would be similar to the catchment of the existing crossing, whereas a new crossing at Location C would attract trips starting in Essex/ East Anglia and ending in Kent (or vice versa). In addition, the new crossing (tunnel) at Location C would offer almost 40% more additional traffic capacity than the proposed bridge at Location A due to the capacity constraints in the vicinity of the existing crossing.

The Form of the Southern Link

4.10.10 The choice of WSL or ESL has little impact on the predicted traffic volumes across the River Thames, either on the existing crossing or the new crossing. ESL would offer greater traffic relief to the A2 and M20 than WSL, but would attract additional traffic to the M2 by providing this traffic with a slightly quicker free-flow link over the River Thames. The ESL would provide a faster route for M2 traffic and, as a result, attract more traffic destined for, and originating in, Kent and slightly less traffic from the M25 south of London.

Selection of the Route Option North of the River

4.10.11 Routes 3 and 4 are predicted to carry similar volumes of traffic, to provide the same relief to the existing crossing and result in broadly the same predicted travel times across the River Thames. Route 3 is expected to attract slightly more traffic to the new crossing, thereby offering the most relief to the A2 and A13, and would attract a lower level of additional traffic to the M2.

TABLE 4.10 - SUMMARY OF KEY RESULTS - COMPARISON OF LOCATIONS A AND C

	Location A (Route 1)	Location C (Routes 3 and 4)
Traffic Volumes on existing crossing	+24% compared to Without Scheme Scenario in 2025 +40% compared to Without Scheme Scenario in 2041 HGVs: +14% compared with Without Scheme Scenario in 2025 HGVs: +28% compared with Without Scheme Scenario in 2041	-9% to -10% compared to Without Scheme Scenario in 2025 Similar to Without Scheme Scenario in 2041 HGVs: -29% compared with Without Scheme Scenario in 2025 HGVs: -21% compared with Without Scheme Scenario in 2041
Traffic Volumes on new crossing	N/A	81,000 to 84,000 AADT in 2025 93,000 to 96,000 AADT in 2041
Traffic Flow Conditions	Although the new crossing will be reasonably free-flowing, congestion problems will occur at some junctions along the M25/ A282 corridor between J2 and J30. The new crossing will be subject to a 50 mph speed limit	The new crossings at Location C (Routes 3 and 4) will improve overall connectivity across the River Thames, by providing a high quality road with free-flowing conditions subject to a 70mph speed limit
Total Volumes crossing the River Thames	+24% / +40% compared to Without Scheme Scenario in 2025 and 2041	+38% / +54% to +55% compared to Without Scheme Scenario in 2025 and 2041
Traffic Volumes of rest of network	Attracts more traffic to the M25 Corridor north of J29 and south of J2, also attracts some additional traffic to the M20 and A13 corridors	Relieves the A2 between Gravesend and Dartford, M20 and A12. Attracts additional traffic to the M2 at Chatham, M25 north of J29 and south of J2, and A226 east of Gravesend
AM Travel Times	Compared to the Without Scheme Scenario: • Travel times across the River Thames at Dartford will be 3-5 minutes shorter • Trips between M2 and M25 north of the River Thames (J28) will be about 3 minutes faster	Compared to the Without Scheme Scenario: • Travel times across the River Thames at Dartford will be 3-5 minutes shorter • Trips between M2 and M25 north of the River Thames (J28) will be 8-12 minutes faster

	Location A (Route 1)	Location C (Routes 3 and 4)
	• M20 trips heading to A127/A1245 will be 2-5 minutes shorter	• M20 trips heading to A127/A1245 will be 14-21 minutes shorter
Catchment Analysis	Will attract traffic into the eastern M25 corridor with the highest radial flows attracted from the A12, M11 and M2	Will attract traffic movements between M1/M11/A13 and Kent.
Hourly Crossing Traffic Capacity (pcus)	19,300 (+53% compared to Without Scheme scenario)	Total 22,000 (+74% compared to Without Scheme scenario)
Achievement of Traffic Scheme Objectives	Route 1 does not achieve the scheme objectives, due to lack of traffic relief and poor network resilience	Routes 3 and 4 positively contribute towards the scheme objectives by providing traffic relief and significantly improving network resilience

TABLE 4.11 - COMPARISON OF WSL AND ESL

	Route 3 WSL	Route 3 ESL
Daily Traffic Volumes on existing crossing (AADT)	154,000 in 2025 169,000 in 2041	155,000 in 2025 169,000 in 2041
Daily Traffic Volumes on new crossing (AADT)	84,000 in 2025 96,000 in 2041	83,000 in 2025 94,000 in 2041
Total Volumes crossing the River Thames	238,000 in 2025 265,000 in 2041	238,000 in 2025 263,000 in 2041
Traffic Volumes on rest of network	Less relief to A2/ M20, less traffic attracted to M2	More relief provided to A2/M20, more traffic attracted to M2.
AM Travel Times	Trips between M20 and A127/ A1245 and between M2 and M25 J28 will be 2 minutes shorter via ESL compared to WSL	
Catchment Analysis	ESL attracts more traffic destined/originating in Kent using the M2/M20 and slightly less traffic from M25 south of London	
Hourly Crossing Capacity (pcus)	Total 22,000	Total 22,000

TABLE 4.12 - COMPARISON OF LOCATION C ROUTES 3 AND 4

	Route 3	Route 4
Traffic Volumes on existing crossing	154,000 - 155,000 in 2025 169,000 in 2041	156,000 in 2025 170,000 - 171,000 in 2041
Traffic Volumes on new crossing	83,000 - 84,000 in 2025 94,000 - 96,000 in 2041	81,000 - 82,000 in 2025 93,000 - 95,000 in 2041
Total Volumes crossing the River Thames	238,000 in 2025 263,000 - 265,000 in 2041	237,000 - 238,000 in 2025 264,000 - 265,000 in 2041
Traffic Volumes on rest of network	By 2041 offers the greatest relief to A2 and M20, attracts the lowest volumes of additional traffic to M2 and provides slight relief to A13	Northern tie-in attracts significantly more traffic to A127, more traffic attracted to M25 north of J29, slightly less relief to A2
AM Travel Times	Travel times between M2 J4 and M25 J28 are not significantly different	
Catchment Analysis	No significant differences between catchment areas	
Hourly Crossing Capacity (pcus)	Total 22,000	Total 22,000

5 Economic Appraisal

5.1 Introduction

5.1.1 This section presents the results of the economic appraisal of the Post-Consultation Appraisal Routes, separated into the different standard types of economic benefits. In addition to economic impacts expressed in monetary terms, it also includes results for those public accounts, environmental and social impacts that are also expressed in monetary terms. These impacts have been appraised using DfT's standard appraisal tools, including TUBA and COBALT. The benefits and costs in this section are all expressed as present values in 2010 prices, discounted to 2010 and compared to each other to provide BCRs.

5.2 Transport Economic Efficiency – User Benefits

5.2.1 The transport economic efficiency of each of the LTC route options has been calculated and this focuses on the assessment of user impacts which include travel time savings, vehicle operating cost (VOC) savings, user charges and construction and maintenance delays to users. Of these benefits, travel time savings are the predominant component of these benefits across all routes. These benefits have been appraised using TUBA and the forecast benefits have been disaggregated between business users, commuters and other consumers and are summarised in **Table 5.1**.

5.2.2 The forecast user benefits vary considerably between the five routes, ranging from £1.46bn for Route 1 to £3.03bn for Route 3 with ESL. In general the benefits for Routes 3 and 4 are forecast to be similar and on average about twice those for Route 1, reflecting the more extensive scale of the improvements to the road network offered by these routes.

5.2.3 For Routes 3 and 4 the user and provider benefits would be fairly similar, ranging between £2.52bn for Route 4 with WSL to £3.03bn for Route 3 with ESL. Route 3 would provide a completely new road alignment in contrast to route 4 which would incorporate upgrading of the A127 corridor.

TABLE 5.1 - USER BENEFITS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

PVBs £bn 2010 prices, discounted to 2010	Route 1	Route 3 WSL	Route 3 ESL	Route 4 WSL	Route 4 ESL
Commuter benefits	0.071	0.050	0.070	0.050	0.059
Other consumer benefits	0.229	0.058	0.143	0.055	0.064
Business benefits	1.162	2.472	2.817	2.413	2.685
Total	**1.462**	**2.580**	**3.030**	**2.518**	**2.808**
Business benefits as % of total	79	96	93	96	96

5.2.4 Route 3 with ESL would provide £450 million of additional user benefits compared with Route 3 with WSL. This is because the alignment of the ESL reflects a more natural desire line for traffic travelling between Kent and Essex and the ESL would be shorter in distance than the WSL (refer to **Figure 4.12**).

5.2.5 For all routes:

- Travel time savings make up over 90% of the overall benefits.
- Benefits to business users represent a very high proportion of total user benefits amounting to over 90% of the total user benefits for Routes 3 and 4. This proportion is 79% for Route 1.

5.3 Other Economic Impacts

Accidents

5.3.1 DfT's COBALT tool has been used to appraise accidents. All route options are forecast to show a net increase in the number of accidents and these increases have been valued in monetary terms and represent accident disbenefits. The current analysis has used the default national average accident rates by road type in COBALT. The reasons for this are explained further in Section 6.

5.3.2 For all routes the number of accidents is forecast to increase due to the increased volume of traffic on the road network. Route 1 is forecast to have the lowest increase in the number of accidents and casualties due to the relatively low levels of additional traffic which are forecast compared to the Without Scheme situation. The highest increase in the number of accidents is expected with Route 3 with WSL option as it is forecast to result in the greatest volume of additional traffic movement compared to the Without Scheme situation. The other Route 3 and 4 options are expected to have similar accident effects to Route 3 WSL but slightly lower as they will result in similar increases in traffic movements to the Route 3 WSL option. Each of these options (for Routes 3 and 4) are forecast to result in 3,650 extra accidents per annum compared to the Without Scheme situation.

5.3.3 As a result of the forecast changes in accidents, Route 1 has the lowest valuation of accident disbenefits of £89 million whilst Route 4 with WSL has the highest at £150 million (refer to **Table 5.2**).

5.3.4 It is anticipated that the outturn accident benefits would be greater than those forecast as local accident rates around the existing Dartford Crossing are higher than average and we would expect lower accident rates on the enhanced crossing and on the alternative LTC crossing options due to their more consistent design quality. In further work, as the scheme is developed, it is proposed to undertake a more detailed accident appraisal to fully take account of existing accident rates on routes affected by the LTC crossing.

5.3.5 Section 6 provides a more detailed explanation of the appraisal of accidents.

Greenhouse gas emissions

5.3.6 For all routes, greenhouse gas emissions are estimated to increase as a result of traffic taking advantage of the enhanced opportunities for travel across the river. These emissions have been estimated in tonnes and valued using the WebTAG workbook approach. Route 1 has the lowest increase (£316 million disbenefit), whilst Route 4 with ESL has the largest increase (£615 million disbenefit) (refer to **Table 5.2**).

Noise impacts

5.3.7 Volume 6 describes how noise impacts have been calculated and valued in monetary terms. The valuation of these impacts, which is included in the appraisal, is relatively low for all of the routes (refer to **Table 5.2**).

Construction delays

5.3.8 A further element of the economic appraisal is an estimate of the impact of construction delays on road users.

5.3.9 For Route 1, delays for travellers caused by LTC construction work are estimated to cost £291 million because of the extensive delays which would be caused to existing traffic on the A282/ M25. For the Route 3 and Route 4 options these construction delays are estimated to cost just £26 million because most of these routes would be completely new and the only disruption to users would be at the junctions with the existing road network (refer to **Table 5.2**).

Indirect taxation

5.3.10 The LTC options result in increases in indirect taxation revenues from fuel duty and VAT that are related to greater traffic levels and the length of journeys made. The increased revenues, expressed in present value terms, range between £222 million for Route 1 to £603 million for Route 4 with ESL (refer to **Table 5.2**).

TABLE 5.2 - OTHER IMPACTS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

PVB £bn 2010 prices, discounted to 2010	Route 1	Route 3 WSL	Route 3 ESL	Route 4 WSL	Route 4 ESL
Greenhouse gas emissions	-0.316	-0.554	-0.560	-0.599	-0.615
Noise	-0.003	-0.003	-0.002	-0.001	-0.001
Accidents	-0.089	-0.147	-0.136	-0.150	-0.138
Construction delays	-0.291	-0.026	-0.026	-0.026	-0.026
Indirect taxation	0.222	0.496	0.511	0.570	0.603

5.3.11 **Table 5.3** presents forecast user impacts along with the other economic impacts to produce estimates of total benefits expressed as Present Values of Benefits (PVBs). Route 3 with ESL would have the highest benefits at £2.82 billion.

5.3.12 Route 3 with ESL would provide £471 million in extra benefits compared to Route 3 with WSL. This differential between ESL and WSL would fall to £318m for Route 4.

TABLE 5.3 - TOTAL BENEFITS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

PVB £bn 2010 prices, discounted to 2010	Route 1	Route 3 WSL	Route 3 ESL	Route 4 WSL	Route 4 ESL
Greenhouse gas emissions	-0.316	-0.554	-0.560	-0.599	-0.615
Noise	-0.003	-0.003	-0.002	-0.001	-0.001
Accidents	-0.089	-0.147	-0.136	-0.150	-0.138
Commuting	0.071	0.050	0.070	0.050	0.059
Other Consumers	0.229	0.058	0.143	0.055	0.064
Business	1.162	2.472	2.817	2.413	2.685
Construction delays	-0.291	-0.026	-0.026	-0.026	-0.026
Indirect Taxation	0.222	0.496	0.511	0.570	0.603
Total	**0.985**	**2.346**	**2.817**	**2.312**	**2.631**

Note: Commuting, Other Consumers and Business includes travel time, vehicle operating costs and user charges.

5.4 Scheme costs

5.4.1 The forecasting of capital and operating costs for the LTC options is explained in Volume 4.

5.4.2 **Table 5.4** presents the costs expressed in present value terms. For the five route options discussed in this section:

- The Investment costs range from £2.0bn (Route 1 with bridge) to £2.9bn (Route 4 with ESL and bored tunnel).
- The operating costs for Route 1 with bridge at £66 million would be much lower than the operating costs for Routes 3 and 4 (with WSL and ESL) with the bored tunnel, which are all around £300 million. The additional costs for Routes 3 and 4 relate to both the additional costs of maintaining a tunnel compared with a bridge and also to the maintenance of the significant additional roadway sections and associated structures with these two options compared with Route 1.
- The total costs range from £2.1 billion (Route 1 with bridge) to £3.2 billion (Route 4 with ESL and bored tunnel). The costs for Routes 3 and 4 are similar, with the ESL costs for each Route being approximately £120m more than the WSL option.

TABLE 5.4 - PRESENT VALUE SCHEME COSTS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

	R1 Bridge	R3/ WSL Bored tunnel	R3/ ESL Bored tunnel	R4/ WSL Bored tunnel	R4/ ESL Bored tunnel
Investment costs	2.002	2.520	2.641	2.735	2.860
Operating costs	0.066	0.295	0.292	0.301	0.298
Total costs	**2.068**	**2.815**	**2.933**	**3.036**	**3.158**

5.5 Revenues

5.5.1 Within the economic appraisal of route options, the changes in revenues generated from user charges compared with the Without Scheme situation, over the 60 year appraisal period, are calculated and are offset against the costs of the new crossing. Hence, as the scale of user charge revenue increases, the effective scheme costs decrease. It is important to note that the revenues considered in appraising each of the route options are the differences in revenues with the route option compared with the revenues which would be received in the Without Scheme situation. Since Location C routes (Routes 3 &4) attract more traffic they generate higher revenues than Route 1.

5.5.2 **Table 5.5** shows the forecast revenues for each of the five route options. The revenues for Routes 3 and 4 with WSL and ESL are all forecast to be around £880 million (present value 2010 prices discounted to 2010).

TABLE 5.5 - REVENUES (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

	R1 Bridge	R3/ WSL Bored tunnel	R3/ ESL Bored tunnel	R4/ WSL Bored tunnel	R4/ ESL Bored tunnel
Revenues	0.567	0.884	0.885	0.876	0.873

5.5.3 For Route 1, the present value of revenues (£567million) over the 60 year appraisal period are forecast to be 27% of the present value of scheme costs set out in Table 5.4 (£2.068bn). In effect, this means that the present value of costs for the scheme is reduced by 27% to reflect the additional revenue which is generated through user charges, which is offset against the scheme costs. For Routes 3 and 4, the revenues would be higher in monetary terms and, as a proportion of the present value of scheme costs, would be in the range of 28% to 31% depending on the specific option. As with Route 1, this additional revenue would reduce the present value of costs for these options.

5.6 Wider Impact Benefits

5.6.1 In addition to User and Provider benefits and other economic impacts, there are two additional economic effects; these are the Wider Impact benefits, including agglomeration, labour supply impacts, imperfect competition and the move to more/less productive jobs, and Journey Time Reliability. These are excluded from the Initial BCR, but are included in the calculation of the Adjusted BCR.

5.6.2 The Wider Impact benefits for the five route options are set out in **Table 5.6**.

5.6.3 The inclusion of the Wider Impact benefits increases the total benefits by between 56% and 64%. This indicates the importance of new capacity to economic development in the area served both by the new crossing and by the existing crossing with an improved level of service.

TABLE 5.6 - WIDER IMPACT BENEFITS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

	R1	R3/ WSL	R3/ ESL	R4/ WSL	R4/ ESL
Agglomeration	0.426	1.111	1.293	1.201	1.380
Output in imperfectly competitive markets	0.128	0.279	0.315	0.269	0.296
Labour supply impacts	0.000	0.002	0.003	0.002	0.003
Move to more/ less productive jobs	Not assessed				
Total	**0.554**	**1.392**	**1.611**	**1.472**	**1.679**
Agglomeration as % of WI benefits	77	80	80	82	82
WI benefits as % of total benefits	56	59	57	64	64

5.6.4 Agglomeration benefits account for about 80% of the total Wider Impact benefits with imperfect competition benefits providing most of the other

effects. Labour supply impacts are estimated to be very small, although it is recognised that business stakeholders have a strong interest in increasing the area from which they can draw labour.

5.6.5 The highest Wider Impact benefits would be generated by Routes 3 and 4, with Route 4 generating larger Wider Impact benefits than Route 3 and ESL generating larger Wider Impact benefits than WSL. These routes provide a substantial increase in accessibility and consequently improve productivity for businesses located to the east of the Dartford Crossing. The movement of labour to more or less productive jobs, which is one of the Wider Impacts, has not been assessed for LTC. This is because DfT's WebTAG appraisal guidance recommends that these impacts are only assessed if there is a land-use transport interaction model, which does not exist for LTC.

5.7 Journey Time Reliability

5.7.1 Changes in journey time reliability have been assessed using an urban journey time reliability equation, as set out in WebTAG Unit A1.3. There are a number of limitations on its use which means that the results should be regarded as indicative. There is, however, widespread understanding of the unreliability of current journey times across the existing Dartford Crossing and on the surrounding road network, which would be improved by the construction of a new road crossing. Whilst there are technical limitations regarding the use of the journey time reliability equation approach, to accurately assess these reliability benefits, it provides an indication of potential benefits.

5.7.2 The key limitations include:

- The speeds at which the journey time reliability equation is robust are between 23mph to 29mph, whilst the speed limits at the Dartford Crossing and on the A282/ M25 are between 50mph and 70mph.
- The equation assumes that in urban areas there are alternative routes. The Dartford Crossing does not have good alternative routes for queuing traffic.

5.7.3 These limitations highlight the potential for both over- and under-estimating the journey time reliability benefits. As explained above, the numbers in **Table 5.7** should be regarded as providing approximate orders of magnitude results only, rather than precise estimates of the impacts.

5.7.4 The journey time reliability benefits are on average split 70:30 between business and other users and would be fairly similar across all routes, ranging from £124 million (Route 1) to £142 million (Route 4 with ESL).

TABLE 5.7 - JOURNEY TIME RELIABILITY BENEFITS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

	R1	R3/ WSL	R3/ ESL	R4/ WSL	R4/ ESL
Business	0.076	0.095	0.099	0.096	0.100
Other users	0.048	0.043	0.042	0.044	0.042
Total	**0.124**	**0.138**	**0.141**	**0.140**	**0.142**

5.7.5 As the scheme is further refined, it is intended that more detailed journey time reliability analysis will be undertaken to better represent the impact of a new crossing on the variability of journey times.

5.8 Conclusions

Economic impacts

5.8.1 The economic impacts of the Post Consultation Appraisal Routes can be sub divided into 5 components:

- User benefits and disbenefits - travel time savings, vehicle operating cost savings, user charges and construction delays.
- Other economic impacts - accidents, greenhouse gas emissions, noise.
- Costs - capital and operating costs.
- User charge revenue - revenue received from user charges.
- Indirect taxation revenue - changes in the amount of indirect tax received by the government.

5.8.2 User benefits account for approximately 107%-110% of direct economic benefits for Routes 3 and 4, largely driven by travel time savings. Other monetised impacts would essentially be disbenefits (increase in number of accidents, increases in greenhouse gas emissions and noise). The other significant direct impact is on indirect tax revenue, where increases in tax revenue associated with each of the options are considered as a benefit to the scheme. These increases in tax revenue are a consequence of the increased traffic movements associated with each LTC option and the resultant additional fuel usage.

5.8.3 Disbenefits to users due to delays caused by LTC construction work are expected to be significant for Route 1 (-£291 million). This impact would be much smaller for Route 3 with ESL (-£26 million). The impacts for other Location C route options have not been appraised, but are expected to be similar to that for Route 3 with ESL.

5.8.4 For Routes 3 and 4 with WSL and ESL, other economic impacts (greenhouse gas emissions, accidents, noise and indirect taxation revenues) would generate approximately £150 million - £210 million of disbenefits (6% - 9% of direct benefits). However, for Route 1, while the disbenefits generated

would be similar (£186 million), their proportion of direct benefits would be much more significant (-19%).

5.8.5 The forecast direct benefits for all Route 3 and 4 options lie in the range of £2.31 billion (Route 4 with WSL) to £2.82 billion for Route 3 with ESL. For Route 1, the level of direct benefits are much lower at £0.99 billion.

Costs and revenues

5.8.6 Route 1 has the lowest total scheme cost at £2.0 bn. The costs for Routes 3 and 4 with WSL and ESL are between £2.5bn and £2.9bn. The present value of operating costs of Route 1 (with a bridge) are estimated to be £66 million over the 60 year evaluation period and this value is about 20% of those for Routes 3 and 4 (with a bored tunnel) which are estimated to lie in the range from £292 million to £301 million depending on the precise scheme option.

5.8.7 The present value of additional forecast revenues for Route 1 (compared to the Without Scheme situation) would be approximately £567 million over the 60 year evaluation period. For Routes 3 and 4 the forecast additional revenue is much higher at around £880 million, reflecting the higher levels of river crossing traffic with Routes 3 and 4 compared to Route 1.

ESL compared with WSL

5.8.8 Route 3 with ESL would provide £471m in extra direct benefits compared to Route 3 with WSL. This differential between ESL and WSL would fall to £319m for Route 4. However, the ESL costs are on average are about £120m more than WSL for Routes 3 and 4.

Wider Impact Benefits

5.8.9 Wider Impact benefits, which are included in the Adjusted BCR, range from £0.55bn for Route 1 to £1.68bn for Route 4 with ESL. As such, they are significant and their inclusion increases the total benefits of the route options by between 56% and 64%. The main component of these Wider Impact benefits are agglomeration benefits, which account for approximately 80% of these values.

Journey Time Reliability

5.8.10 Journey time reliability benefits are similar for all options ranging from £124m to £142m.

6 Social Impact Appraisal

6.1 Introduction

6.1.1 This section presents the results of the Social Impact Appraisal (SIA) for the Post-Consultation Appraisal Routes. The appraisal has been carried out in line with the WebTAG Unit A4.1.

6.2 Accidents

6.2.1 The appraisal of accidents has been carried out using DfT's COBALT appraisal tool. This estimates the change in the number of accidents and casualties as a result of each option and calculates the accident benefits in present value terms over the 60 year period from scheme opening. The cost of the forecast accidents is calculated by multiplying the predicted number of accidents by the cost per accident. These savings (or costs) are then annualised and extrapolated over the 60 year appraisal period, and then discounted to produce a 2010 present value of accident benefits in 2010 prices.

6.2.2 COBALT forecasts the total number of accidents across the whole modelled network. Whilst it is possible to input local accident rates for each link of the network, the size of the modelled network made this approach impractical at this stage. To ensure consistency across the whole network the default national values were used throughout. A location specific accident appraisal has also been carried out using actual network accident data and has looked at the Fatalities and Weighted Injuries (FWI) rate per billion vehicle kilometres. The existing accident appraisal is reported in SAR Volume 2, and the appraisal of the options is reported in SAR Volume 4.

6.2.3 **Table 6.1** shows the estimated change in the number of accidents and casualties, disaggregated into three severity levels - fatal, serious and slight. The results show increased numbers of accidents and casualties are forecast for all route options and consequent increases in total accident costs. The increases in accidents reflect the predicted increases in traffic (vehicle-kilometres) as a result of the new crossing options.

6.2.4 Route 1 is estimated to have the lowest number of additional accidents, as it would produce the lowest increase in total traffic volumes and distances travelled compared with the other options. With Routes 3 and 4 much higher volumes of traffic movement are enabled and this additional traffic can be expected to lead to higher levels of accidents.

6.2.5 **Table 6.2** shows the forecast accident disbenefits for all of the Post Consultation Appraisal Routes, ranging from £89m for Route 1 to £150m for Route 4.

TABLE 6.1 - NUMBER OF ADDITIONAL ACCIDENTS AND CASUALTIES (COMPARED TO 'WITHOUT SCHEME' SCENARIO)

		R1	R3/ WSL	R3/ ESL	R4/ WSL	R4/ ESL
Total Additional Accidents Associated with LTC		1745	2790	2590	2485	2310
Additional Casualties Associated with LTC	Fatal	24	41	38	52	47
	Serious	192	318	293	369	340
	Slight	2311	3852	3581	3241	3013

TABLE 6.2 - ACCIDENT BENEFITS (PVB £BN 2010 PRICES, DISCOUNTED TO 2010)

	R1	R3/ WSL	R3/ ESL	R4/ WSL	R4/ ESL
PVB £ bn	-0.089	-0.147	-0.136	-0.150	-0.138

6.3 Physical activity: non-motorised users

6.3.1 One of the scheme requirements for LTC is to include provision for non-motorised users (cyclists and pedestrians). In the appraisal of the route options, impacts on physical activity refers to the physical activity of these road users. Provision has been included in the design of the route options for existing public-rights-of-ways (including footpaths and bridleways) and cycleways which are affected by the routes to be maintained by providing new bridge crossings or diversions. Therefore, the Post-Consultation Appraisal Routes in this appraisal have been assessed to have no impact on physical activity. Consideration of provision for non-motorised users will continue as the scheme is developed.

6.4 Journey quality

6.4.1 The assessment of the journey quality impacts for users of each route during their construction and operation is a requirement of WebTAG Unit A4.1. The assessment of journey quality is used to consider other factors associated with the journey experience, which are not part of other appraisal criteria. An example of such an element would be the quality of signing and wayfinding, as well as the provision of other forms of driver information. Another aspect might be the perceived personal security/ safety of a route due to, for example, provision of lighting.

6.4.2 Poor journey quality can lead to traveller frustration and stress. This section presents the results of a qualitative assessment of journey quality impacts for the Post-Consultation Appraisal Routes. In accordance with WebTAG guidance, this journey quality assessment has been carried out for the construction phase and the operational phase for each route option. Further detail on construction of the routes is provided in the Post-Consultation SAR Volume 4.

Construction stage

6.4.3 During construction the impacts on journey quality would be most adverse for Route 1. The existing site is a highly congested section of the A282 with the Dartford Crossing currently causing significant delays. The construction process, involving HGV and other construction traffic, would further exacerbate these delays. Traffic management measures would be required including narrow lanes with a temporary speed restriction of 40mph.

6.4.4 Construction stage impacts on journey quality for Routes 3 and 4 are likely to be comparatively smaller because these would be mainly new off-line routes. These construction stage journey quality impacts would be similar for the WSL and ESL route options. **Table 6.3** presents the overall assessment for the three routes. For Routes 3 and 4 there would be adverse journey quality impacts during construction, where these new routes connect to the existing road network. The tunnels would require large amounts of spoil to be removed from their portals and under the River Thames which would need to be transported out of the area. This could be transported by water. Where this is transported by road, there would be adverse impacts on journey quality with increased delays, causing stress and frustration to users. However, it has been assumed that the majority of spoil would be transported during off-peak hours. These adverse impacts would be as follows:

- Route 3 impacts A2 (WSL) or M2 junction construction (ESL), A13 junction and M25 junction.
- Route 4 impacts A2 (WSL) or M2 junction construction (ESL), A13 junction, A127 and M25 junction.

6.4.5 Route uncertainty and disruption for pedestrians and cyclists would occur during construction as public paths are temporarily severed.

TABLE 6.3 - CONSTRUCTION STAGE JOURNEY QUALITY IMPACT SUMMARY

Route 1	Route 3	Route 4
Bridge	Tunnel	Tunnel
High Adverse	**Moderate Adverse**	**Moderate Adverse**

Operational stage

6.4.6 The follow sections set out the assessment which has been made of journey quality during the operational stage for each of the routes. **Table 6.4** presents the overall assessment for the three routes compared to the Without Scheme scenario.

Route 1

6.4.7 Route 1 would lead to improved access and capacity at Dartford Crossing connecting facilities north and south of the river for motorised users. The user experience is anticipated to improve due to the reduction in time spent in congested traffic. Although a small number of users may feel uncomfortable using a bridge crossing, the majority may also appreciate the

views from the bridge. For northbound traffic a bridge is likely to require fewer closures than the existing tunnels due to lower levels of maintenance and incidents.

6.4.8 There would, however, be significant additional congestion on the approaches to the crossing compared to the Without Scheme scenario situation which would reduce journey quality, particularly when combined with the high proportion of heavy goods vehicles in the traffic stream. In addition under these congested conditions, it is expected that incidents on the approach roads will have an even greater effect than today with delays building rapidly once incidents occur. Taken together these will have a major adverse effect on journey quality.

6.4.9 Fear of accidents is likely to reduce for northbound traffic using Route 1 compared to the existing narrow tunnels, as the bridge would be built to modern standards.

6.4.10 It is expected that drivers who previously tried to avoid congestion on key east-west links, such as the A13 by using local roads, would be less likely to do this due to the greater capacity along Route 1. However the existing problems are unlikely to be fully resolved as HGV traffic from Tilbury Docks and London Gateway Port would potentially still travel on local roads to reach the crossing. Future congestion on the approach roads to the Dartford Crossing with Route 1 will still influence drivers to seek rat-runs within the local network and these will overall have an adverse impact on journey quality.

6.4.11 At this stage additional provision for non-motorised users has been considered but has not been included in the scheme designs. The journey quality for cyclists is currently low but any future provision would be of an appropriate quality and meet safety standards. Pedestrians are not currently able to access the Dartford crossing and at this stage no allowance has been made for pedestrian access for Route 1.

Routes 3 and 4

6.4.12 The operational stage journey quality impacts of Routes 3 and 4 would be similar. Routes 3 and 4 with ESL or WSL would create direct access to facilities north and south of the river in Thurrock and Gravesend for motorised users. The routes would also provide improved connections to the motorway network. This would benefit traffic from Tilbury and London Gateway Port and provide congestion relief for traffic on both strategic and local roads who are impacted by delays on the existing crossing at Dartford.

6.4.13 Route uncertainty is likely to reduce as Routes 3 and 4 would be used by HGVs that currently use the area as a “rat run”. This would relieve future congestion with the expansion of Tilbury Docks and London Gateway Port.

6.4.14 Road users’ fear of accidents is likely to reduce with Routes 3 and 4 due to the reduced level of congestion and the standard of the new roads.

6.4.15 The existing tunnels at Dartford would still be operational. Fewer people would be using the existing crossing but their journey quality would be affected by delays due to the traffic management arrangements for restricted vehicles. The new tunnel at Route 3 and 4 would be built to modern

standards, and would not require controls on the passage of restricted vehicles.

6.4.16 The ESL or WSL would provide a direct link between Routes 3 and 4 and the A2/M2. This would improve journey quality for motorised users travelling along these routes. There may, however, be some adverse impact on users of the local road network in the vicinity of Routes 3 and 4.

TABLE 6.4 - OPERATIONAL STAGE JOURNEY QUALITY IMPACT SUMMARY (MOTORISED USERS)

Without Scheme	Route 1	Route 3	Route 4
High adverse	Neutral	Moderate beneficial	Moderate beneficial

6.5 Severance

6.5.1 This section presents a summary of the potential impacts of the three main routes on severance of public rights of way, and estimates the population that is likely to be affected. A further assessment of severance on community facilities is presented in Volume 6 of the Post-Consultation SAR.

6.5.2 Severance across the river currently exists for non-motorised users (pedestrians and cyclists). The only existing provision is a vehicle that carries cyclists across the Dartford Crossing when requested and the Gravesend to Tilbury ferry. At this stage specific provision for non-motorised users has not been included in the illustrative designs for the crossing structures, but this will be considered in the next stage of scheme development.

6.5.3 There are a number of existing public rights of way and cycle routes which would be affected by the option layouts. There is a commitment that all routes would include safe re-provision of affected public rights of way.

6.5.4 **Table 6.5** summarises the results of the severance appraisal for the construction and operational stages (combined) based on the current engineering designs for the routes.

6.5.5 The population figures are based on an analysis of cycling and pedestrian data, Office for National Statistics (ONS) travel to work census data, and the Department for Transport's National Trip End Model (NTEM).

TABLE 6.5 - SUMMARY TABLE SHOWING RELATIVE SCALE OF SEVERNACE IMPACTS FOR EACH ROUTE AT OPERATIONAL STAGE

	Population Affected (based on estimate of the local population that would cycle or walk within 10km boundary of the routes in 2025)		
	Route 1	Route 3	Route 4
Change in severance	Slight Adverse	Slight Adverse	Slight Adverse
Population affected	284,200	389,400	372,000

6.6 Property acquisition

6.6.1 The assessment of property acquisition is described in Volume 4.

6.7 Personal security

6.7.1 WebTAG Unit A4.1 requires an assessment of the changes in security and the likely numbers of users affected. It does not however, provide formal guidance for highways schemes. In order to assess the impacts, a qualitative review of the security considerations and impacts has been carried out drawing on the table of security indicators in WebTAG Unit A4.1. The personal security features of each route option (and the Without Scheme situation) are set out in **Table 6.6**. It also provides an overall scoring of each route option relative to the Without Scheme situation.

6.7.2 At this stage a very high level assessment has been carried out. A 3 point-scale has been used to assess each of the route features as follows:

- **High** relates to an excellent level of security, this could be for any of the security indicators listed in the table below, such as formal surveillance, ensuring there is an effective CCTV system in operation.
- **Moderate** indicates a fair level of security that could be improved with modifications. For example in terms of formal surveillance a CCTV system in place, but the number of cameras or location of the system is not optimal.
- **Low** would indicate a substandard level of security. This scoring level has not been applied to any of the route.

6.7.3 The results show that for Route 1 the personal security impacts are considered to be ‘neutral’, in other words similar to the Without Scheme situation and for Routes 3 and 4 the impacts are considered to be ‘slight adverse’ due to the assessed lower lighting and visibility scoring for these routes.

6.7.4 Security will be explored in more depth during the development stage of the scheme and examined in relation to the Without Scheme situation.

TABLE 6.6 - ASSESSED LEVEL OF PERSONAL SECURITY FOR ROUTE OPTIONS

Security Indicator	Relative importance	Without scheme	Route 1	Route 3 ESL & WSL	Route 4 ESL & WSL
Site perimeters	High	High	High	High	High
Entrances and exits	High	High	High	High	High
Formal surveillance	High	Moderate	Moderate	Moderate	Moderate
Lighting and visibility	High	High	High	Moderate	Moderate
Emergency call	High	Moderate	Moderate	Moderate	Moderate
Overall Assessment Relative to Without Scheme	-	-	**Neutral**	**Slight Adverse**	**Slight Adverse**

6.8 Personal affordability

6.8.1 The personal affordability criteria is designed to identify the impacts on personal affordability of any changes to user charges. WebTAG states that the changes need to be greater than +/- 10% in order to require an assessment.

6.8.2 For the LTC appraisal, the user charges for the LTC crossings have been assumed to remain the same as those at Dartford Crossing today and in future years to rise in line with inflation. Consequently there will be no significant change in personal affordability.

6.9 Conclusions

6.9.1 The social impact assessment has drawn on the WebTAG Unit A4.1 guidance and includes a limited number of components: accidents, physical activity, severance, journey quality, and security. The key conclusions from the appraisal are set out below.

6.9.2 The appraisal of accidents using COBALT found that accidents are likely to increase on all routes as a result of the scheme. Route 1 is forecast to have the lowest increase in casualties. Routes 3 and 4 would all be consistently higher than Route 1. However, using the default national accident values in COBALT may underestimate the benefits of the options, as described above, and a separate location specific accident appraisal is provided in Volume 4.

6.9.3 Existing public rights of way and cycleways affected by the options would be maintained through provision of new bridge crossings or diversions. Therefore, the options in this appraisal have been assessed to have no impact on physical activity. Consideration of provision for non-motorised users will continue as the scheme is developed.

6.9.4 In terms of journey quality impacts, Route 1 has been assessed as neutral, while Routes 3 and 4 have been assessed as moderately beneficial.

6.9.5 Security impacts have only been assessed at a very high level at this stage in the scheme. Overall the impacts on security of Route 1 were considered neutral and for Routes 3 and 4 slight adverse.

7 Benefit Cost Ratios (BCR)

7.1 Introduction

7.1.1 The BCR provides a summary comparative measure for those economic, social and environmental impacts that can be expressed in monetary terms and presented in discounted 2010 present value terms. Benefits are expressed as Present Value of Benefits (PVBs) and costs as Present Value of Costs (PVCs). PVBs less PVCs provide Net Present Values (NPVs) and the ratio of the PVB to the PVC constitutes the BCR.

7.1.2 WebTAG requires that two BCRs are calculated for each option – an Initial BCR, which excludes Wider Economic Benefits and Reliability impacts, and an Adjusted BCR, which includes Wider Economic Benefits and Reliability impacts.

7.2 Conclusions

7.2.1 **Table 7.1** presents the Initial BCRs and Adjusted BCRs for the five route options considered in this document.

TABLE 7.1 - BENEFIT COST RATIOS (BCRS)

PVs 2010 prices discounted to 2010	R1	R3 WSL	R3 ESL	R4 WSL	R4 ESL
Crossing type	BR	BT	BT	BT	BT
PVB (excl WEBs & Reliability) (£bn)	0.985	2.346	2.817	2.312	2.630
PVC (£bn)	1.500	1.931	2.048	2.160	2.285
NPV (£bn)	-0.515	0.415	0.769	0.152	0.345
Initial BCR	**0.66**	**1.21**	**1.38**	**1.07**	**1.15**
Wider Impact benefits(£bn)	0.554	1.392	1.611	1.472	1.679
Reliability (£bn)	0.124	0.138	0.141	0.140	0.142
Adjusted BCR	**1.11**	**2.01**	**2.23**	**1.82**	**1.95**

7.2.2 **Table 7.1** shows that:

- Route 3 with Eastern Southern Link and a bored tunnel would have the highest Initial BCR of 1.38 representing Low Value for Money based on DfT's Value for Money categories.
- All of the other route options at Location C with a bored tunnel would have Initial BCRs between 1.07 and 1.21 and represent Low Value for Money. Route 1 with a bridge has an Initial BCR of 0.66 and represents Poor Value for Money.

- Route 3 with ESL and a bored tunnel and Route 3 with WSL and a bored tunnel would have the highest Adjusted BCRs of 2.23 and 2.01 respectively, representing High Value for Money.
- Route 4 with ESL and WSL and a bored tunnel would have adjusted BCRs of 1.95 and 1.82 respectively, representing Medium Value for Money.
- Route1 would have the lowest adjusted BCR of only 1.11 which represents Low Value for Money.
- The Initial and Adjusted BCRs for Route 3 with ESL are greater than those for Route 3 with WSL and, similarly, the BCRs for Route 4 with ESL are greater than those for Route 4 with WSL.

8 Sensitivity tests

8.1 Introduction

8.1.1 The previous sections in this volume have outlined the appraisal of the Post-Consultation Appraisal Routes which has been carried out. In order to examine the robustness of this appraisal, sensitivity tests have been carried out to determine the impact of different levels of traffic growth on the appraisal results.

8.2 High and Low Traffic Growth

8.2.1 An analysis of the sensitivity of the economic appraisal results for Route 3 options to high and low growth traffic forecasts have been undertaken using the methodology set out in Section 4.3 of WebTAG Unit M4 'Forecasting and Uncertainty'. This excludes any treatment of local growth uncertainty (paragraph 2.4.8 of WebTAG refers) at this stage, as the overall growth must still be constrained to National Uncertainty. The sensitivity testing was carried on all of the Post Consultation Appraisal Routes.

8.2.2 Essentially, the low and high growth scenarios have been prepared by adding a proportion of base year demand (high growth) and subtracting (low growth) to the demand in the core scenario. The proportion is dependent on the number of years into the future of the forecast year. Based on WebTAG advice, the calculations give a +15% to -15% demand range over a period of 36 years or more.

8.2.3 The methodology was applied to the core traffic growth scenario to produce estimates of changes in traffic flows across the crossings and the resultant effect on benefits. The change in benefits has been estimated from the changes in travel time savings as these are the primary contributor of overall benefits.

8.2.4 The resulting AADT traffic forecasts for the core, high and low growth scenarios for 2041 are presented in **Tables 8.1**, **8.2** & **8.3** for Route 1, Route 3 and Route 4 options respectively. For comparative purposes, the Without Scheme core growth traffic forecasts are also shown.

TABLE 8.1 - ROUTE 1 LOW, CORE AND HIGH GROWTH RIVER CROSSING TRAFFIC FORECASTS IN 2041

Crossing	Without Scheme Core	Route 1 Low	Route 1 Core	Route 1 High
Dartford Crossing & LTC Route 1	171,000	235,000	239,000	242,000
Total	171,000	235,000	239,000	242,000
% growth over Without Scheme Core	-	+37%	+40%	+42%

TABLE 8.2 - ROUTE 3 LOW, CORE AND HIGH GROWTH RIVER CROSSING TRAFFIC FORECASTS IN 2041

Crossing	Without Scheme Core	Route 3 ESL Low	Route 3 ESL Core	Route 3 ESL High	Route 3 WSL Low	Route 3 WSL Core	Route 3 WSL High
Dartford Crossing	171,000	168,000	169,000	170,000	168,000	169,000	169,000
LTC Route 3	-	91,000	94,000	97,000	93,000	96,000	99,000
Total	171,000	259,000	263,000	267,000	261,000	265,000	268,000
% growth over Without Scheme Core	-	+51%	+54%	+56%	+53%	+55%	+57%

TABLE 8.3 - ROUTE 4 LOW, CORE AND HIGH GROWTH RIVER CROSSING TRAFFIC FORECASTS IN 2041

Crossing	Without Scheme Core	Route 4 ESL Low	Route 4 ESL Core	Route 4 ESL High	Route 4 WSL Low	Route 4 WSL Core	Route 4 WSL High
Dartford Crossing	171,000	170,000	171,000	171,000	169,000	170,000	170,000
LTC Route 4	-	89,000	93,000	96,000	92,000	95,000	98,000
Total	171,000	259,000	264,000	267,000	261,000	265,000	268,000
% growth over Without Scheme Core	-	+51%	+54%	+56%	+53%	+55%	+57%

8.2.5 Key features of the traffic forecasts set out in **Tables 8.1-8.3** are as follows:

- In 2041 with Route 1, total river crossing traffic would be around 40% higher than that in the Without Scheme situation.
- In 2041 with all Route 3 and 4 options, total river crossing traffic would be around 55% higher than that in the Without Scheme situation, significantly greater than that with Route 1.
- In 2041, total river crossing traffic in the Low Growth situation would be approximately 2% lower than in the Core Growth situation for all route options.
- In 2041, total river crossing traffic in the High Growth situation would be approximately 1% higher than the Core Growth situation for all route options.
- In 2041, for all Route 3 & 4 options, there would be very little difference between the forecast traffic volumes at Dartford Crossing

as the forecasts suggest the Crossing would be operating close to its capacity

- In 2041, all Route 3 & 4 options would attract similar volumes of traffic although it is notable that the Route 3 WSL option would attract the highest traffic volumes under each growth scenario and the Route 4 ESL option would attract the lowest traffic volumes under each growth scenario.

8.3 High & Low Growth Economic Appraisal Impacts

8.3.1 The resulting impacts on the economic benefits for the Route options are presented in **Tables 8.4, 8.5 and 8.6**. For Routes 3 and 4 which incorporate a bored tunnel under the Thames, it has been assumed that the construction costs allow for a third lane in each tunnel bore at the crossing for future-proofing provision. The costs for the low and high growth scenarios, are same as those for the core scenario. This is because the scheme engineering configuration and construction would be identical in all three scenarios (para 4.2.10 of WebTAG Unit M4 refers).

8.3.2 Changes in user charge revenue between options also impact the overall Present Value of Costs (PVC), as any additional revenue is considered as reducing the overall cost of the scheme. As a result, growth scenarios which produce higher user charge revenue have a lower PVC than those growth scenarios which produce lower levels of revenue, even though the scheme construction and operating costs are identical.

TABLE 8.4 - LOW, CORE AND HIGH GROWTH COSTS AND BENEFITS FOR ROUTE 1 (PVS £BN 2010 PRICES, DISCOUNTED TO 2010)

	Route 1 Low	Route 1 Core	Route 1 High
Present Value of Benefits (PVB) £bn	0.982	0.985	1.049
Present Value of Costs (PVC) £bn	1.555	1.500	1.450
Net Present Value (NPV) £bn	-0.573	-0.515	-0.401
Initial BCR	**0.63**	**0.66**	**0.72**
VfM category	Poor	Poor	Poor
Wider Impacts £bn	0.726	0.554	0.458
Reliability £bn	0.111	0.124	0.137
Present Value of Benefits (PVB) incl. Wider Impacts & Reliability £bn	1.819	1.663	1.644
Net Present Value (NPV) incl. Wider Impacts & Reliability £bn	0.264	0.163	0.194
Adjusted BCR	**1.17**	**1.11**	**1.13**
VfM category	**Low**	**Low**	**Low**

TABLE 8.5 - LOW, CORE AND HIGH GROWTH COSTS AND BENEFITS FOR ROUTE 3 (PVS £BN 2010 PRICES, DISCOUNTED TO 2010)

	Route 3 ESL Low	Route 3 ESL Core	Route 3 ESL High	Route 3 WSL Low	Route 3 WSL Core	Route 3 WSL High
Present Value of Benefits (PVB) £bn	2.423	2.817	3.145	2.007	2.346	2.563
Present Value of Costs (PVC) £bn	2.116	2.048	1.986	2.000	1.931	1.873
Net Present Value (NPV) £bn	0.307	0.769	1.159	0.008	0.415	0.690
Initial BCR	**1.14**	**1.38**	**1.58**	**1.00**	**1.21**	**1.37**
VfM category	Low	Low	Medium	Low	Low	Low
Wider Impacts £bn	1.854	1.611	1.645	1.673	1.392	1.327
Reliability £bn	0.124	0.141	0.156	0.122	0.138	0.153
Present Value of Benefits (PVB) incl. Wider Impacts & Reliability £bn	4.402	4.569	4.946	3.802	3.875	4.043
Net Present Value (NPV) incl. Wider Impacts & Reliability £bn	2.285	2.520	2.960	1.803	1.944	2.170
Adjusted BCR	**2.08**	**2.23**	**2.49**	**1.90**	**2.01**	**2.16**
VfM category	**High**	**High**	**High**	**Medium**	**High**	**High**

TABLE 8.6 - LOW, CORE AND HIGH GROWTH COSTS AND BENEFITS FOR ROUTE 4 OPTIONS (PVS £BN 2010 PRICES, DISCOUNTED TO 2010)

	Route 4 ESL Low	Route 4 ESL Core	Route 4 ESL High	Route 4 WSL Low	Route 4 WSL Core	Route 4 WSL High
Present Value of Benefits (PVB) £bn	2.290	2.630	3.181	1.965	2.312	2.587
Present Value of Costs (PVC) £bn	2.360	2.285	2.219	2.234	2.160	2.099
Net Present Value (NPV) £bn	-0.070	0.345	0.961	-0.269	0.152	0.487
Initial BCR	**0.97**	**1.15**	**1.43**	**0.88**	**1.07**	**1.23**
VfM category	Poor	Low	Low	Poor	Low	Low
Wider Impacts £bn	1.870	1.679	1.696	1.685	1.472	1.421
Reliability £bn	0.127	0.142	0.158	0.125	0.140	0.156
Present Value of Benefits (PVB) incl. Wider Impacts & Reliability £bn	4.287	4.451	5.035	3.775	3.924	4.164
Net Present Value (NPV) incl. Wider Impacts & Reliability £bn	1.927	2.167	2.816	1.540	1.765	2.065
Adjusted BCR	**1.82**	**1.95**	**2.27**	**1.69**	**1.82**	**1.98**
VfM category	**Medium**	**Medium**	**High**	**Medium**	**Medium**	**Medium**

8.3.3 Key features of the results of these sensitivity tests are as follows:

- The level of direct benefits (PVB) which would be achieved by each option is strongly affected by the level of traffic growth, with benefits achieved under high growth scenarios being 10-15% above core growth scenarios and benefits under low growth scenarios being 10-15% lower than those for the core growth scenario. The exception is for Route 1, where capacity constraints within the approach road network strongly constrain the impacts of traffic growth on scheme benefits and the results indicate that the traffic growth would have very limited impact on direct benefits.
- Although the level of traffic growth would have a significant impact on the direct benefits of route options, it does not change the ranking of route options. Route 1 performs worst under all growth scenarios and Route 3 ESL performs best under all growth scenarios.

- Due to the levels of congestion in the regional road networks, the Wider Impacts benefits are greatest in the Low traffic growth scenarios and lowest in the High traffic growth scenario.
- The compensating effects of the changes in direct benefits and Wider Impacts mean that adjusted BCRs are forecast to be in relatively small range for each route option regardless of the traffic growth scenario. As a result, the value for money rating of route options are relatively insensitive to growth assumptions.

9 Summary of Conclusions

9.1 Introduction

9.1.1 This section summarises the conclusions from the traffic appraisal, economic appraisal and social impact appraisal and presents the BCRs.

9.2 Traffic appraisal

9.2.1 With Routes 3 and 4, total traffic volumes at the existing Dartford Crossing in 2025 are predicted to be around 9% lower than the Without Scheme scenario with heavy goods vehicle flows forecast to reduce by 29%. This significant reduction in heavy goods vehicle traffic continues through to 2041, where heavy goods vehicle flows are 21% lower than those in the Without Scheme situation.

9.2.2 Routes 3 and 4 would improve the overall connectively of the road network across the River Thames, releasing suppressed trips in the existing crossing corridor and inducing new trips from proposed developments to the east of Dartford. Routes 3 and 4 would also provide the most congestion relief to the existing crossing, a key objective of LTC, as well as providing substantial relief to the A2, M20 and A13. Although Route 1 would allow more traffic to access the existing crossing corridor, other areas of congestion on the M25 and its feeder routes such as the A13, A2 and M20 will become evident over time.

9.2.3 Future travel times for journeys using the existing crossing are likely to remain unchanged, particularly for northbound traffic where the existing Dartford tunnels will continue to limit speeds and traffic volumes due to capacity constraints. As expected, the catchment for a crossing at Route 1 would be similar to the catchment of the existing crossing. Routes 3 and 4 would attract trips with origins and destinations in Essex, East Anglia and Kent. With a 70mph speed limit, Routes 3 and 4 offers 14% more capacity than Route 1, which would continue to have a speed limit of 50mph.

9.2.4 Overall, a new crossing at Location A (Route 1) would not meet the objective to relieve the congested Dartford Crossing and approach roads and improve their performance by providing free flowing north-south capacity for the following reasons:

- Whilst providing some improvements in congestion at the existing crossing and providing journey time savings for M25 traffic between J3 and J28, it would not provide wider network journey time improvements. There would be increased congestion on key radial routes - M20, A2 and A13.
- The crossing and approaches would be restricted to a 50mph speed limit, due to constraints imposed by the layout of the crossing structures, junctions and existing development along the route; the route could not be transformed into a free-flowing 70mph solution.
- Construction of Route 1 would take approximately 6.5 years. During this time traffic would be restricted to a 40mph speed limit, with

complex traffic management arrangements. The capacity at the existing crossing would be reduced during construction, imposing delays on existing users and increased unreliability of journey times.

9.2.5 In terms of operational resilience, a crossing at Location C would provide considerably greater flexibility in the event of a major incident on the M25/ A282 corridor than a crossing at Location A.

9.2.6 Route 1 would not meet the objective to improve resilience of the Thames crossings and Strategic Road Network. Whilst it provides additional crossing resilience, it would not improve the resilience of the wider road network, for the following reasons:

- Traffic would still be funnelled through the existing M25/ A282 corridor between Junction 2 and Junction 30.
- There would be more traffic along the route; by 2041, there would be a 40% increase in traffic at the crossing, with a 28% increase in the number of HGVs.
- Route 1 would not provide an independent alternative route for traffic to use. Incidents along the corridor and approach routes would still lead to long delays and severe congestion.

9.2.7 The choice of WSL or ESL would have little impact on the predicted traffic volumes across the River Thames, either on the existing crossing or the new crossing. The ESL would offer greater relief to the A2/ M20 than the WSL but would attract additional traffic to the M2 by providing a quicker free-flow link over the River Thames.

9.2.8 Routes 3 and 4 would:

- Carry similar volumes of traffic
- Provide the same relief to the existing crossing
- Result in broadly the same predicted travel times across the River Thames

9.2.9 Route 3 would attract slightly more traffic to the new crossing thereby offering the most relief to the A2 and A13 and attracts the lowest levels of additional traffic to the M2.

9.3 Economic appraisal

9.3.1 User and Provider benefits, driven largely by travel time savings, would account for most of the direct benefits across all five route options. These benefits for Route 3 & 4 options would range from £2.52 billion for Route 4 with WSL to £3.03 billion for Route 3 with ESL. These benefits for Route 1 would amount to £1.46 billion.

9.3.2 Disbenefits for users from delays during construction for Route 1 would be valued at £291 million. The delays associated with the construction of Route 3 with ESL would be £26 million and the disbenefits due to the other Route 3 and Route 4 options would be of a similar magnitude.

9.3.3 Direct benefits for all options would be fairly similar and fall within the range £2.31bn (Route 4 with WSL) to £2.82bn (Route 3 with ESL) except for Route 1 where direct benefits are forecast to be £0.99bn.

9.3.4 Route 1 would have the lowest total present value scheme cost at £2.1bn, but also generates the least revenue from user charges. The costs for Routes 3 and 4 with WSL and ESL are between £2.8bn and £3.1bn.

9.3.5 User charge revenues for Route 1 are forecast to be approximately £570 million (present value), whilst revenues for Routes 3 and 4 are around £880 million (present value).

9.3.6 Route 3 with ESL would provide £471m in extra direct benefits compared to Route 3 with WSL.

9.3.7 Wider Impacts benefits are forecast to be in the range from £0.55bn (Route 1) to £1.68bn (Route 4 with ESL) and their inclusion increases the total benefits of the routes by between 56 and 64 per cent.

9.3.8 Journey time reliability improvements add between £124m and £142m to the benefits dependent on the option.

9.4 Social impact appraisal

9.4.1 Based on the appraisal of accidents using DfT's COBALT appraisal tool, accidents would increase on all routes as a result of the greater traffic flows associated with the schemes. Route 1 is forecast to have the lowest increase in casualties compared to Routes 3 and 4.

9.4.2 Existing public rights of way and cycleways affected by the options would be maintained through provision of new bridge crossings or diversions. Therefore, the options in this appraisal have been assessed to have no impact on physical activity. Consideration of provision for non-motorised users will continue as the scheme is developed.

9.4.3 All of the route options would impact on severance. The impact of Route 1 is likely to be lower than the impact of Routes 3 and 4.

9.4.4 In terms of journey quality impacts, Route 1 would have a neutral impact whilst Routes 3 and 4 have been assessed as moderately beneficial.

9.4.5 Security impacts have only been assessed at a very high level at this stage in the scheme. Overall the impacts on security at Route 1 were considered to be neutral and Routes 3 and 4 have been assessed as slight adverse.

9.5 Benefit Cost Ratios

9.5.1 As shown in **Table 9.1**, Route 3 with ESL would have the highest Initial BCR of 1.38. Route 3 with WSL would have the next highest Initial BCR of 1.21, followed by Route 4. Route 1 has the lowest Initial BCR of 0.66.

9.5.2 Route 3 with ESL would have the highest Adjusted BCR of 2.23 representing High Value for Money. Route 3 with WSL would have the next highest Adjusted BCR of 2.01 also representing High Value for Money. Route 4 would have an Adjusted BCR of 1.82-1.95 representing Medium Value for Money, and Route 1 would have an Adjusted BCR of 1.11 representing Low Value for Money.

TABLE 9.1 - COST BENEFIT RESULTS FOR POST-CONSULTATION APPRAISAL ROUTE OPTIONS (PVS £BN 2010 PRICES, DISCOUNTED TO 2010)

PVs £bn 2010 prices, discounted to 2010	R1	R3 WSL	R3 ESL	R4 WSL	R4 ESL
Crossing type	BR	BT	BT	BT	BT
PVB (excl WEBs & Reliability) (£bn)	0.985	2.346	2.817	2.312	2.630
PVC (£bn) based on P50 costs	1.500	1.931	2.048	2.160	2.285
NPV (£bn)	-0.515	0.415	0.769	0.152	0.345
Initial BCR	**0.66**	**1.21**	**1.38**	**1.07**	**1.15**
Wider Impact benefits (£bn)	0.554	1.392	1.611	1.472	1.679
Reliability (£bn)	0.124	0.138	0.141	0.140	0.142
Adjusted BCR	**1.11**	**2.01**	**2.23**	**1.82**	**1.95**

9.6 Sensitivity tests

9.6.1 Sensitivity tests have been carried out on each of the options to assess the robustness of the appraisal results to changes to key parameters used in the appraisal. Tests were specifically carried out to examine the impact of low and high traffic growth assumptions.

9.6.2 Low and high traffic growth forecasts were prepared by subtracting or adding a proportion of the base year demand to the demand in the core scenario based on the WebTAG recommended approach, with the proportion increasing over time to reflect the increasing levels of uncertainty at more distant time horizons.

9.6.3 The key findings from the resulting traffic forecasts were as follows:

- In 2041, with Route 1, total river crossing traffic would be around 40% higher than that in the Without Scheme situation.
- In 2041, with all Route 3 and 4 options, total river crossing traffic would be around 55% higher than that in the Without Scheme situation, significantly greater than that with Route 1.
- In 2041, total river crossing traffic in the Low Growth situation would be approximately 2% lower than in the Core Growth situation for all route options.
- In 2041, total river crossing traffic in the High Growth situation would be approximately 1% higher than the Core Growth situation for all route options.
- In 2041, for all Route 3 and 4 options, there would be very little difference between the forecast traffic volumes at Dartford Crossing as the forecasts suggest the Crossing would be operating close to its capacity

- In 2041, all Route 3 and 4 options would attract similar volumes of traffic, although it is notable that the Route 3 WSL option would attract the highest traffic volumes under each growth scenario and the Route 4 ESL option would attract the lowest traffic volumes under each growth scenario.

9.6.4 The sensitivity test traffic forecasts were used to examine the sensitivity of the economic appraisal to the level of traffic growth which occurs, results revealed the following:

- The level of direct benefits (PVB) which would be achieved by each option is strongly affected by the level of traffic growth, with benefits achieved under high growth scenarios being 10-15% above core growth scenarios and benefits under low growth scenarios being 10-15% lower than those for the core growth scenario. The exception is for Route 1, where capacity constraints within the approach road network strongly constrain the impacts of traffic growth on scheme benefits and the results indicate that the traffic growth would have very limited impact on direct benefits.
- Although the level of traffic growth would have a significant impact on the direct benefits of route options, it does not change the ranking of route options. Route 1 performs worst under all growth scenarios and Route 3 ESL performs best under all growth scenarios.
- Due to the levels of congestion in the regional road networks, the Wider Impacts benefits are greatest in the Low traffic growth scenarios and lowest in the High traffic growth scenario.
- The compensating effects of the changes in direct benefits and Wider Impacts mean that adjusted BCRs are forecast to be in relatively small range for each route option regardless of the traffic growth scenario. As a result, the value for money rating of route options are relatively insensitive to growth assumptions.

10 References

Title	Document number
DFT: Review of Lower Thames Crossing Options: Final Review Report	2013
HM Treasury Green Book	2003

11 Abbreviations and Glossary

Abbreviation	Description
2025 Opening year	A modelled year in the LTC traffic model in which flows are estimated for each option
2041 Design year	A modelled year in the LTC traffic model. The design year is typically 15 years after opening, but for LTC 2041, 16 years after opening, was assessed as it is the maximum horizon year for current growth assumptions. Traffic flows are estimated for each option.
AADT	Average Annual Daily Traffic
ADMS-Roads	Comprehensive software for modelling road traffic pollution.
AECOM	AECOM Technology Corporation
Affected Road Network	This comprises the area within which roads could be considered within the air quality model (selection of the roads within the model depends upon a number of criteria such as changes in Heavy Duty Vehicle flows).
Alignment	The alignment is the horizontal and vertical route of a road, defined as a series of horizontal tangents and curves or vertical crest and sag curves, and the gradients connecting them.
AM	07:00 to 10:00
AMCB	Analysis of monetary costs and benefits
ANPR	Automated Number Plate Recognition
AOD	Above ordnance datum, vertical datum used by an ordnance survey as the basis for delivering altitudes on maps.
AONB	Area of Outstanding Natural Beauty: Statutory designation intended to conserve and enhance the ecology, natural heritage and landscape value of an area of countryside.
APS	Annual Population Survey
APTR	All-purpose trunk road
AQMA	Air Quality Management Area: an area, declared by a local authority, where air quality monitoring does not meet Defra's national air quality objectives.
AQS	Air Quality Strategy
AQSO	Air Quality Strategy Objective, set by the Air Quality Strategy for England, Scotland, Wales and Northern Ireland to improve air quality in the UK in the medium term. Objectives are focused on the main air pollutants to protect health.
AST	Appraisal Summary Table; a summary of impacts of introducing new infrastructure, setting out impacts using a structured set or economic, social and environmental measures.
AURN	Defra's Automatic Urban and Rural Network: the UK's largest automatic monitoring network and the main network used for compliance reporting against the Ambient Air Quality Directives.
BAP	Biodiversity Action Plan: National, local and sector-specific plans established under the UK Biodiversity Action Plan, with the intention of securing the conservation and sustainable use of biodiversity.
Batter slope	In construction is a receding slope of a wall, structure, or earthwork. The term is used with buildings and non-building structures to identify when a wall is intentionally built with an inward slope.
Benefit Cost Ratio (BCR)	The net benefit of a scheme divided by the net cost to Government. The ratio of present value of benefits (PVB) to present value of costs (PVC), an indication of value for money.
BGS	British Geological Survey: a partly publicly funded body which aims to advance geoscientific knowledge of the United Kingdom landmass and its continental shelf by means of systematic surveying, monitoring and research.
Birds Directive	Council Directive 2009/147/EC on the conservation of wild birds is a European Union directive. It replaces Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds and aims to protect all European wild birds and the habitats of listed species, in particular through the designation of Special Protection Areas (SPAs).
Bluewater	Bluewater Shopping Centre, an out of town shopping centre in Stone, Kent, outside the M25 Orbital motorway, 17.8 miles (28.6 km) east south east of London's centre.
BR	Bridge (when used as part of a LTC Post-Consultation Appraisal Route reference)
Bridge Management System (BMS)	A means for managing bridges throughout design, construction, operation and maintenance of the bridges.
BSL	British Sign Language

Abbreviation	Description
BT	Bored tunnel
BTEC	Business and Technology Education Council
BTO	British Trust for Ornithology: an organisation founded in 1932 for the study of birds in the British Isles.
C2 enquiry	An initial enquiry made to a utility company under the New Roads and Street Works Act (NRWSA) about the locations of their plant and equipment.
Capex	Capital expenditure, the cost of developing or providing non-consumable parts of the product or system.
Catchpit chamber	Catchpits are a precast concrete drainage product that are recommended for use as a filter and collector in land drainage systems that do not make use of any sort of geo-membrane. A catchpit is essentially an empty chamber with an inlet pipe and an outlet pipe set at a level above the floor of the pit. Any sediment carried by the system settles out whilst in the catchpit, from where it can be periodically pumped out or removed
CCC	Highways England Customer Contact Centre
CCTV	Closed-circuit television. Highways England CCTV cameras are used to monitor traffic flows on the English motorway and trunk road network primarily for the purposes of traffic management.
CDA	Critical Drainage Area, an area which has critical drainage problems and which has been notified to the local planning authority by the Environment Agency.
CEMP	Construction Environmental Management Plan
CESS	Highways England Commercial Services Division Cost Estimation Summary Spreadsheet
CFMP	Catchment Flood Management Plan: A strategic planning tool through which the Environment Agency works with other key decision-makers within a river catchment to identify and agree policies for sustainable flood risk management.
CO2e	Carbon dioxide equivalent; a standard unit for measuring carbon footprints. The idea is to express the impact of each different greenhouse gas in terms of the amount of CO2 that would create the same amount of warming.
COBALT	New 'light touch' version of COBA, COst Benefit Analysis computer program, DfT's tool for estimating accident benefits. The COBA program compares the costs of providing road schemes with the benefits derived by road users
CoCP	Code of Construction Practice
Connect Plus	Connect Plus (M25) Ltd, management company for the Dartford-Thurrock Crossing.
C.RO Ports	C.RO is the brand name for the subsidiaries of C.RO Ports SA that operate ro-ro terminals in the UK, the Netherlands and Belgium.
CSR	Client Scheme Requirements, the formal means by which the DfT instruct Highways England to develop a scheme and define the scope of a project.
D2AP	Dual two-lane all-purpose road
Dart Charge	The Dartford Crossing free-flow electronic number plate recognition charging system (operates between 0600 and 2200).
Dartford Cable Tunnel	An £11m tunnel upstream of the Dartford Crossing, built in 2003-4, whose diameter is ~3m and designed to carry - and allow for - maintenance of 380kV National Grid electrical cable beneath the River Thames.
DBFO	Design, build, finance, operate: a way of creating "public–private partnerships" (PPPs) by funding public infrastructure projects with private capital.
DC	Dartford Crossing
DCC	Dartford Crossing Control Centre
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs: the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland.
DfT	Department for Transport: the government department responsible for the English transport network and a limited number of transport matters in Scotland, Wales and Northern Ireland that have not been devolved.
DGV	Dangerous goods vehicle. DGVs are subject to restrictions under the ADR Regulations (Accord Dangereux Routier, European regulations concerning the international transport of dangerous goods by road). The passage of Dangerous Goods Vehicles through the Dartford Tunnels is determined according to the procedure described in the Dartford Dangerous Goods Listing. The Dartford tunnels are a category C tunnel according to the categories defined in the ADR regulations. Vehicles with Tunnel Restriction Codes A, B, and C are prevented from using the tunnels (with some minor

Abbreviation	Description
	exceptions for vehicle Tunnel Restriction Code C). Vehicles with Tunnel Restriction Codes D and E are subject to convoying or “check and allow” using the procedures describe in the Dartford Dangerous Goods Listing.
Disbenefit	A disadvantage or loss resulting from something.
Distributional Impact	Distributional impacts (DIs) consider the variance of transport intervention impacts across different social groups. The analysis of DIs is mandatory in the appraisal process and is a constituent of the Appraisal Summary Table (AST).
DMRB	Design Manual for Roads and Bridges: A comprehensive manual (comprising 15 volumes) which contains requirements, advice and other published documents relating to works on motorway and all-purpose trunk roads for which one of the Overseeing Organisations (Highways England, Transport Scotland, The Welsh Government or the Department for Regional Development (Northern Ireland)) is highway authority. The DMRB has been developed as a series of documents published by the Overseeing Organisations of England, Scotland, Wales and Northern Ireland. For the Lower Thames Crossing the Overseeing Organisation is Highways England.
DP World	Dubai Ports World, London Gateway Port
DV	District Valuer
DWT	Deadweight tonnage, a measure of how much weight a ship is carrying or can safely carry.
EA	Environment Agency: The Environment Agency was established under the Environment Act 1995, and is a Non-Departmental Public Body of Defra. The Environment Agency is the leading public body for protecting and improving the environment in England and Wales. The organisation is responsible for wide-ranging matters, including the management of all forms of flood risk, water resources, water quality, waste regulation, pollution control, inland fisheries, recreation, conservation and navigation of inland waterways.
Eastern Southern Link (ESL)	The Eastern Southern Link (ESL) is an alternative for Routes 3 and 4 to the south of the River Thames. The route would connect into Junction 1 of the M2 and would pass to the east of Shorne and then northwest towards Church Lane and Lower Higham Road. This route could connect into either of the Routes 3 and 4 north of the river utilising all of the crossing options for these route options.
EB	eastbound
Environment Impact Assessment (EIA)	The purpose of Environmental Impact Assessment is to protect the environment by ensuring that a consenting authority, when deciding whether to grant consent for a project which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision making process.
ERA	Emergency Refuge Area: on roads for use in emergency or breakdown only and separated from the main carriageway.
EU	European Union: A politico-economic union of 28 member states that are located primarily in Europe.
Fastrack	A bus rapid transit scheme operating in the Thames Gateway area of Kent, operated by Arriva Southern Counties.
FRA	Flood Risk Assessment.
FSA	Flood Storage Area: a natural or man-made area basin that temporarily fills with water during periods of high river levels.
FWI	Fatalities and Weighted Injuries: a statistical measurement of all non-fatal injuries added-up using a weighting factor to produce a total number of ‘fatality equivalents’.
GDP	Gross Domestic Product
GIS	Geographic information system: an integrated collection of computer software and data used to view and manage information about geographic places, analyse spatial relationships, and model spatial processes.
GVA	Gross Value Added
Ha	Hectares
Habitats Directive	The Habitats Directive (the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora) is a European Union directive adopted in 1992 as an EU response to the Berne Convention. It is one of the EU's two directives in relation to wildlife and nature conservation, the other being the Birds Directive; it aims to protect some 220 habitats and approximately 1,000 species listed in the directive's Annexes.
Habitats Regulations	The Conservation of Habitats and Species Regulations 2010 (as amended) are the principal means by which Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the ‘Habitats Directive’) and the Birds Directives Council Directive 2009/147/EC are transposed into English law.
Habitats Regulations	This is a multi-stage process undertaken to determine whether a project, plan or policy will have an adverse effect on the integrity of any Natura 2000 or European sites (Special Areas of Conservation, Special Protection Areas and Ramsar sites), (either in isolation or in combination with other plans and

Abbreviation	Description
Assessment (HRA)	projects). The outcomes of this process should inform decision-making and whether consent should be granted for a project.
HAGDMS	Highways England Geotechnical Data Management System
Hanson	Hanson UK, part of the HeidelbergCement Group.
HGV	Heavy Goods Vehicle
HHJV	Halcrow Hyder Joint Venture: a joint venture between Halcrow Group Limited and Hyder Consulting Limited appointed as technical adviser by Highways England in June 2014.
HMRC	HM Revenue & Customs
HRA	Habitats Regulations Assessment
HS1	High Speed 1 rail line (formerly Channel Tunnel Rail Link (CTRL))
IAN	Interim Advice Notice: Issued by Highways England from time to time. They contain specific guidance, which should only be used in connection with works on motorways and trunk roads in England.
Inter-peak	10:00 to 16:00
IP	Internet Protocol
IPA	Infrastructure and Projects Authority
Ipsos MORI	A UK market research organisation appointed by Highways England to analyse and report on the responses to the LTC public consultation.
IROPI	Imperative Reasons of Overriding Public Interest
IT	Immersed tunnel
ITS	Intelligent Transportation System
KMEP	Kent and Medway Economic Partnership
Lafarge Tarmac	Lafarge Tarmac Limited is a British building materials company headquartered in Solihull, Birmingham.
Lakeside	Lakeside Shopping Centre, branded as Intu Lakeside, is a large out-of-town shopping centre located in West Thurrock, in the borough of Thurrock, Essex just beyond the eastern boundary of Greater London.
London Distribution Park (LDP)	An area, 70 acres (28Ha), of land for industrial and logistics development 6.5 miles from the M25, adjacent to Port of Tilbury, London.
LGV	Light Goods Vehicle
Location A	The location for LTC route options close to the existing Dartford crossing.
Location B	The location for a new crossing in the vicinity of the Swanscombe peninsula. It would connect the A2 to the south in the vicinity of Dartford to the A1089 to the north in the vicinity of Tilbury Docks. This route would cross the Eastern Quarry development site and the Swanscombe Peninsular.
Location C	The location for LTC route options connecting the A2/ M2 east of Gravesend with the A13 and M25 (between Junctions 29 and 30) north of the River Thames.
Location C Variant	As for options at Locations C and A with additional widening of the A229 between the M2 and the M20.
Locations D and E	The two most easterly of five locations originally examined by the DfT for the proposed Lower Thames Crossing, both were eliminated from further consideration.
LoHAM	Transport for London's Highway Assignment Model
London Gateway	A new deep-water port, able to handle the biggest container ships in the world, and part of the London Gateway development on the north bank of the River Thames in Thurrock, Essex, 20 miles (32 km) east of central London.
LRCH	London Resort Company Holdings, developer for the proposed entertainment resort on the Swanscombe peninsula, Kent.
LSOA	Lower Super Output Area; LSOAs typically contain 4 to 6 OAs (census output areas, the smallest unit for which census data is published) with a population of around 1500.
LTC	Lower Thames Crossing: a proposed new crossing of the Thames estuary linking the county of Kent with the county of Essex, at or east of the existing Dartford Crossing.
LTS railway	London, Tilbury and Southend railway
LVIA	Landscape and Visual Impact Assessment
LWS	Local wildlife site
Mainline	The through carriageway of a road as opposed to a slip road or a link road at a junction
Mardyke	A small river, mainly in Thurrock, that flows into the River Thames at Purfleet, close to the QEII Bridge.

Abbreviation	Description
Marine Conservation Zones (MCZs)	A Marine Conservation Zone (MCZ) is a type of marine nature reserve in UK waters. They were established under the Marine and Coastal Access Act (2009) and are areas designated with the aim to protect nationally important, rare or threatened habitats and species.
Marine Management Organisation (MMO)	An executive non-departmental public body in the UK established under the Marine and Coastal Access Act 2009. The MMO exists to make a significant contribution to sustainable development in the marine area, and to promote the UK government's vision for clean, healthy, safe, productive and biologically diverse oceans and seas.
National Cycle Route (NCR)	A cycle route part of the National Cycle Network created by Sustrans to encourage cycling throughout Britain.
National Vegetation Classification (NVC)	A system of classifying natural habitat types in Great Britain according to the vegetation they contain.
Natura 2000	A network of nature protection areas in the territory of the EU. It is made up of Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) designated respectively under the Habitats Directive and Birds Directive. The network includes both terrestrial and marine sites (Marine Protected Areas (MPAs)).
NB	northbound
NIDP	National Infrastructure Delivery Plan
NMU	Non-motorised user, e.g. pedestrians, cyclists, equestrians.
NO_2	Nitrogen dioxide
Noise-important area (NIA)	Defra published noise maps for England's roads in 2008, with the noise action plans following 2 years later in 2010. The action plans set out a framework for managing noise, rather than propose specific mitigation measures, and were designed to identify 'Important Areas' that are impacted by noise from major sources and therefore must be investigated. NIAs are where the 1% of the population that are affected by the highest noise levels from major roads are located, according to the results of Defra's strategic noise maps.
NPPF	National Planning Policy Framework: published in March 2012 by the UK's Department of Communities and Local Government, consolidating over two dozen previously issued documents called Planning Policy Statements (PPS) and Planning Policy Guidance Notes (PPG) for use in England.
NPS	National Policy Statement (see NPSNN)
NPSNN	National Policy Statement for National Networks: The NPSNN sets out the need for, and Government's policies to deliver, development of nationally significant infrastructure projects on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.
NSIP	Nationally significant infrastructure project: major infrastructure developments in England and Wales, such as proposals for power plants, large renewable energy projects, new airports and airport extensions, major road projects etc.
NPV	Net present value, a measure of the total impact of a scheme upon society, in monetary terms, expressed in 2010 prices.
NTCC	National Technology Control Centre: based in the West Midlands, the NTCC is an ambitious telematics project aimed at providing free, real-time information on England's network of motorways and trunk roads to road users, allowing them to plan routes and avoid congested areas.
NTEM	DfT's National Trip End Model
NTIS	Highways England National Traffic Information Service
NUTS	Nomenclature of Territorial Units for Statistics
NVQ	National Vocational Qualification
O&M	Operations and Maintenance
ONS	Office for National Statistics: the executive office of the UK Statistics Authority, a non-ministerial department which reports directly to the UK Parliament.
Opex	An operating expense or operating expenditure or operational expense or operational expenditure: an ongoing cost for running a product, business or system.
PA	Public accounts Public address
PACTS	Parliamentary Advisory Council for Transport Safety: a registered charity and an All-party parliamentary group of the UK parliament. Its charitable objective is to protect human life through the promotion of transport safety for the public benefit.

Abbreviation	Description
PCM	Pollution Climate Model
pcu	passenger car units. This is a metric to allow different vehicle types within traffic flows in a traffic model to be assessed in a consistent manner. Typical pcu factors are: 1 for a car or light goods vehicle; 2 for a bus of heavy goods vehicle; 0.4 for a motorcycle; and 0.2 for a pedal cycle.
Peel Ports	Britain's second largest group of ports, part of the Peel Group.
PIA	Personal Injury(ies) Accident(s)
PIE	Public Information Event. Highways England held a total of 24 PIEs in 20 locations during the six-week public consultation period between January and March 2016; almost 13,000 people attended.
PLA	Port of London Authority: a self-funding public trust established by The Port of London Act 1908 to govern the Port of London. Its responsibility extends over the Tideway of the River Thames and its continuation (the Kent/ Essex strait). It maintains and supervises navigation, and protects the river's environment.
PM	16:00 to 19:00
PM_{10}	Particulate matter (in this example, particulates smaller than 10µm that can cause health problems).
Post-Consultation Appraisal Routes	The routes appraised, following the public consultation, using updated version of the LTC traffic model (v2.1), which takes account of updated data following the opening of Dart Charge, enhancements to improve highway network representation and future patterns of local development in Kent and Essex, and new values of time issued by DfT.
PRA	Preferred Route Announcement
pSPA	Potential Special Protection Area: Sites which are approved by Government that are in the process of being classified as Special Protection Areas.
PTSD	Highways England Professional and Technical Services Division
PV	Present Values
PVB	Present value of benefits: PVBs less PVCs provide estimates of Net Present Values (NPVs) and the ratio of the PVB to the PVC constitutes the BCR.
PVC	Present value of costs: a measure of the monetary cost of a scheme, less revenues, discounted to and expressed in 2010 prices.
QEII Bridge	Queen Elizabeth ll Bridge, part of the Dartford-Thurrock crossing.
QUADRO	QUeues And Delays at ROadworks computer program: a Highways England sponsored computer program maintained and distributed by TRL Software; its primary use is in rural areas. It estimates the effects of roadworks in terms of time, vehicle operating and accident costs on the users of the road. Individual roadworks jobs can be combined to produce the total cost of maintaining the road over time.
R&D	Research and development.
Ramsar site	A wetland of international importance, designated under the Ramsar convention.
Recommended Preferred Route	The preferred route of the Lower Thames Crossing as recommended by Highways England in the Post-Consultation SAR.
RIS	DfT's Road Investment Strategy
rMCZ	Recommended Marine Conservation Zone: A site put forward for designation under the Marine and Coastal Access Act 2009 to conserve the diversity of nationally rare, threatened and representative habitats and species.
Route 1 (Post-Consultation Appraisal Route)	A new trunk road connecting M25 Junction 2 to M25 Junction 30, with a new 4 lane bridge crossing to the west of Dartford crossing, with significant improvements to Junctions 30 and 31. Smart Motorway Technology is to be implemented from Junction 2 to 1b (with no widening) and Junction 1b to 1a (with widening to dual 5 lanes).
Route 2 (shortlist route)	A new trunk road connecting A2 (2 km east of Gravesend) to M25 between Junctions 29 and 30, using A1089 (upgrading), with dual 2 lane crossing option of a bridge/ twin-bored tunnel/ immersed tunnel. See also Eastern Southern Link and Western Southern Link.
Route 3 (Post-Consultation Appraisal Route)	A new trunk road connecting the A2 (2 km east of Gravesend) to the M25 (between Junctions 29 and 30), with dual 2 lane crossing of a twin-bored tunnel river crossing large enough to accommodate a future dual 3 lane carriageway. Junction with the A13 at the existing junction with the A13 and A1089 and a junction with Brentwood Road, with Brentwood Road upgraded to dual 2 lane to Orsett Cock interchange. See also Eastern Southern Link and Western Southern Link.
Route 4 (Post-Consultation Appraisal Route)	A new trunk road connecting the A2 (2 km east of Gravesend) to the M25 (between Junctions 29 and 30), with dual 2 lane twin-bored tunnel river crossing large enough to accommodate a future dual 3 lane carriageway. Junction with A13 between Orsett Cock (A128) and Manor Way (A1014) junctions. Single carriageway road provided from B186 to A128 parallel with the A127. See also Eastern Southern Link and Western Southern Link.

Abbreviation	Description
RSPB	Royal Society for the Protection of Birds: A charitable organisation that works to promote conservation and protection of birds and the wider environment through public awareness campaigns, petitions and through the operation of nature reserves throughout the United Kingdom.
RTC	Road traffic collision
RWE npower	A leading integrated UK energy company.
SAC	Special Area of Conservation: defined in the European Union's Habitats Directive (92/43/EEC), also known as the *Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora*. SACs are to protect the 220 habitats and approximately 1000 species listed in annex I and II of the directive which are considered to be of European interest following criteria given in the directive.
Sanef	Société des Autoroutes du Nord et de l'Est de la France, a motorway operator company.
SAP	LTC Stakeholder Advisory Panel: comprises key local authority stakeholders to share local knowledge, their needs, priorities and opinions with respect to LTC. SAP meetings have been held at key stages of the LTC scheme; bi-lateral meetings with SAP members have also been held.
SAR	Scheme Assessment Report, on the Lower Thames Crossing. The Pre-Consultation SAR was issued in January 2016, prior to the public consultation; the Post-Consultation SAR is a revised report that reports on the consultation, response to consultation findings and presents Highways England's Recommended Preferred Route.
SATURN	Simulation and Assignment of Traffic to Urban Road Networks, Transport Model
SCADA	Supervisory Control and Data Acquisition
S-CGE	Spatial Compatible General Equilibrium economic model
SEB(s)	Statutory Environmental Body(ies): Any principal council as defined in subsection (1) of section 270 of the Local Government Act 1982 for the area where the land is situated. Where the land is situated in England; Natural England, Historic England, the Environment Agency, Natural Resources Wales and the National Assembly for Wales where, in the opinion of the Secretary of State, the land is sufficiently near to Wales to be of interest to them and any other public authority which has environmental responsibilities and which the Secretary of State considers likely to have an interest in the scheme.
SELEP	South East Local Enterprise Partnership: the business-led, public/ private body established to drive economic growth across East Sussex, Essex, Kent, Medway, Southend and Thurrock.
Setting	This is defined in the National Planning Policy Framework as 'The surroundings in which a heritage asset is experienced. Its extent is not fixed and may change as the asset and its surroundings evolve. Elements of a setting may make a positive or negative contribution to the significance of the asset, may affect the ability to appreciate that significance or may be neutral.'
SIA	Social Impact Appraisal
Smart motorway	Term for a range of types of actively controlled motorway, using technology to optimise use of the carriageway including the hard shoulder.
SOCC	Statement of Community Consultation, sets out how local communities in the vicinity of the scheme will be consulted. Directly affected and neighbouring local authorities will be consulted on the content of the SOCC before it is finalised.
SoS	Secretary of State (for Transport)
SPA	Special Protection Area: A designation under the European Union Directive on the Conservation of Wild Birds.
SPZ	Source protection zone: EA-defined groundwater sources (2000) such as wells, boreholes and springs used for public drinking water supply. These zones show the risk of contamination from any activities that might cause pollution in the area.
SRN	Strategic Road Network: the core road network, managed in England by Highways England.
SSSI	Site of Special Scientific Interest: A conservation designation denoting an area of particular ecological or geological importance.
STEM subjects	Science, Technology, Engineering and Mathematics
SuDS	A sustainable drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
Sustrans	A UK charity enabling people to travel by foot, bike or public transport for more of the journeys they make every day; their flagship project is the National Cycle Network.
SWMP	Surface Water Management Plan: Plan to provide sufficient information to support the development of an agreed strategic approach to the management of surface water flood risk within a given geographical area by ensuring the most sustainable measures are identified.
TAME	Highways England's Traffic Appraisal Modelling and Economics division
TBM	Tunnel boring machine, machine used to excavate tunnels with a circular cross section.

Abbreviation	Description
TE2100	EA's Thames Estuary 2100 project (formed November 2012) to develop a comprehensive action plan to manage flood risk for the Tidal Thames from Teddington in West London, through to Sheerness and Shoeburyness in Kent and Essex.
TEE	Transport Economic Efficiency (economic efficiency of the transport system)
TEN-T	Trans-European transport network
TfL	Transport for London: created in 2000, the integrated body responsible for London's transport system.
TGSEP	Thames Gateway South Essex Partnership
Thames Estuary 2050 Growth Commission	The Thames Estuary 2050 Growth Commission, announced in March 2016, is tasked with developing an ambitious vision and delivery plan for North Kent, South Essex and East London up to 2050.
TM	Highways England's Traffic Management (directorate)
TMC	Traffic Management Cell
TRRL	Transport and Road Research Laboratory (now TRL Ltd): a fully independent private company offering a transport consultancy and research service to the public and private sector. Originally established in 1933 by the UK Government as the Road Research Laboratory (RRL), it was privatised in 1996.
TUBA	Transport Users Benefit Appraisal (DfT economic appraisal software tool)
ULEV	Ultra Low Emission Vehicle
Urban All Purpose	A road in an urban area designed for all types of traffic in accordance to the relevant DMRB Standards.
VAT	Value Added Tax
VfM	Value for Money
VMSL	Variable Mandatory Speed Limit(s)
VOC	Vehicle operating cost(s)
Vopak	Royal Vopak N.V. is a Dutch company that stores and handles various oil and natural gas-related products.
Vortex separator/ device	A vortex separator is a device for effective removal of sediment, litter and oil from surface water runoff.
VOSA	Vehicle and Operator Services Agency, now merged with the Driving Standards Agency into a single agency, the Driver and Vehicle Standards Agency (DVSA).
vpd	Vehicles per day
WASHMS	Wind and Structural Health Monitoring System: the process of implementing a damage detection and characterisation strategy for engineering structures.
WB	westbound
WEBs	Wider economic benefits
WebTAG	Department for Transport's web-based multi-modal guidance on appraising transport projects and proposals.
Western Southern Link	The Western Southern Link (WSL) is an alternative for Post-Consultation Appraisal Routes 3 and 4 to the south of the River Thames. The route would connect into the A2 to the east of Gravesend and would go to the west of Thong and Shorne and east of Chalk towards Church Lane and Lower Higham Road. This route could connect into either of the Routes 3 and 4 north of the river utilising all of the crossing options for these route options.
WFD	Water Framework Directive: A European Community Directive (2000/60/EC) of the European Parliament and council designed to integrate the way water bodies are managed across Europe.
Wider Impacts (WI)	Land use-related economic consequences of transport interventions, not directly related to impacts on users of the transport network, such as increased productivity.
Without Scheme/ With Scheme	Without Scheme: The scenario where government takes the minimum amount of action necessary and is used as a benchmark in the appraisal of options. With Scheme: An option that provides enhanced services by comparison to the benchmark Without Scheme scenario.

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