Lower Thames Crossing

Pre-Consultation Scheme Assessment Report

Volume 3: Identification and Description of Shortlist Routes

Volume 3

Lower Thames Crossing
Route Consultation 2016

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Figures

The designs shown and described in this Pre-Consultation SAR 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 Pre-Consultation Scheme Assessment Report

1.1.1 The Pre-Consultation Scheme Assessment Report (SAR) brings together the engineering, safety, operational, traffic, economic, social and environmental appraisal of the shortlist routes for the Lower Thames Crossing. The appraisal of the longlist options was reported in the *Technical Appraisal Report* (TAR) (refer to Sections 2 and 3 of this volume).

1.1.2 Drawing on the results of the appraisal the SAR recommends which routes should be taken to public consultation. It also sets out Highways England's proposed scheme.

1.1.3 The SAR is set out in a number of Volumes, as follows:

- Volume 1 – Executive Summary
- Volume 2 – Introduction and Existing Conditions
- **Volume 3 – Identification and Description of Shortlist Routes**
- Volume 4 – Engineering, Safety and Cost Appraisal
- Volume 5 – Traffic and Economics Appraisal
- Volume 6 – Environmental Appraisal
- Volume 7 – Appraisal Conclusions and Recommendations

1.1.4 Following public consultation, this document will be reviewed and updated to produce a final Post-Consultation Scheme Assessment Report that takes account of the comments received. It will also include the report on public consultation, and the recommendation for the Preferred Option. The Preferred Option will be the scheme that Highways England recommends should be taken forward into an application for development consent.

1.2 Structure of this Volume

1.2.1 The structure of this volume is as follows:

- Section 2 sets out the scheme study area and the key stages in the option identification and selection.
- Section 3 outlines all route options considered, routes not selected and the rationale for selection of the shortlist routes.
- Section 4 sets out the approach to stakeholder engagement and the bodies consulted.
- Section 5 describes the shortlist route options.

2 Study Area and Option Selection

2.1 Study Area

2.1.1 The Study Area for the identification and appraisal of options at Locations A and C is shown in **Figure 2.1.**

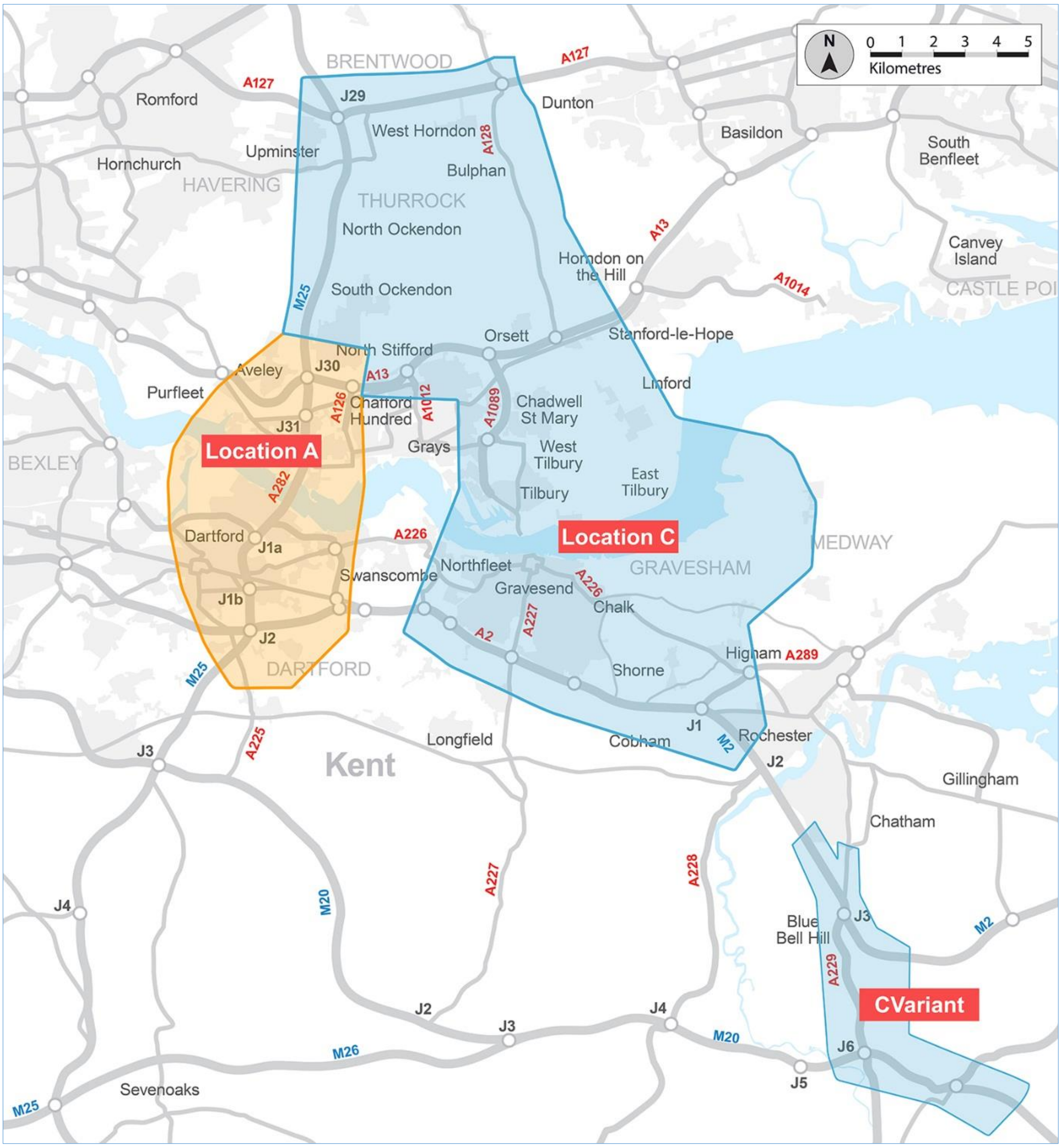

FIGURE 2.1 - STUDY AREA

2.2 Option Identification and Selection

2.2.1 The approach taken to the Stage 1 Options Identification and Stage 2 Options Selection process on Lower Thames Crossing is shown in **Figure 2.2** below. The red arrow indicates the current stage i.e. prior to public consultation.

FIGURE 2.2 - OVERVIEW OF OPTIONS IDENTIFICATION AND SELECTION PROCESS

2.2.2 The key stages in the appraisal are set out below. These stages are briefly described in Section 3.

a) **Viability Check.** A list of route options was developed for Locations A and C. Route options which performed poorly against the scheme objectives (refer to Volume 2 for details of the scheme objectives) or were considered unviable (e.g. due to not being technically viable or having unacceptable environmental impacts) were not selected for the longlist.

b) **Appraisal of longlist.** The longlist options were appraised. The appraisal of the longlist options was undertaken in two stages and is reported in detail in the *Technical Appraisal Report*. The result of this appraisal was the shortlist of options.

c) **Appraisal of shortlist.** A detailed appraisal of the shortlist routes has been undertaken and is described in Volumes 4 (Engineering, safety, construction impacts, operations and maintenance, risk and cost), 5 (Traffic, economics and social impacts) and 6 (Environmental). Based on the detailed appraisal of the shortlist routes those that performed satisfactorily against the scheme objectives and were considered deliverable were identified and proposed for public consultation. This is reported in Volume 7.

d) **Public Consultation on options and proposed scheme.** Those shortlist routes that perform satisfactorily against the scheme objectives and are considered viable, will be presented at public consultation. This will include the proposed scheme, being the route that Highways England considers to perform best overall. Following public consultation, a Preferred Option will be determined taking account of this appraisal and the responses to the public consultation.

3 Option Appraisal

3.1 Route Options Considered

3.1.1 For both Location A and Location C a number of route options were developed to a sufficient level to determine a route in terms of their technical feasibility whilst taking account of the environmental and physical constraints, including known planned development where such data was available. Information received through the engagement with stakeholders (refer to Section 4) was also taken into consideration in the development and appraisal of the route options at each stage of the process.

3.1.2 A design speed and cross-section were assumed for a route and the alignment was then developed taking account of the constraints: environmental, physical (including known planned development), junctions and what impacts these could have on the geometry and crossing locations. The alignments, junctions and cross-sectional designs were carried out in accordance with the relevant Design Manual for Roads and Bridges (DMRB) standards.

3.1.3 The majority of routes were designed as dual two lane all-purpose carriageways with a design speed of 120kph (70mph) and grade-separated junctions. However, options at Location A close to the existing crossing which involved widening or improvement of the existing A282 had a design speed of 85kph (50mph). This is due to the constraints of the existing site including the highway geometry and the closely spaced junctions. This design speed matches the design speed and speed limit of the existing road. Lane provision and junction layouts were determined from predicted traffic flows from the traffic modelling undertaken to support the development and appraisal of route options (refer to Volume 5 for more details).

3.1.4 There has been a three-stage appraisal in order to develop the route options to identify the current shortlist and ultimately a proposed scheme. These stages were the pre-longlist, longlist and shortlist (refer to **Figure 2.2**).

3.1.5 At the pre-longlist stage sixteen route options were considered within Location A (refer to **Figure 3.1)**, six main options within Location C (refer to **Figure 3.2**) and four options within C Variant (refer to **Figure 3.3**). At Location C there were also thirteen “combination options” (C7 to C19 - refer to **Table 3.1**) which involved combining sections from the main options (refer to Section 5.4 of the *Technical Appraisal Report* for more details).

3.1.6 All of the route options that have been considered are described in detail in the *Technical Appraisal Report*, Section 5.

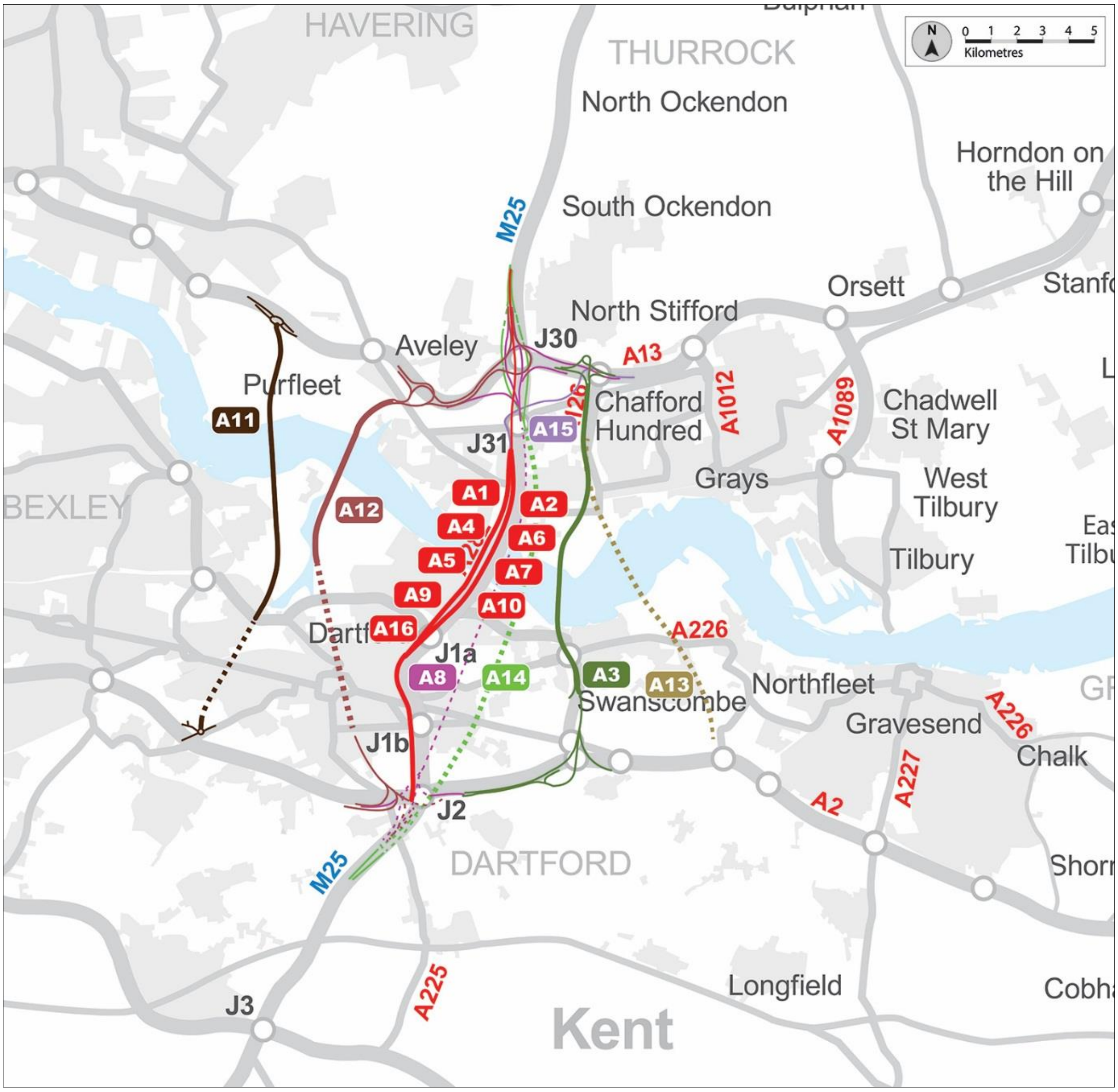

FIGURE 3.1 - LOCATION A - ALL ROUTE OPTIONS

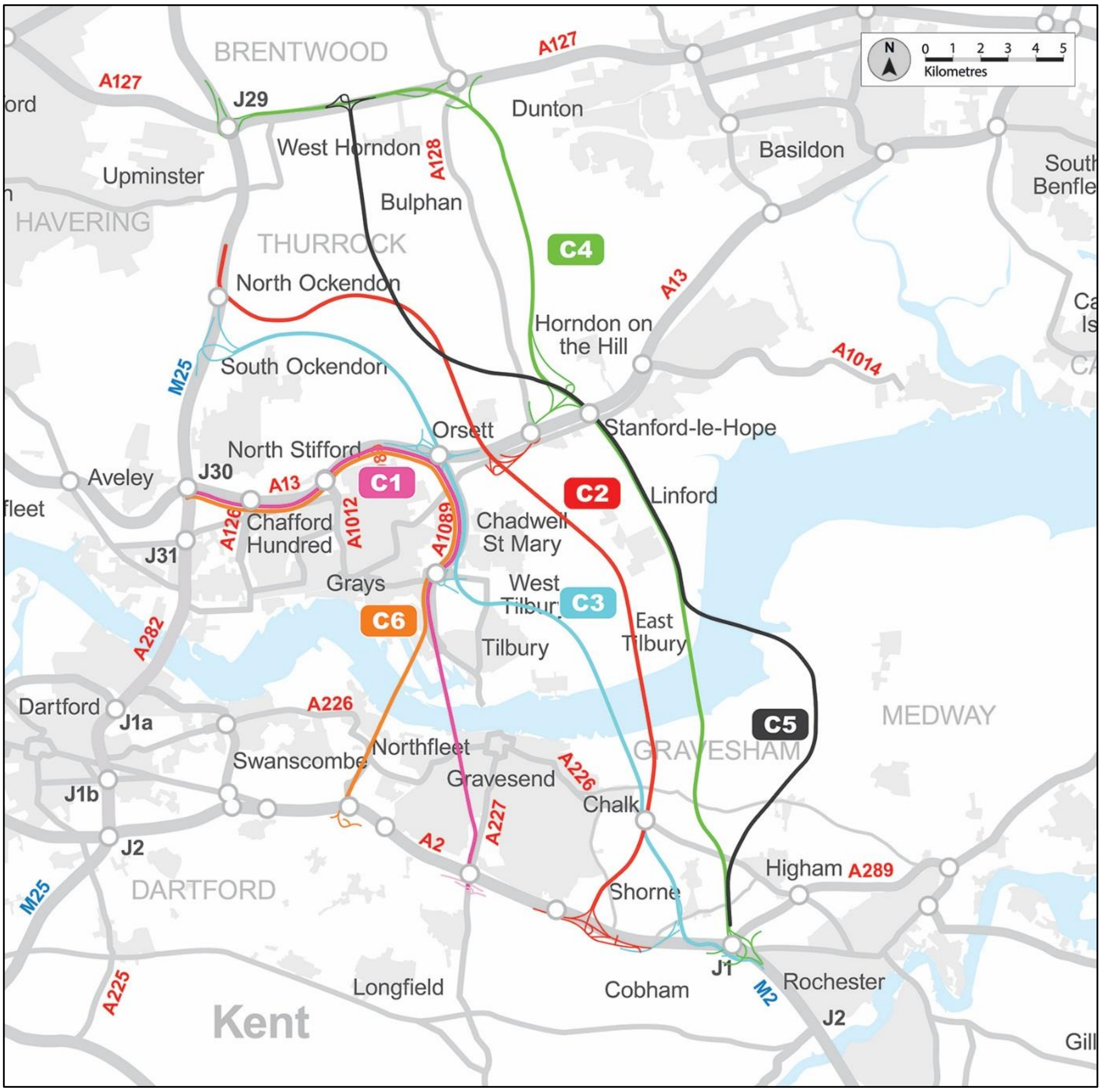

FIGURE 3.2 - LOCATION C - MAIN ROUTE OPTIONS

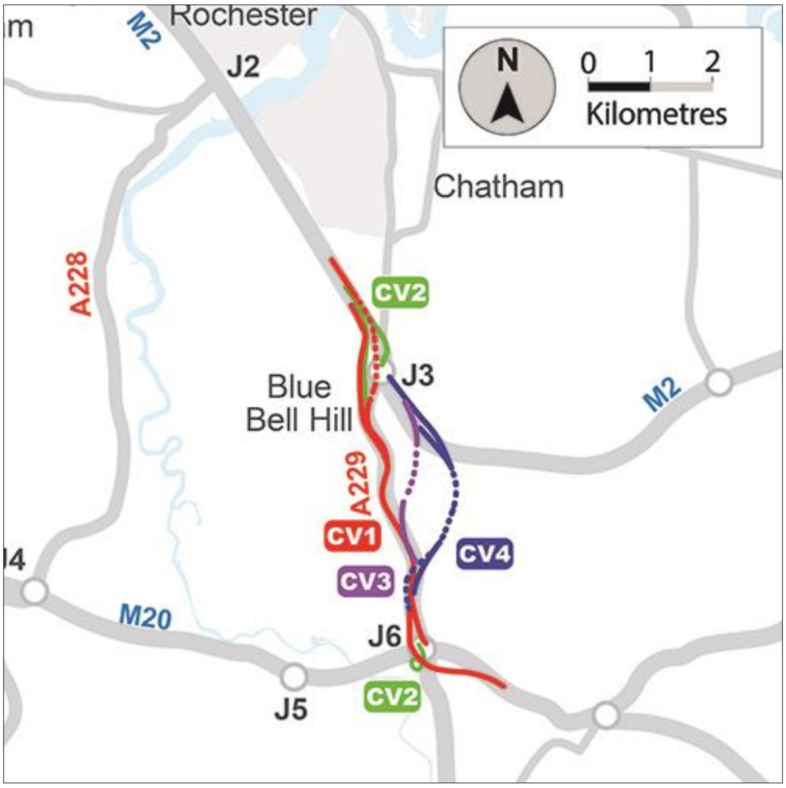

FIGURE 3.3 - C VARIANT - ALL ROUTE OPTIONS

TABLE 3.1 - LOCATION C - COMBINATION OPTIONS

Route Reference	Route Description
C7	Southern section of C1 connecting to C3 west of Chadwell St Mary
C8	Southern section of C2 connecting to C3 south of Chalk
C9	Southern section of C2 connecting to C4 north west of East Tilbury
C10	Southern section of C2 connecting to C3 north west of Orsett
C11	Southern section of C3 connecting to C2 south east of Chalk
C12	Southern section of C3 connecting to C1 existing A13 junction
C13	Southern section of C3 connecting to C2 south east of Chalk and then connecting back to C3 north west of Orsett
C14	Southern section of C3 connecting to C2 south east of Chalk and then connecting to C4 south west of East Tilbury
C15	Southern section of C4 connecting to C3 south east of Chalk
C16	Southern section of C4 connecting to C3 south east of Chalk and then connecting to C1 at the existing A13 junction
C17	Southern section of C4 connecting to C2 east of Chalk
C18	Southern section of C4 connecting to C2 north of Orsett and then connecting to C3 South Ockendon
C19	Southern section of C4 connecting to C2, C3 or C9 east of Chalk

3.2 Routes Not Selected for Longlist

3.2.1 As part of the pre-longlist appraisal, initially a wide range of route options within Locations A, C and C Variant were considered, and an initial viability check undertaken considering technical feasibility and a high level appraisal against the scheme objectives. This resulted in the recommendation that eleven options should not be considered further and not included in the longlist as shown in **Table 3.2**. A detailed justification for this recommendation is reported in the *Technical Appraisal Report,* Section 5.

TABLE 3.2 - ROUTE OPTIONS NOT SELECTED FOR LONGLIST

Route Option	Key Reason for Decision
A3 - Bluewater/ Lakeside corridor	High cost and complexity of construction directly impacting access to Bluewater and Lakeside shopping centres, and impact on new Eastern Quarry housing development
A5 - Double deck tunnel	Technical non-viability; insufficient space to create effective connections to existing roads
A6 – Two-lane bored tunnels east and west of existing crossing	Significant impact on existing development north and south of the river east of existing crossing
A7- Bored tunnel east	Significant impact on existing development north and south of the river east of existing crossing
A10 - Immersed tube tunnel east	Significant impact on existing development north and south of the river east of existing crossing
A11 - A2/ A13 connection (west)	Doesn't solve strategic traffic problem, too far from Dartford and too close to proposed TfL Belvedere crossing
A13 - Swanscombe Peninsular (east)	Impact on new development (Paramount London and Ebbsfleet Garden City)
C5 - East route	Significant environmental impacts on protected ecological sites (Ramsar, Special Protection Area (SPA)) and Cliffe Pools (RSPB)
C6 - Ebbsfleet junction connection.	Technical non-viability due to insufficient space to effectively connect to A2 and impact on new development (Ebbsfleet Garden City)
Cv3 – Bored tunnel and viaducts at M2 J3	Impact on Blue Bell Hill village and construction impact at M2 Junction 3
Cv4 – Two bored tunnels at M2 J3	Significant environmental impact and high cost of tunnels

3.3 Routes Not Selected for Shortlist

3.3.1 Following the pre-longlist viability check, the longlist comprised nine options at Location A, four at Location C and two for C Variant. These are shown in **Figure 3.4**. The "combination options" referred to in paragraph 3.1.5 were also included in the longlist but are not shown in **Figure 3.2** for clarity.

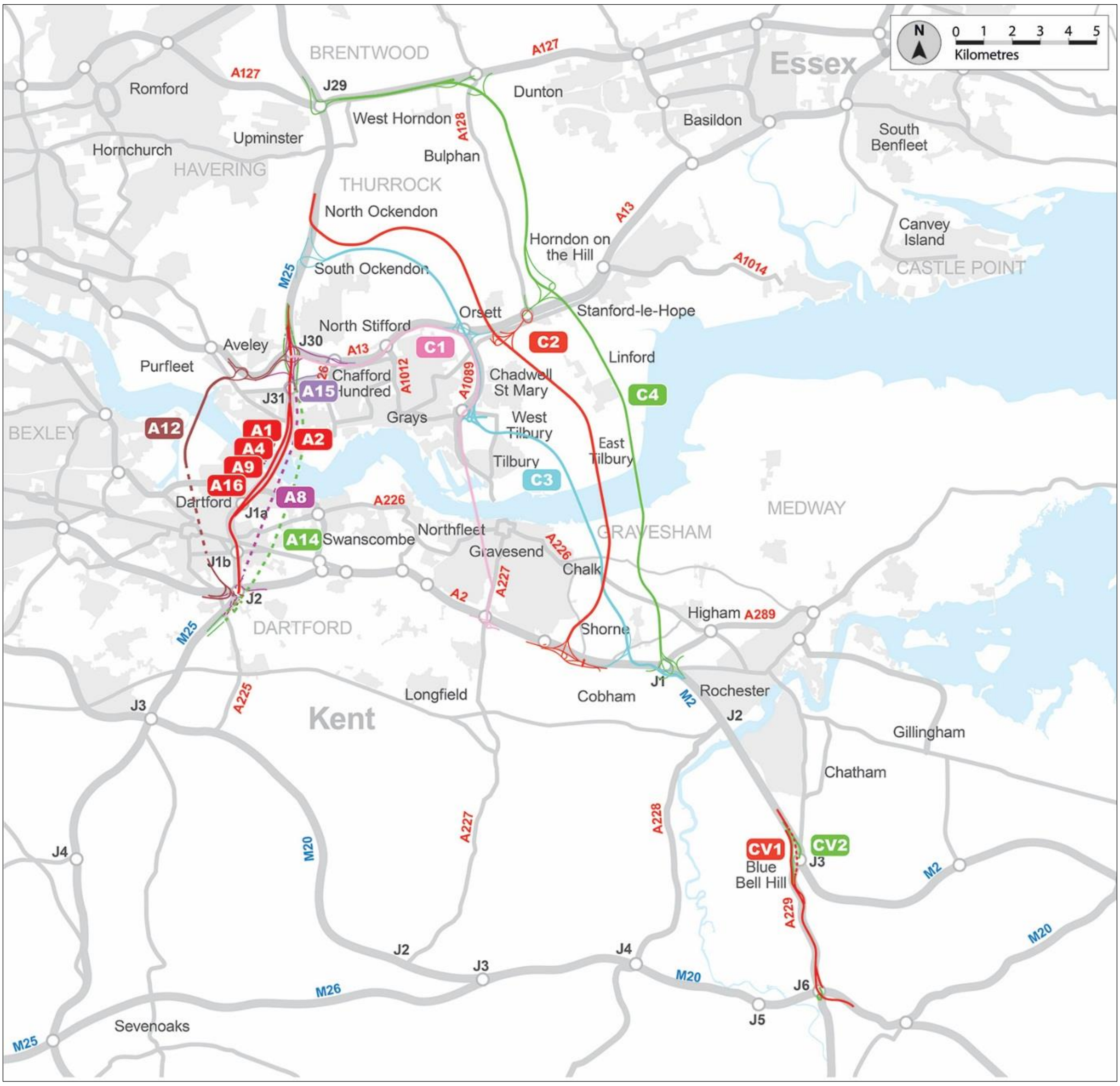

FIGURE 3.4 - PLAN OF LONGLIST ROUTES

3.3.2 The longlist appraisal was carried out in two stages. The first stage involved appraisal against the following criteria:

- Value for money (cost against economic benefit).
- Significant environmental impact.
- Other significant impacts (e.g. congestion, network resilience, impact on planned or existing developments).

3.3.3 Following this first stage appraisal three route options were not considered to be viable and the section of Route Option C3 south of the River Thames connecting to the A2 was also not considered viable. This also resulted in combination options C11 to C14 not being selected as they included this section of Option C3. **Table 3.3** shows the key reasons for these conclusions. For more details of reasons for not selecting these options refer to Section 12 of the *Technical Appraisal Report*.

TABLE 3.3 - LONGLIST ROUTE OPTIONS NOT SELECTED, FIRST STAGE APPRAISAL

Route Option	Key Reason for Decision
A12 - Western Route Junction 2 to Junction 30 tunnel under Dartford with bridge over river	Cost approximately three times A1. Poor economic benefits, significant impact on planned development at Purfleet. Potential impact on a Site of Special Scientific Interest (SSSI).
A14 - Long tunnel south of Junction 2 to north of Junction 30	Cost approximately more than twice A1. Poor level of economic benefit due to limited attraction of traffic.
A8 - Long tunnel Junction 2 to Junction 30	Cost approximately more than twice A1. Very complex junctions required to connect A2 and A13 traffic with significant impact on existing property.
C3 (Connection to A2)	Environmental impact on an Area of Outstanding Natural Beauty (AONB), SSSI and ancient woodland. Reasonably practicable alternative available (southern section of C2).

3.3.4 The remaining route options could not be differentiated on the basis of the limited criteria set out in paragraph 3.3.2. A second stage of appraisal of the longlist was therefore carried out. This involved appraisal of the remaining route options against criteria considered to be significant in making the choice between these route options as set out in **Table 3.4**.

TABLE 3.4 - LONGLIST SECOND STAGE APPRAISAL CRITERIA

Main Criteria	Sub-Criteria
Strategic	Fit with wider transport & government objectives
	Fit with other (regional) objectives
Economic	Travel time savings
	Congestion
	Resilience
	Accident benefits
	Wider economic benefits
	Impact on current/ planned infrastructure
Environmental	Carbon emissions
	Historic environment
	Biodiversity
	Landscape & townscape
	Air quality
	Noise
	Water environment
	Construction disruption
Management	Implementation timetable
	Practical feasibility
Financial	Capital cost
	Operation and maintenance cost
Commercial	Revenue costs

3.3.5 **Table 3.5** shows the route options that were not selected following the second stage of the longlist appraisal. In this table the most significant criteria from **Table 3.4** are noted in brackets after the reasons for the decision.

TABLE 3.5 - LONGLIST ROUTE OPTIONS NOT SELECTED, SECOND STAGE APPRAISAL

Route Option	Key Reason for Decision
A9 - Immersed tube west	High technical risks, significantly more difficult to construct than other options (practical feasibility). Impact on river/ jetty operations unlikely to be acceptable to owners/ operators or Port of London Authority (PLA) (impact on current/ planned infrastructure & construction disruption).
A2 - Bridge east	Poor value for money (limited benefits from travel time savings or congestion relief compared to capital cost). Significant impact on commercial property north and south of the river east of existing crossing PLA (impact on current/ planned infrastructure). Impact on SSSI (biodiversity).
A15 – Alternative Junction 30 improvement	Significant impact on commercial property around Junction 31 (impact on current/ planned infrastructure). Major high voltage overhead cable diversions required (construction disruption and implementation timetable).
C1 – A2 junction south of Gravesend to M25 Junction 30. Long tunnel under Gravesend and Tilbury docks. Widening of A13.	Poor value for money (high capital cost, low benefits from travel time savings). Poor resilience due to use of A13 (resilience). Potential impacts on Tilbury Docks from tunneling under existing structures (impact on current/ planned infrastructure).
C4 – A2/ M2 Junction 1 to M25 Junction 29. Long tunnel under Ramsar site and Coalhouse fort, north west of East Tilbury then parallel to A128 and along A127 to Junction 29	High cost (capital cost). Impact on scheduled monuments (historic environment). There are better, lower cost options available.
C Variant with A or C Option	Relatively small impact on transferring M20 traffic from existing Dartford Crossing onto new route at C (limited congestion relief). Significant impact on AONB (biodiversity and landscape). High cost (capital cost). Does not bring wider benefits that materially add value to the Lower Thames Crossing scheme (travel time savings and congestion relief).
A16 – Any C option combined with a 2 lane northbound tunnel at Dartford	Poor value for money. High cost solution with limited additional economic benefits (high capital cost and limited benefits from travel time savings or congestion relief).

3.3.6 As a result of Options C1 and C4 not being included in the shortlist combination options C7, C15, C16, C17 and C18 were not selected as they included parts of these main options. As option C2 was included in the shortlist the other combination options based on this option (C8 and C10) were not specifically ruled out. This is because they were sufficiently closely related to both Option C2 and Option C3 to provide potential future developments of these two route options.

3.3.7 Detailed information regarding the justification of the decision not to select these route options is contained within the *Technical Appraisal Report,* Section 12.

3.3.8 The options taken forward to the shortlist were: A1, A4, C2, C3, C9 and C19.

3.4 Shortlist Routes

3.4.1 Following the longlist appraisal, **Figure 3.5** shows the route options that were taken forward as the shortlist. For the purpose of the remainder of this report route options will be referred to as shortlist routes as set out in **Table 3.6** below.

3.4.2 Following the shortlisting described in the *Technical Appraisal Report* and summarised above, the shortlist routes were further developed and refined. This development and refinement was a result of the receipt of further more detailed information, discussion with stakeholders (e.g. the statutory environmental bodies) and the provision of greater detail required for the detailed appraisals (e.g. land take boundaries). As a result of this work a number of refinements were made to the routes and these are described in Section 5.1.

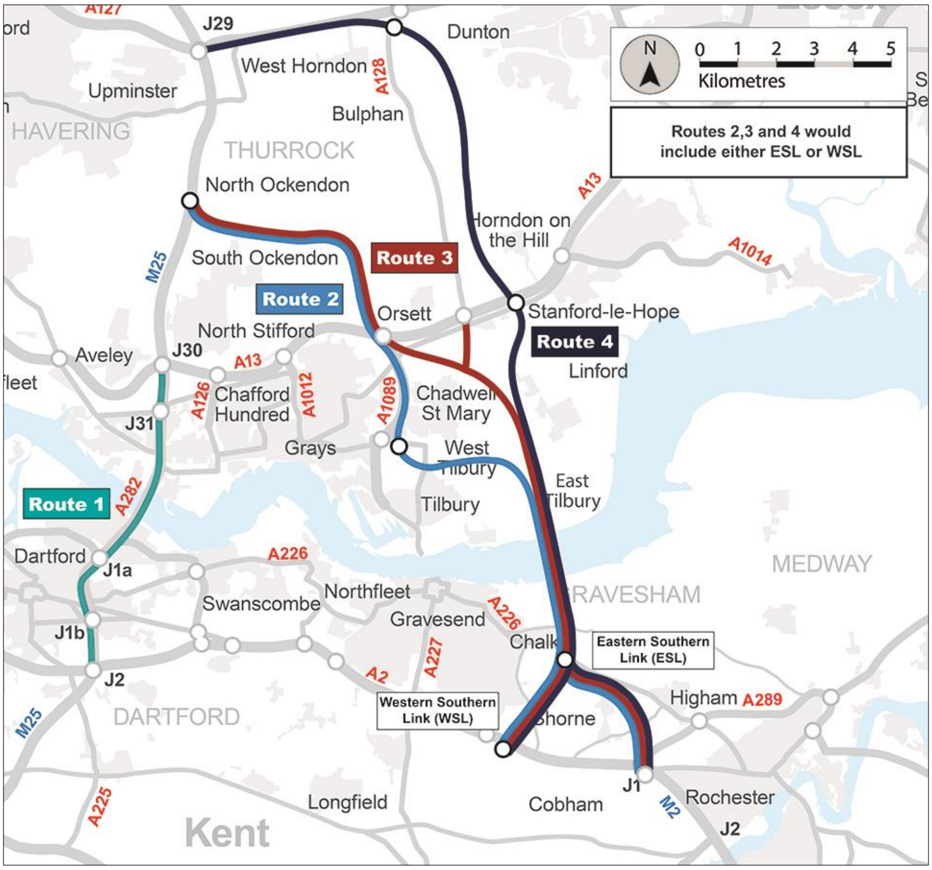

FIGURE 3.5 - SHORTLIST ROUTES

3.4.3 There are four principal shortlist routes, one at Location A and three at Location C. Each of these routes has a number of possible alternatives or sub-options. Specifically the crossing type and two alternative A2/ M2 junction locations.

3.4.4 The crossing types are:

- Bridge (all routes)
- Bored tunnel (all routes)
- Immersed Tunnel (Routes 2, 3 and 4)

3.4.5 For shortlist Routes 2, 3 and 4 there are two possible junctions with the A2/ M2 with associated alignments south of the river. The first is to the east of Gravesend and the second is further east at A2/ M2 Junction 1. For the remainder of this report the two junctions and associated alignments south of the river are referred to as:

- Western Southern Link (WSL) (junction east of Gravesend)
- Eastern Southern Link (ESL) (A2/ M2 Junction 1)

3.4.6 The full list of 20 possible alternatives that have been considered for the four shortlist routes is shown in **Table 3.6**.

TABLE 3.6 - SHORTLIST ROUTES

Shortlist Route	Shortlist Reference	TAR Reference
Route 1 with Bridge	Route 1 (BR)	A1
Route 1 with Bored Tunnel	Route 1 (BT)	A4
Route 2 with Western Southern Link and Bridge	Route 2 WSL (BR)	C3 (BR)
Route 2 with Western Southern Link and Bored Tunnel	Route 2 WSL (BT)	C3 (BT)
Route 2 with Western Southern Link and Immersed Tunnel	Route 2 WSL (IT)	C3 (IT)
Route 2 with Eastern Southern Link and Bridge	Route 2 ESL (BR)	C3 (BR) and C19
Route 2 with Eastern Southern Link and Bored Tunnel	Route 2 ESL (BT)	C3 (BT) and C19
Route 2 with Eastern Southern Link and Immersed Tunnel	Route 2 ESL (IT)	C3 (IT) and C19
Route 3 with Western Southern Link and Bridge	Route 3 WSL (BR)	C2 (BR)
Route 3 with Western Southern Link and Bored Tunnel	Route 3 WSL (BT)	C2 (BT)
Route 3 with Western Southern Link and Immersed Tunnel	Route 3 WSL (IT)	C2 (IT)
Route 3 with Eastern Southern Link and Bridge	Route 3 ESL (BR)	C2 (BR) and C19
Route 3 with Eastern Southern Link and Bored Tunnel	Route 3 ESL (BT)	C2 (BT) and C19
Route 3 with Eastern Southern Link and Immersed Tunnel	Route 3 ESL (IT)	C2 (IT) and C19
Route 4 with Western Southern Link and Bridge	Route 4 WSL (BR)	C9 (BR)
Route 4 with Western Southern Link and Bored Tunnel	Route 4 WSL (BT)	C9 (BT)
Route 4 with Western Southern Link and Immersed Tunnel	Route 4 WSL (IT)	C9 (IT)
Route 4 with Eastern Southern Link and Bridge	Route 4 ESL (BR)	C9 (BR) and C19
Route 4 with Eastern Southern Link and Bored Tunnel	Route 4 ESL (BT)	C9 (BT) and C19
Route 4 with Eastern Southern Link and Immersed Tunnel	Route 4 ESL (IT)	C9 (IT) and C19

4 Stakeholder Engagement

4.1 Approach to Engagement

4.1.1 The project undertook early engagement starting in September 2014 to determine constraints and priorities which would affect the identification and development of feasible options for a new Lower Thames Crossing. A planned and focused approach to engagement has been adopted to ensure high quality and meaningful engagement. This provided opportunities for sharing complex and technical information and facilitated relationship building with opportunities for further engagement. Key stakeholders for this purpose were local authorities, statutory undertakers and businesses which might be affected. The public and stakeholders will have the opportunity to share their views on the options through the public consultation planned for early 2016.

4.2 Stakeholder Advisory Panel

4.2.1 The Stakeholder Advisory Panel (SAP) was originally convened by the Department for Transport (DfT). It was reconvened for the options phase of the project with the first meeting held in December 2014. The purpose of the SAP is to help Highways England draw upon local knowledge and understand stakeholders' needs, priorities and opinions with respect to a new crossing of the Lower Thames. The panel meets at key stages in the project and is designed to be a consultative and advisory group, currently comprising officers of the organisations listed in **Table 4.1** below:

TABLE 4.1 - STAKEHOLDER ADVISORY PANEL MEMBERS

SAP Members	
Basildon Borough Council	Maidstone Borough Council
Brentwood Borough Council	Medway Council
Dartford Borough Council	South East Local Economic Partnership (SELEP)
Ebbsfleet Development Corporation	Southend Borough Council
Essex County Council	Thames Gateway Kent Partnership
Gravesham Borough Council	Thames Gateway South Essex Partnership (TGSEP)
Kent County Council	Thurrock Council
London Borough of Bexley	Tonbridge and Malling Borough Council
London Borough of Havering	Transport for London

4.2.2 Bilateral meetings were also held with officers and representatives of SAP member organisations to obtain information on existing highway networks, development plans, information to feed into the traffic model and any other constraints that could potentially affect route option selection.

4.2.3 During the options phase SAP meetings were held at key stages in the project to share and discuss the emerging findings of the options development and appraisal work. The project explained the staged approach to appraisal and criteria for each stage of the options phase, seeking feedback on the process through the post-SAP bilateral meetings.

4.2.4 As the project moved through the options phase, SAP members were given the opportunity to provide feedback on the proposed routes at key stages including the emerging longlist, longlist, emerging shortlist, shortlisted routes and the proposed approach to consultation. The views of SAP members have been considered throughout the options phase.

4.2.5 The project has also sought to engage council leaders and MPs in directly affected and neighbouring areas.

4.3 Statutory and Environmental Bodies

4.3.1 Throughout the options phase, the project has engaged with statutory and environmental bodies to share the emerging findings of the options process and provide an overview of the approach to the environmental appraisal of the routes. These bodies comprise the Environment Agency, Historic England, Natural England and the Marine Management Organisation; with involvement from the Kent Downs Area of Outstanding Natural Beauty, Essex and Kent County Archaeologists and the Greater London Archaeology Advisory Service who have been engaged through bilateral meetings. Meetings have also been held with the Royal Society for the Protection of Birds and ornithological data has been obtained from the British Trust for Ornithology.

4.3.2 Through this engagement the project has gained a detailed understanding of the environmental constraints associated with each of the route options. Discussions held covered issues including ecological impact, flood risk, hydrodynamic impact and potential mitigation. The approach to the Habitats Regulations Assessment was also discussed.

4.4 Industry and Utilities

4.4.1 Key major industry stakeholders have been identified to seek important technical information including constraints associated with existing assets and future development plans. Organisations approached included Port of London Authority, London Gateway Port, Network Rail, HS1, RWE npower, National Grid, UK Power Networks Tilbury Docks, Lafarge-Tarmac, Hanson, Peel Ports, C.RO Ports, Vopak, London Paramount and the Port of Dover.

4.4.2 The project has also engaged with wider industry stakeholders comprising prominent local businesses from the ports, logistics and retail sectors, along with the Kent and Essex Chambers of Commerce. Briefing sessions have been held to inform small to medium sized enterprises on the aims of the project and bilateral meetings have been used to raise awareness and to provide valuable insight on the needs of the business community. Information was also obtained in these meetings and has informed the refinement of the route options.

4.4.3 Preliminary enquiries have been made to utility companies about the locations of their assets to assist with understanding the impact of these assets on the proposed route options. Follow up discussions were held with the owners of assets potentially significantly impacted by the proposed routes to understand possible diversion costs and lead times.

5 Route Descriptions

5.1 Introduction

5.1.1 Following the shortlisting described in the *Technical Appraisal Report* and summarised in Section 3, the routes were further developed and refined. This development and refinement was a result of the receipt of further more detailed information, discussion with stakeholders (e.g. the statutory environmental bodies) and the provision of greater detail required for the detailed appraisals (e.g. land take boundaries).

5.1.2 The developments and refinements made are summarised in **Table 5.1** below and described in more detail in Sections 5.2, 5.3, 5.4 and 5.5. The routes as described in these sections were subject to the detailed engineering, safety, operation and maintenance, traffic, economic, social and environmental appraisals described in Volumes 4, 5 and 6 of this SAR.

TABLE 5.1 - CHANGES FROM TECHNICAL APPRAISAL REPORT TO SCHEME ASSESSMENT REPORT

Route	Location	Design Change Description
1	M25 Junction 2	Local widening of southbound off-slip
1	A282 Junction 1a	New overbridge to the south of the existing A206 overbridge over the A282. Existing overbridge to be demolished. New western and eastern realigned roundabout junctions provided at Junction 1a. New northbound on-slip from Junction 1a to the northbound A282. The existing southern loop onto the A282 northbound would be removed.
1	M25 Junction 30	New A282 northbound freeflow link to westbound A13. New northbound link parallel to the existing link from Junction 31 to Junction 30. The existing link would be removed. New one lane gain merge to A13 Stifford Clays Road/ A1012 Junction. The existing A13 eastbound carriageway would be widened to four lanes. A new southbound link from Junction 30 to Junction 31 replaces and runs parallel and to the east of the existing southbound link. One movement to provide the westbound off slip to Junction 30 and the other to provide a free-flow A13 west to A282 southbound movement.
2, 3, 4	River crossing	Design development to identify a suitable common crossing location for all options.
2, 3, 4	A226	Design development to include a junction on the A226 on the WSL and ESL. Junction layout with the A226 depends on the river crossing option. Junction included in response to stakeholder feedback (particularly from Kent CC) on the need for local connectivity across the River Thames.
2, 3	Approach to M25 Junction	Highway alignment combined to provide a common alignment to the north of South Ockendon approaching the proposed junction on the M25.
2	M25 Junction	Junction changed to be the same as the Route 3 junction.
3	A13 Junction	Junction with the A13 developed to provide a more suitable junction layout to accommodate predicted traffic flows.

Route	Location	Design Change Description
		Junction now proposed at the existing A13/ A1089 junction to the west of Orsett. Slip roads connecting to improved Brentwood Road with connection to Orsett Cock roundabout.
4	A127/ A128 Junction	Junction arrangement changed to maintain the A127 layout through the existing junction. The proposed Lower Thames Crossing (LTC) westbound now joins the A127 as a two lane gain through to M25 Junction 29. LTC eastbound is a two lane drop from the A127.
4	M25 Junction 29	Proposed off-slip from the M25 southbound to LTC southbound, moved further east to provide a higher speed link.

5.1.3 The routes as described in Sections 5.2, 5.3, 5.4 and 5.5 were the basis of the cost estimates and appraisal of risk discussed in Sections 6 and 7 of Volume 4.

5.1.4 The designs of the routes described in Sections 5.2, 5.3, 5.4 and 5.5 have been developed for the detailed appraisal of options as part of the study and may be subject to change in later stages of the scheme development.

5.1.5 Provision for non-motorised users (NMUs) at the crossing and along the new route will be considered further as part of the next stage of the scheme’s development.

5.1.6 Where existing NMU routes including footpaths, bridleways and cycleways would be affected or severed by the proposed routes the designs include alternative provision such as overbridges or underpasses or diversion of the affected routes. This is discussed in more detail as part of the engineering appraisal of the routes discussed in Volume 4 of this SAR.

5.1.7 All locations and features referred to in the descriptions in Sections 5.2, 5.3, 5.4 and 5.5 are shown in Appendix 2.2 to Volume 2.

5.2 Route 1

(Refer to **Appendix 3.1** for Plan and Profile drawings and **Appendix 3.2** for Typical Cross Section drawings)

5.2.1 The shortlist option at Location A, known as Route 1, is a route with either a bridge or a bored tunnel to the west of the existing crossing. This route is shown in **Figure 5.1**. Controlled motorway technology would be implemented between Junction 2 and Junction 30.

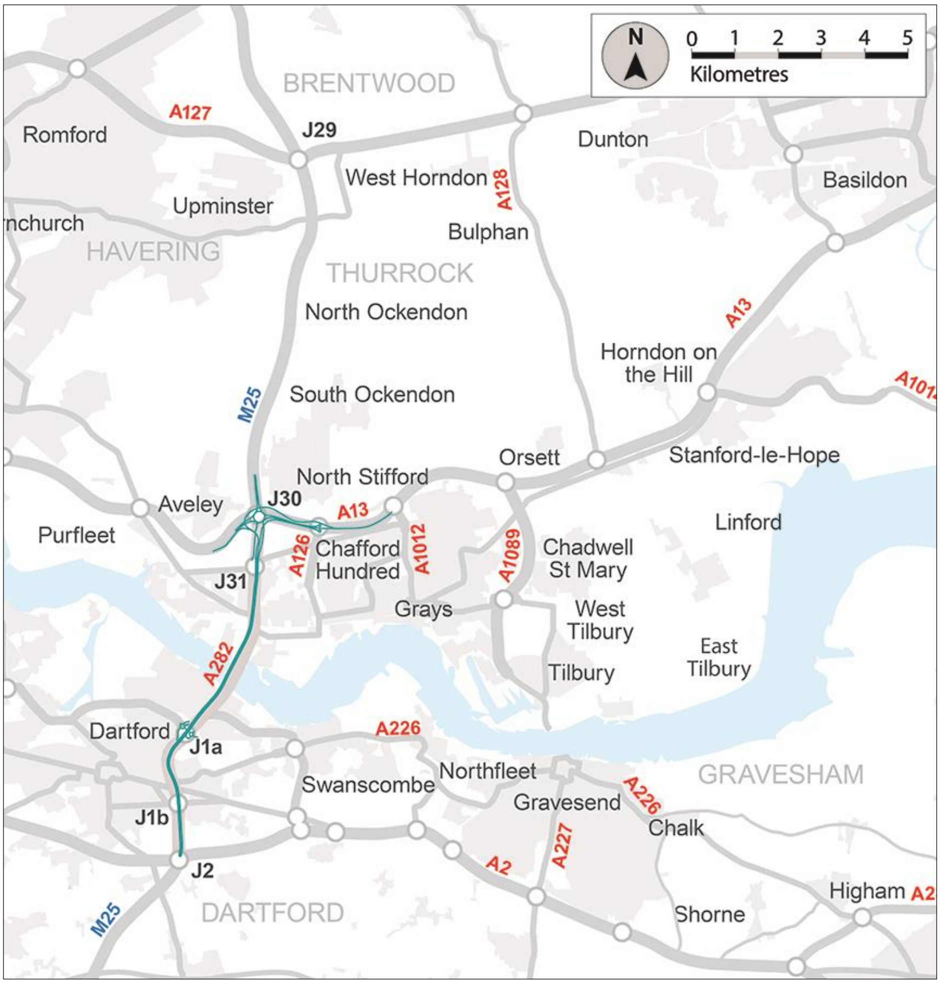

FIGURE 5.1 - ROUTE 1

5.2.2 Works would include the following:

- Local widening to Junction 2 southbound off-slip.
- Junction 2 - 1b no widening.
- Junction 1b -1a widening to dual five lanes by conversion of existing hard shoulder.
- Improvements to Junction 1a.
- Proposed bridge/ bored tunnels crossing the River Thames.
- Improvements to Junctions 31 and 30 and free-flow links to/ from the A13.

5.2.3 The comparison of number of existing lanes and those provided by Route 1 are shown in **Table 5.2** and illustrated in **Figure 5.2**.

TABLE 5.2 - COMPARISON OF NUMBER OF EXISTING LANES AND ROUTE 1

M25/A282 section	Without Scheme		Route 1		
	Northbound	Southbound	Northbound	Southbound	Comments
Junction 3 to 2	4	4	4	4	No additional widening
Junction 2 to 1b	3 (4 Lanes after A2 on-slip)	4 (3 Lanes after B260 overbridge)	3 (4 Lanes after A2 on-slip)	4 (4 Lanes after B260 overbridge)	Local widening at southbound off-slip to A2 (after B260 overbridge)
Junction 1b to 1a	4	4	5	5	1 additional lane in each direction
Junction 1a to 31	4	4	6	6	4 additional lanes provided at River Thames crossing
Junction 31 to 30	3	3	5	5	Northbound 3 Lanes after new A13 Link Southbound 3 Lanes before new A13 Link
Junction 30 to 29	4	4	4	4	No additional widening

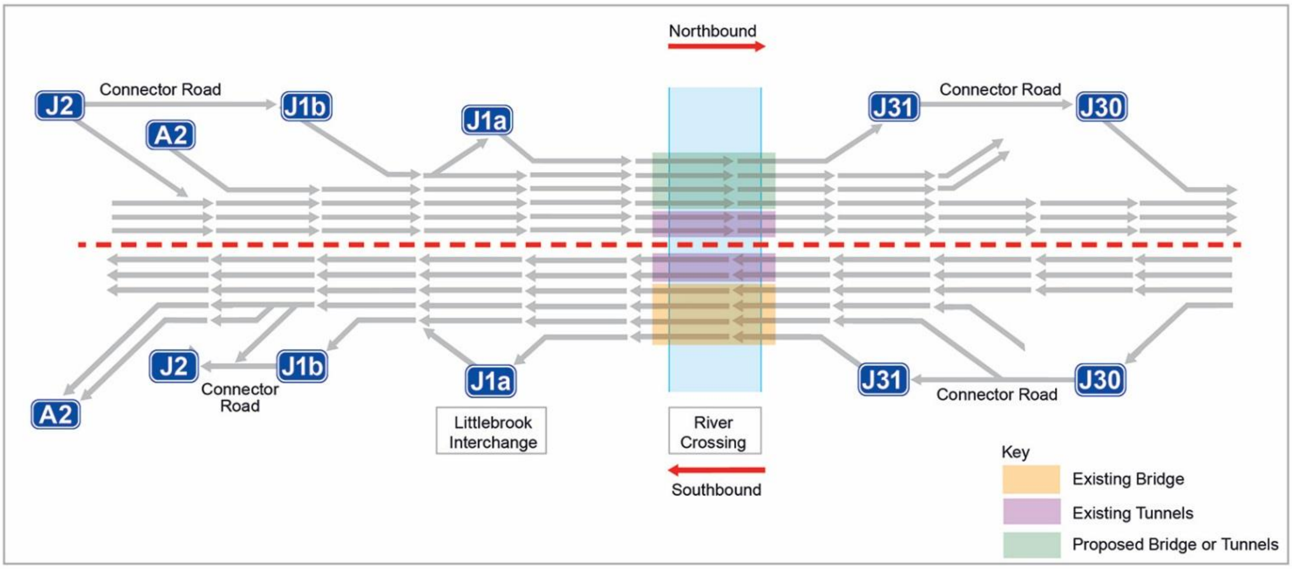

FIGURE 5.2 - ROUTE 1 SCHEMATIC LANE LAYOUT

Route Alignment (horizontal)

5.2.4 The horizontal route alignment has been designed in accordance with DMRB TD 9/93 and the junctions to TD 22/06, based on an Urban All Purpose road classification with a design speed of 85kph (50mph) (refer to paragraph 3.1.3).

Junction 2

5.2.5 Local widening of the southbound off-slip to accommodate traffic flows predicted by the traffic modelling.

Junction 1b

5.2.6 No works would be required at Junction 1b.

Junction 1b to 1a

5.2.7 Widening of existing carriageway from dual four-lane to dual five-lane by the conversion of the existing hard shoulder to a running lane except at the structures which would need to be widened.

Junction 1a

5.2.8 The existing A282 Junction 1a would require significant upgrading to accommodate traffic flows predicted by the traffic modelling and to provide a suitable connection with the new crossing. This would involve the following works:

- Replacement overbridge directly south of the existing A206 overbridge, which would be demolished.
- Alterations to the west roundabout to accommodate the relocation of the bridge.
- Removal of the existing northbound loop on-slip road to the A282.
- New two-lane northbound on-slip road from west roundabout to the new river crossings. The existing west tunnel would not be accessible from this slip road.

The roundabout to the east would be improved and all existing movements would be maintained. An additional lane would be provided on both main carriageways through this junction.

Route Alignment (horizontal – crossing)

5.2.9 There would be a total of 6 lanes northbound and southbound at the River Thames crossing. For both the tunnel and bridge options the existing west tunnel would take lanes 5 and 6 northbound and the flow in the existing east tunnel would be reversed to take lanes 5 and 6 southbound. To accommodate this new Traffic Management Cell arrangements would be required, including arrangements for restricting access by restricted vehicles to southbound lanes 5 and 6 in the existing east tunnel.

Route Alignment (horizontal – bridge)

5.2.10 The 5 northbound lanes from Junction 1a would separate immediately after passing under the A206 overbridge. The 2 eastern lanes would tie-in to the existing west tunnel, whilst 3 lanes would split and merge with a single lane from Junction 1a northbound on-slip with 4 lanes over the new bridge. The 2 southbound lanes from the east tunnel would continue through Junction 1a. The 4 southbound lanes from the bridge would have a lane drop with 3 lanes continuing through Junction 1a to merge with lanes from the east tunnel. At the lane drop there would be southbound off-slip road to the A206.

5.2.11 The mainline would pass above the existing Fastrack bus route and continue north where National Grid overhead cables would require diverting.

5.2.12 The route across the River Thames would take the alignment close to the existing ventilation building whilst providing sufficient clearance between the bridge foundations for the towers and piers and the existing west road tunnel and the Dartford Cable Tunnel.

5.2.13 The bridge would cross jetties north and south of the river which would affect their use during construction and potential future operation.

5.2.14 North of the River Thames the alignment would continue through the site of an aggregate and cement works to enable it to merge with the existing A282. The alignment has been designed to mitigate against the impact on this site by keeping as far east as feasibly possible.

5.2.15 North of this site lie two existing railways; HS1, and the London Tilbury Southend (LTS) line which are a key constraint in this location. The two railways are in close proximity with HS1 on a viaduct and the LTS line in a shallow cutting.

5.2.16 The bridge would tie-in to existing road levels south of Junction 31 and the road layout would provide an off-slip to Junction 31 before merging with the two lanes from the existing Dartford west tunnel. These lanes would not be able to access Junction 31. The off-slip would require additional land take and a retaining wall to limit the effect on adjacent property to allow for the existing highway to be widened.

5.2.17 The five lanes would continue northbound until a two lane drop is required for the link road to the A13 at Junction 30. Three lanes and a hard shoulder would continue north to tie-in to the existing highway layout prior to the Mardyke river bridge at Junction 30.

Route Alignment (vertical – bridge)

5.2.18 The new bridge would follow existing highway levels before connecting to the southern approach viaduct where the road rises at a gradient of 4%.

5.2.19 The gradient of the southern viaduct would continue for 1000m before connecting to the new bridge.

5.2.20 The vertical alignment of the approach viaduct would allow for sufficient clearance under the structure to enable the Traffic Management cell to operate as existing in the long-term. Control areas would be resited and accessed under the approach viaducts.

5.2.21 The vertical alignment would provide significant clearance of about 15m above the Fastrack bus route.

5.2.22 The new bridge is assumed to continue for a length of 810m spanning the River Thames. Navigational clearances are assumed to be the same as the existing bridge.

5.2.23 The northern viaduct would have a flatter gradient of 3.5% and descend for a length of about 1370m and tie-in to the existing ground levels. Where it passes over HS1 a vertical clearance of about 11m would be maintained whilst also providing 26m above the LTS railway line.

Route Alignment (horizontal – bored tunnel)

5.2.24 The horizontal alignment for the tunnel would be similar to that described above for the bridge leaving the existing alignment at the same location. However, the 6 northbound lanes would be provided by 2 new bored tunnels and the existing west tunnel.

5.2.25 Four lanes would run under the Fastrack bus route overbridge between the existing piers, where the four lanes would then divide to create two separate western and eastern approaches to the new tunnel for the river crossing.

5.2.26 The proposed eastern tunnel would maintain a clearance of about 15m from the existing ventilation building, and remain clear of the existing Dartford Cable Tunnel near the west tunnel approach.

5.2.27 The proposed eastern and western tunnel approaches would enter the southern portals about 170m north of the Fastrack overbridge. The alignment of the tunnel would maintain a parallel alignment nominally 50m offset from the existing Dartford west tunnel.

5.2.28 The tunnel would continue for a length of about 1760m between portals after which the two pairs of lanes would merge to form a single four-lane carriageway prior to approaching the HS1 crossing. The northern tunnel portal would impact on the site of an existing aggregate and cement works.

5.2.29 The alignment would continue from the portal onto a structure which would pass between existing piers of the HS1 Thurrock viaduct.

5.2.30 The alignment would merge with the existing highway prior to Junction 31 and would adopt the same lane arrangements, merges, diverges and horizontal alignment as for the bridge option as described in paragraphs 5.2.16 and 5.2.17.

Route Alignment (vertical – bored tunnel)

5.2.31 The bored tunnel approaches would follow existing ground levels and a vertical clearance of about 9m would be provided under the Fastrack bus route with a gradient of 4%.

5.2.32 The crown of the tunnel would intersect the ground level about 170m north of the Fastrack overbridge and this would be the location of the southern portal. A section of cut and cover structure would be required up to the point where the bored tunnel construction would commence.

5.2.33 The gradient of the tunnel rising towards the northern portal would be fixed at 4% to provide suitable ground cover over the structure beneath the river bed whilst achieving the necessary clearances at the existing HS1 and LTS railways. The northern portal would emerge in an existing aggregate and cement works site north of the river, impacting its operation.

5.2.34 The vertical alignment would maintain its gradient and would require a structure to thread between HS1 and LTS railways. The vertical clearance under HS1 would be 6.7m and the clearance above the LTS line would be 5.1m.

5.2.35 The alignment would then pass over the A1090 to tie-in to existing levels.

Highway Structures – Junction 2 to 1a

5.2.36 The opportunity to widen the A282 route between Junctions 2, 1b and 1a is largely constrained by the existing retaining walls. It is considered impracticable, in terms of cost, traffic disruption, and potential land take to provide new retaining walls outside the existing highway boundary. So the widening would be limited to north of the A226 London Road overbridge.

This would avoid the need to demolish and reconstruct the A226 and B2500 Watling Street overbridges.

5.2.37 The proposed additional lane southbound under the B260 overbridge would require construction of a new bridge and a realignment of the B260. Between Junctions 1b and 1a there would be a need to widen the carriageway which is constrained by the Bow Arrow rail underbridge. The existing northbound structure would be widened on the outside of the bend to allow for an additional lane and appropriate stopping sight envelope. This would also require a length of new retaining wall on the approach to the bridge. The existing southbound structure would be replaced by a wider structure which would provide the necessary headroom to the existing Dartford to Gravesend railway. The adjacent footbridges would also be replaced.

5.2.38 In summary the new and replacement structures between Junctions 2 and 1a would be:

- Replacement B260 overbridge.
- Widening of northbound Bow Arrow rail underbridge including new retaining wall on the southern approach.
- Replacement of southbound Bow Arrow rail underbridge.
- Replacement of footbridges adjacent to Bow Arrow rail underbridge.

Junctions 31 and 30

5.2.39 The modified Junction 30 would provide a free-flow link from the A282 north of Junction 31 to the A13 this would diverge and then split into two two-lane links, one for eastbound and one for westbound traffic.

5.2.40 The new northbound link from Junction 31 to Junction 30 would run parallel and to the west of the existing northbound link between Junction 31 and 30.

5.2.41 The new A13 eastbound free-flow link would pass beneath the new northbound link from Junction 31 to Junction 30 and underneath the westbound A13 main carriageway and Junction 30/ A13 westbound on-slip. The link would then continue east over the M25 mainline and M25/ A13 eastbound off-slip passing beneath the existing railway to tie-in to the existing A13 east of the A126 junction.

5.2.42 The new westbound 2 lane free-flow link would be provided and diverge from the new A13 eastbound free-flow link and tie in to the A13 after Ship Lane overbridge.

5.2.43 A new free-flow link from the A13 westbound to A282 southbound would replace the existing off slip to Junction 30 and diverge from the A13 to A282, between the A126 dumbbell and existing Junction 30. This free-flow link would have a two lane fork, one movement would provide the westbound off-slip to Junction 30 and the other would provide free-flow A13 west to A282 southbound movement. The link would merge with the southbound A282 as close as possible to Junction 30, with a lane gain merge.

5.2.44 A new southbound link from Junction 30 to Junction 31 would replace and run parallel and to the east of the existing southbound link. The new southbound link would split, one movement would provide access to

Thurrock services and the other would merge with the A282 south of Junction 31.

Highway Structures – Junction 1a

5.2.45 The existing A282 Junction 1a would be upgraded with a proposed replacement overbridge directly south of the existing A206 overbridge, which would be demolished. The construction of the new overbridge would be carried out off-line, to minimise traffic disruption.

Highway Structures – Junction 1a to 31 (Bridge Crossing)

5.2.46 North of the river, the new A282 alignment would require embankments/ retaining walls due to the limited width available at the merging location. The bridges for the M25 over Junction 31 would require widening, using the same form of construction as the existing bridges.

Highway Structures – Junction 1a to 31 (Bored Tunnel)

5.2.47 For the bored tunnel option the approach to the southern portal would require a length of retaining wall followed by a further length of retaining walls connected by a base slab beneath the road (trough structure), which would need to support the bridge foundations to the Fastrack bus route.

5.2.48 At the northern portal retaining walls would be provided to take the route on a similar vertical alignment as the existing tunnel approaches. A new viaduct would be required to take the route under HS1 and over the LTS railway and the A1090. Construction methods would dictate the form of bridge designs adopted in order to minimise disruption to these important networks.

5.2.49 Retaining walls would be required up to Junction 31 to tie-in to the existing A282 embankment and to reduce land-take. At Junction 31, the existing bridges would need to be widened over the junction using a similar form of construction to the existing bridges.

Highway Structures – Junction 30

5.2.50 Junction 30 would include 12 new structures on the new links and crossings of the Mardyke river, A13 and M25 as listed below:

- 6 viaducts
- 3 overbridges
- 2 underpasses (one under the A13 and west facing slip roads west of Junction 30 and one under the railway line east of the A126)
- 1 footbridge

5.2.51 For the locations of these structures refer to drawing Route 1 Junctions 30 and 31 General Plan Layout in **Appendix 3.1**.

River Crossing - Location

5.2.52 Two crossing options are considered at Location A for Route 1, a bridge and bored tunnel.

5.2.53 The height and span of the bridge crossing would be determined by the clearances required for river navigation. A clearance for shipping between the river water level and underside of the bridge (air-draft) of 57.5m has been adopted matching that of the existing bridge and as discussed with the PLA.

5.2.54 The length of the bored tunnel would be driven by the depth necessary to get under the river and provide suitable ground cover over the structure beneath the river bed.

5.2.55 Both options impact on the site of an aggregate and cement works on the north side of the river and avoiding this was not found to be possible.

5.2.56 On the south bank of the river, the route alignment passes through the area where the Dartford Control Centre, TM cell and other crossing operational facilities for the existing crossing are located. In order to accommodate the new route, it is proposed that these facilities would be demolished and replaced elsewhere in a phased manner. It is envisaged that both the existing and new crossings would be controlled from an integrated traffic control centre. This, along with other crossing operational facilities, would require land outside the existing highway.

River Crossing - Bridge

(Refer to **Appendix 3.3** for Bridge General Arrangement Drawing)

5.2.57 A 450m span cable-stayed bridge has been considered to match the existing QEII Bridge and to provide clear spans for navigation that would meet the PLA requirements for shipping at the existing bridge.

5.2.58 The total length of the bridge would be 3180m. The suspended spans would be 810m long with 1000m and 1370m long southern and northern approach viaducts respectively. The bridge configuration is shown in **Figure 5.3**:

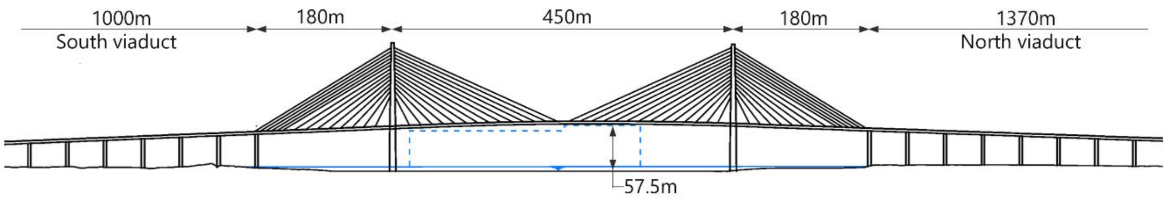

FIGURE 5.3 - BRIDGE CONFIGURATION AT LOCATION A

5.2.59 The new bridge is assumed to carry an all-purpose road with a design speed of 85kph (50mph) in accordance with TD 27/05 with four 3.65m lanes northbound, 1.0m hard strips (no allowance for hard shoulders) and 0.6m verges.

5.2.60 To reduce the risk of any damage to the existing west road tunnel during construction, a clear lateral distance not less than 50m between the new bridge and the west tunnel has been allowed, similar to the distance between the foundations of the existing bridge and the existing west tunnel.

5.2.61 Dartford Cable Tunnel is located upstream and parallel to the existing tunnel. The horizontal alignment of the new bridge would be as far east as possible to maximise clearance to the Dartford Cable Tunnel.

5.2.62 With a main span of 450m, a cable-stayed bridge with a steel-concrete composite deck is considered to be the most appropriate bridge form, matching the existing crossing. The bridge deck section is shown in **Figure**

5.4. Arch or suspension bridge solutions are dismissed as unlikely to be economic or reasonable solutions at this location. The span is too long for deep girders or other structural forms to be feasible.

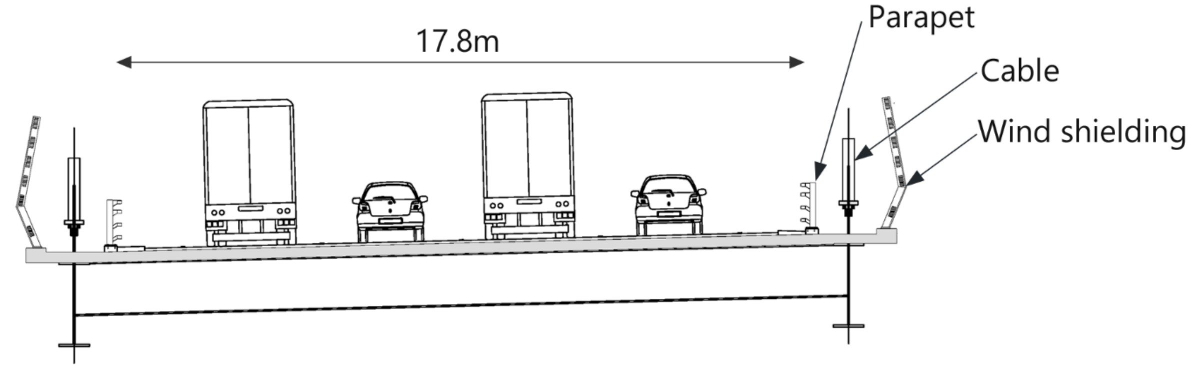

FIGURE 5.4 - BRIDGE CROSS SECTION AT LOCATION A

5.2.63 The concrete deck slab would allow standard thin surfacing to be applied over the suspended spans such as stone mastic asphalt. This has the benefit that it can be machine laid by readily available equipment.

5.2.64 The approach viaducts would comprise repetitive spans that are assumed to have spans in the range of 50-80m. It is likely that concrete or steel concrete composite decks would be supported on reinforced concrete piers which in turn would be supported by spread or piled foundations.

5.2.65 Design quality is an important consideration in the development of the options. Bridges are an important component of the built environment, they are highly visible forms that have a significant impact on their locality and on the people who live there. The sketch included as **Figure 5.5** shows the illustrative bridge option proposed at Location A.

FIGURE 5.5 - VISUALISATION OF BRIDGE AT LOCATION A

River Crossing - Bored Tunnel

(Refer to **Appendix 3.4** for Bored Tunnel General Arrangement Drawing)

5.2.66 The crossing would comprise twin-bored tunnels with cut and cover and ramp structures at each end carrying northbound traffic. Both bores of the tunnel would carry northbound traffic and each would contain an all-purpose road designed in accordance with TD 27/05. The assumed design speed of the new crossing is 85kph. The twin bored tunnels and the cut and cover tunnels would each contain a 7.3m wide two-lane carriageway and a 1m wide emergency walkway on each side of the carriageway. The assumed bored tunnel section is shown in **Figure 5.6**.

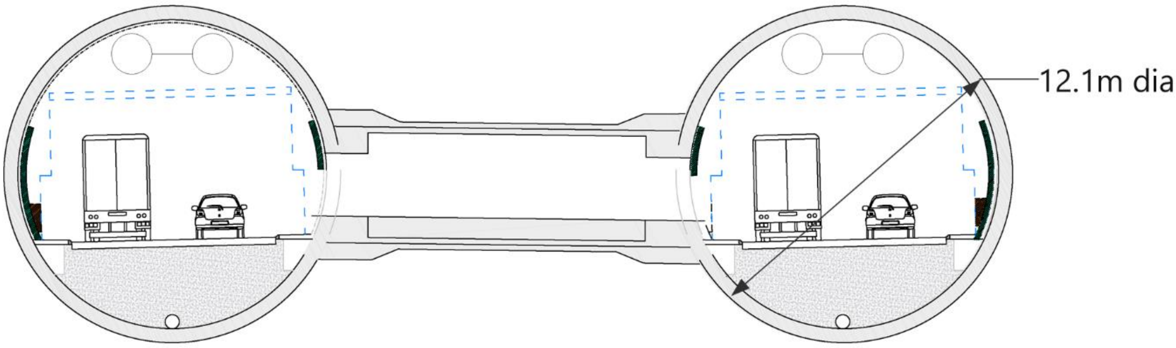

FIGURE 5.6 - BORED TUNNEL CROSS SECTION AT LOCATION A

5.2.67 The tunnels for Route 1 would be about 1760m long between portals. The bored part of the tunnels are based on solutions with a 12.1m external diameter and 11.1m internal diameter, and would be about 1225m long. Cut and cover structures and retained ramps at each end of the bored part of the tunnel would have an aggregate length of about 535m and 430m respectively. Cross passages between the tunnel bores at 100m intervals are assumed for use in the event of an incident in the tunnel to provide an access route for emergency services and an escape route for tunnel users to leave the incident.

5.2.68 The horizontal alignment of the crossing would lie to the west of the existing Dartford Crossing road tunnels and to the east of the existing Dartford Cable Tunnel. The clearance of the new tunnels to these existing structures has been chosen so that both existing and new tunnels would not be impacted adversely by the other. Throughout the route new construction would be in close proximity to the existing Dartford crossing and other infrastructure and the design and construction of the new route would be required to maintain these in operation at all times.

5.2.69 The vertical alignment of the road passing through the tunnel would drop from ground level on the river banks and would pass under the river bed before rising to ground level on the opposite bank. The maximum gradient on the inclined lengths of tunnel would be 4%. The vertical alignment has been designed to provide minimum cover over the crown of the tunnel and under the river bed of approximately one diameter such that flotation and structural stability criteria for the tunnel would be satisfactory.

5.2.70 The bored tunnels would be constructed by excavating the tunnel bore with a tunnel boring machine (TBM) and lined with reinforced concrete segmental linings fitted with gaskets to ensure water tightness.

5.2.71 The approaches to the tunnels on each bank of the river would be formed from reinforced concrete structures comprising retained ramps and cut and cover tunnels. To counter the high groundwater and high permeability of the ground, it is expected that extensive dewatering or treatment would be required in order to facilitate construction of these and other underground structures.

5.2.72 On completion of the heavy civil engineering works associated with tunnel and approach works construction, the tunnel would be fitted out with civil works such as road construction and mechanical and electrical installations, including longitudinal ventilation using jet fans, lighting, signing, signaling, monitoring.

5.3 Route 2

(Refer to **Appendix 3.5** for Plan and Profile drawings and **Appendix 3.6** for Typical Cross Section drawings)

5.3.1 This route would connect the A2 or M2 to the M25 between Junctions 29 and 30, near Ockendon Road. To the south of the River Thames there are two route alignment options. To the west there is the Western Southern Link (WSL) which connects into the A2 to the east of Gravesend and to the east there is the Eastern Southern Link (ESL) which connects into Junction 1 of the M2. This route is shown in **Figure 5.7**.

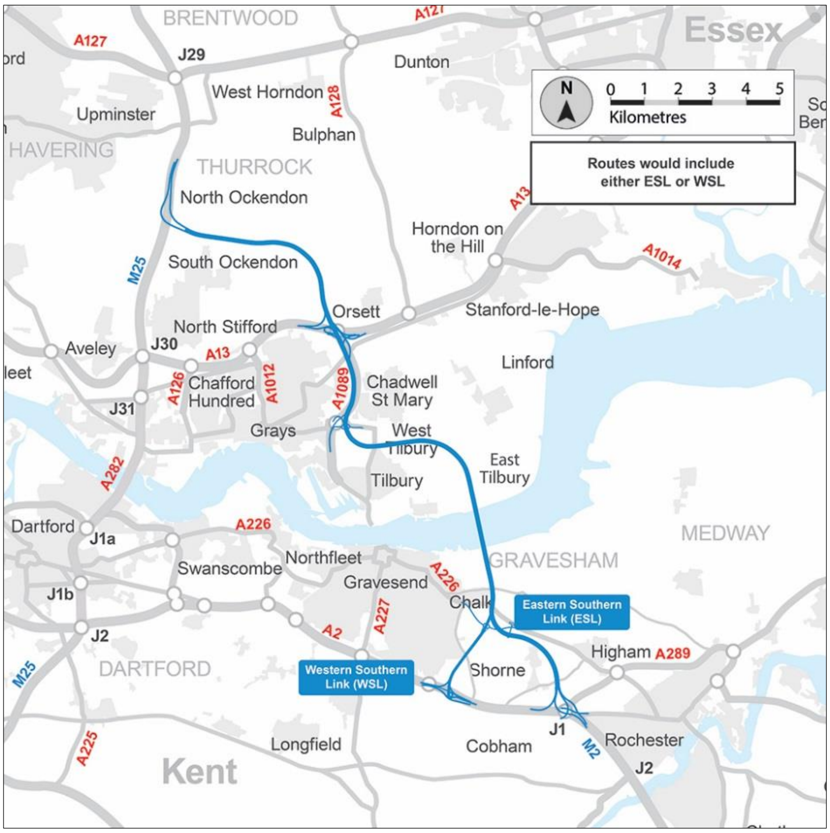

FIGURE 5.7 - ROUTE 2

5.3.2 Route 2 has three options for the main crossing, bridge, bored tunnel and immersed tunnel. The horizontal alignment of the crossing for all options is the same allowing the WSL and the ESL to connect into all three crossing types.

5.3.3 North of the river the route would go north between Tilbury and East Tilbury. The route would connect with the A13 at the existing A1089 and A13 junction and then the M25 near Ockendon Road.

Route 2 South of River Thames - WSL Alignment (horizontal)

(Refer to **Appendix 3.7** for Plan and Profile drawings)

5.3.4 The WSL would connect into the A2 to the east of Gravesend via a free flow junction in the area between Gravesend and Thong.

5.3.5 The main carriageway horizontal and vertical alignments have been designed to the DMRB TD 09/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

5.3.6 To the north of the A2 the route would pass across Thong Lane between Gravesend and Thong and would cross a golf course towards the A226. The route would cross the A226, the Thames Medway canal and the adjacent North Kent railway line before crossing the River Thames towards the east of Tilbury power station.

5.3.7 At the A226 to the east of Chalk there would be a proposed grade separated junction. This junction would provide for all movements from LTC and the A226. The location of the junction is dependent on the crossing type as the vertical alignment associated with the crossing option has a significant impact on where this junction could be located.

WSL Alignment (vertical) - Bridge

5.3.8 To the north of the proposed A2 junction the route would be on embankment before moving into cutting to the west of Thong, which requires the route to pass beneath Thong Lane. The route typically would remain in cutting with a gradient of -4% until it started to rise approximately 200m south of Gravesend Road (A226). To the north of Gravesend Road the route would continue to rise at 4% on the approach to the bridge and cross over the river providing the minimum required clearance over the river's navigation channel.

WSL Alignment (vertical) - Bored Tunnel

5.3.9 The vertical alignment for the bored tunnel option would connect to the A2 via the same junction arrangement as the bridge option and connect at the same level. The route would follow a similar vertical alignment to the bridge between the A2 and Thong Lane. To the north east of Thong Lane the bored tunnel vertical alignment would become significantly different to the bridge.

5.3.10 The route would enter a long section of deep cutting (up to 26m depth) which would continue down at -4% to the bored tunnel portal which would be located between the A226 and Lower Higham Road.

WSL Alignment (vertical) - Immersed Tunnel

5.3.11 The vertical alignment for the main alignment north of the A2 would be similar to the bored tunnel alignment. From north east of Thong Lane this route would differ from the bored tunnel alignment. The immersed tunnel alignment where it exits the southern boundary of the Ramsar site is shallower so the long section of cutting on the approach to the portal would not be as deep (up to 15m). The gradient through the cutting would continue down at -4% to the immersed tunnel portal which would be located between the A226 and Lower Higham Road.

WSL - A2 Junction

(Refer to **Appendix 3.8** for Junction drawing)

5.3.12 At the connection with the A2 an all-movement free-flow compact junction has been developed. To provide a junction in this location with sufficient spacing from the existing junctions to the east and west with the required weaving length it is proposed that the existing A2 would be re-aligned north over an approximate length of 2.5km. The re-alignment would also mitigate the impact of the proposed junction on the existing constraints within the vicinity of this junction, including the adjacent HS1. A new link road would be provided between Henhurst Road roundabout and Brewers Road roundabout on the south side of the A2. This would replace the eastbound merge to the A2 from Hever Court Road roundabout.

5.3.13 Design speeds of the slip roads and link roads are as follows:

- A2 eastbound to LTC northbound slip road - 85kph (50mph)
- A2 westbound to LTC northbound slip road - 50kph (30mph)
- LTC southbound to A2 westbound slip road - 50kph (30mph)
- LTC southbound to A2 eastbound slip road - 100kph (60mph)
- Link road between Henhurst Road roundabout and Brewers Road roundabout - 85kph (50mph)

5.3.14 The re-alignment of the A2 would have a design speed of 120kph (70mph).

5.3.15 The free-flow interchange would impact on the local roads and the connectivity with the A2. The proposal would remove the existing A2 eastbound merge from the roundabout with Hever Court Road and Valley Drive. The link road described above would provide access for vehicles onto the eastbound A2 from this location. Vehicles would then access the eastbound A2 via the junction near Shorne Woods Country Park off Brewers Road.

5.3.16 Vehicles on the westbound A2 who currently access the junction at Henhurst Road would not be able to do this as the proposed junction arrangement would remove the exit slip road. Vehicles would have to exit the A2 at the off-slip onto the roundabout with Brewers Road before using the proposed link road between Henhurst Road roundabout and Brewers Road roundabout.

WSL Route - A226 Junction

(Refer to **Appendix 3.9** for Junction drawings)

5.3.17 It is proposed that a connection would be provided between this route option and the A226. The proposal is for a grade-separated junction on the alignment of the A226 and LTC. Depending on the river crossing type, this determines the potential location and configuration of the junction with the A226. For a bridge crossing it would be possible to have the junction along the line of the existing A226.

5.3.18 The tunnel options would require the junction to be located further south from the A226, which would result in the existing A226 needing to be re-aligned to tie into the new junction. The location of the junction for the tunnel options is determined by the requirement to fit the slip roads in before the tunnel portals, in order to comply with the relevant design standards. As a consequence of the requirements the junction would be located approximately 1km from the proposed tunnel portal to the south of Lower Higham Road.

WSL - Highway Structures

5.3.19 The WSL route would require the construction of a number of highway structures crossing the A226 and minor roads and public rights of way. A single underbridge would also be required at the junction with the A2. The range of structures required is summarised in **Table 5.3**.

TABLE 5.3 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 2 WITH WESTERN SOUTHERN LINK

Structure Type	Mainline Structures			Junction Structures
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A2
New rail bridges	0	0	0	0
New road overbridges	3	3	1	0
New road underbridges (up to 4 spans)	1	1	2	1
New road viaducts (5 spans or more)	0	0	0	0
New footbridges	3	3	2	0
New underpasses	0	0	0	0
New main river bridges	0	0	0	0
Existing structures to be modified	0	0	0	0
Existing structures to be demolished	0	0	0	0
Total	**7**	**7**	**5**	**1**

Route 2 South of River Thames - ESL Alignment (horizontal)

(Refer to **Appendix 3.5** for Plan and Profile drawings)

5.3.20 This route would connect into Junction 1 of the M2 and would go to the west of Great Crabbles Wood and east of Shorne and then northwest towards Church Lane, Lower Higham Road and Chalk. This route option could connect into any of the proposed river crossing options; bridge, bored tunnel and immersed tunnel.

5.3.21 Horizontal and vertical alignments have been designed to the DMRB TD 9/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

ESL Alignment (vertical) – Bridge

5.3.22 To the north of the junction with the M2, the alignment would be elevated on a viaduct. It would then go into deep cutting beneath Peartree Lane and then embankment for approximately 800m. At Crown Lane the route would go into cutting for approximately 500m. To the north of this the alignment would typically be above existing ground level approaching the bridge at a gradient of 4%.

ESL Alignment (vertical) - Bored Tunnel

5.3.23 To the north of the junction with the M2, the alignment would be elevated on a viaduct. It would then go into deep cutting beneath Peartree Lane and then embankment for approximately 800m. At Crown Lane the route would go into cutting for approximately 500m before a short length of embankment at the proposed A226 junction. After the A226 junction the route would go into a cutting up to 16m deep (-4% gradient) which would continue to the tunnel portal to the south of Lower Higham Road.

ESL Alignment (vertical) - Immersed Tunnel

5.3.24 The alignment for the immersed tunnel would be very similar to the bored tunnel. The main difference would be the cutting from Crown Lane to the portal would not be as deep (approximately 4m shallower on average).

ESL - M2 Junction 1

(Refer to **Appendix 3.10** for Junction drawing)

5.3.25 This is a complex junction that would provide links to the M2 and A2 via a series of slip/ link roads at different levels on new structures. The proposed layout would require four levels with the lowest being the existing A289 connection to the A2/ M2 and the highest being the proposed LTC link roads.

5.3.26 Design speeds of the slip roads and link roads are as follows:

- A2 eastbound to LTC northbound slip road has a design speed of 120kph (70mph).
- M2 westbound to LTC northbound has a design speed of 100kph (60mph).
- LTC southbound to A2 westbound has a design speed of 85kph (50mph).
- LTC southbound to M2 eastbound has a design speed of 100kph (60mph).

5.3.27 This junction would require a number of major structures as it is located at the existing junction between the A2, M2 and A289. The complexity of the junction requires four levels of slip roads and the heights of the slip roads are further increased by the topographical dip located between the existing junction and the LTC mainline located on the Shorne to Higham ridge.

5.3.28 A series of five viaducts would therefore be required with lengths varying from 300m to 1000m with pier heights up to 23m.

5.3.29 The main change from the *Technical Appraisal Report* layout is the removal of the connections with the A289 as the proposed junction with the A226 would now provide this movement.

ESL - A226 Junction

(Refer to **Appendix 3.11** for Junction drawings)

5.3.30 The proposed junction with the A226 would have the same horizontal layout for the three river crossing options, but would change vertically depending on if a bridge or tunnel option is considered.

5.3.31 The proposal would have a new roundabout on the existing A226 and would have a bridge under the new route, which would connect into another roundabout, forming an elongated dumbbell arrangement.

ESL - Highway Structures

5.3.32 The route would require the construction of a number of highway structures including crossings of A226 and a number of unclassified roads and public rights of way. There would also be a number of significant structures required at the junction with the A2/ M2. The structures required are summarised in **Table 5.4** below.

5.3.33 All the structure details given in this section are indicative of potential solutions and are subject to change as the routes are developed and appraised further.

TABLE 5.4 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 2 WITH EASTERN SOUTHERN LINK

Structure Type	Mainline Structures			Junction Structures
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A2 / M2/ A289
New rail bridges	0	0	0	0
New road overbridges	3	3	3	3
New road underbridges (up to 4 spans)	2	2	2	0
New road viaducts (5 spans or more)	0	0	0	4
Jacked box highway underbridges	0	0	0	0

Structure Type	Mainline Structures			Junction Structures
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A2 / M2/ A289
Cut and cover tunnel	0	0	0	0
New footbridges	2	2	2	0
New underpasses	1	1	1	1
New main river bridges	0	0	0	0
Existing structures to be modified	0	0	0	0
Existing structures to be demolished	0	0	0	0
Total	**8**	**8**	**8**	**8**

River Crossings - Location

5.3.34 Three crossing options are considered at Location C for Route 2, a bridge, bored tunnel and immersed tunnel. As explained in the following paragraphs the crossing location has been fixed to be common to all three shortlist routes at Location C.

5.3.35 The key constraints taken into account in determining a crossing at Location C include:

- The Ramsar site, the SPA, functionally linked land and a SSSI.
- The village of Chalk.
- Listed buildings including the Grade II* listed Church of St Mary.
- Impact on the river hydrodynamics (current, water level and sediment dispersion).
- Impacts on river navigation and PLA considerations.
- The Metropolitan Police facilities.
- Physical constraints including existing major services beneath river (HV cable tunnel, gas main), overhead power cables, clearances under/over the North Kent Railway and Thames and Medway Canal.

5.3.36 **Figure 5.8** below demonstrates how moving further west, in the case of a bridge or an immersed tunnel, would increase impact on the village of Chalk, potentially requiring substantial demolition. This would also lead to greater noise levels, air quality effects and visual intrusion. Depending on the alignment, it could also require demolition of the Metropolitan Police training centre.

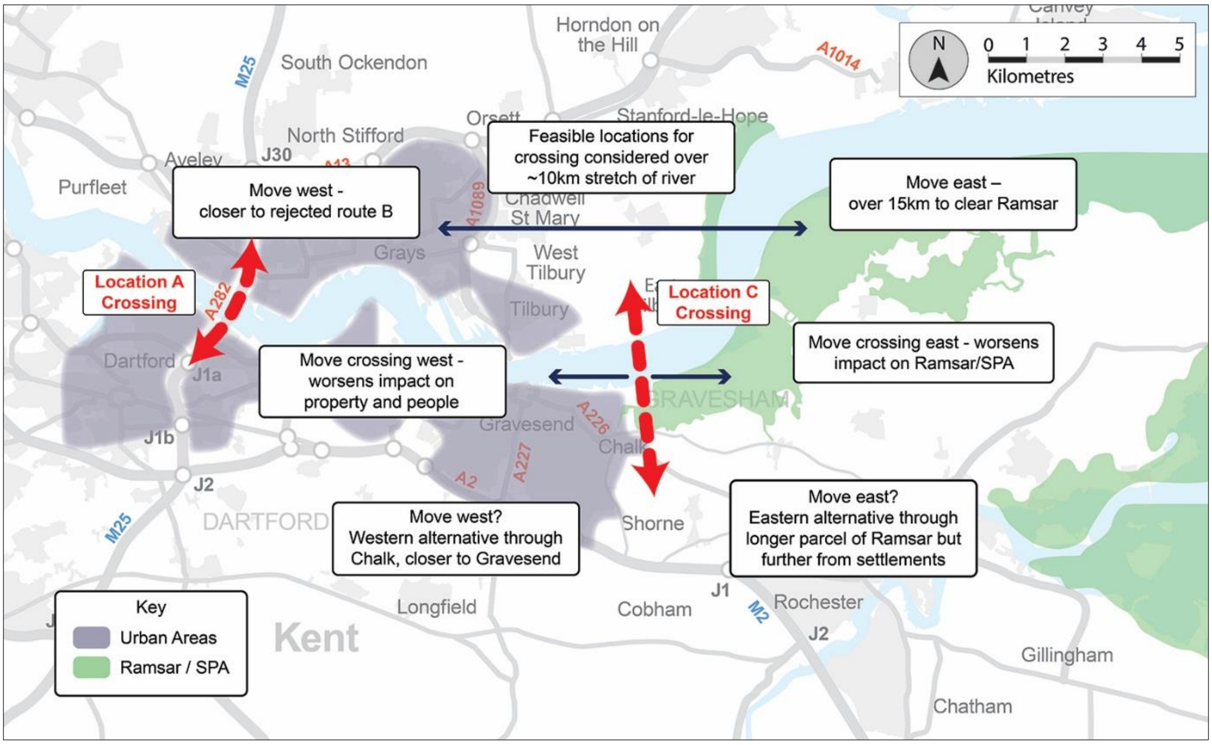

FIGURE 5.8 - DETERMINATION OF CROSSING POSITION AT LOCATION C

5.3.37 A bridge located further to the west that just avoided physical construction within the Ramsar site was judged to require demolition of a significant number of additional properties. There would also be significant worsening of noise and air quality impacts on many more properties, including a school. An immersed tube tunnel concept at this location was judged to be no better than a bridge and was not examined further.

5.3.38 Moving further east would intrude further into the Ramsar site and SSSI and physically affect the SPA. It may also directly affect listed buildings and would be less favoured by the PLA as it would be closer to the bend in the river.

5.3.39 The selected alignment, approximately 200m from the village of Chalk, balances air quality, noise and visual effects, avoiding listed buildings, reducing intrusion into the Ramsar, avoiding the SPA and limiting impact on the Metropolitan Police training facilities to the area of land used as a firing range. The location chosen is at the western extent of the Ramsar site and just west of the western extent of the SPA. The same alignment has been adopted for the three crossing types of bridge, immersed tunnel and bored tunnel. The crossing would be perpendicular to the River Thames to minimise length and cost.

5.3.40 The bridge concept height and length is determined by navigation clearances for river traffic. This directly impacts the extent of the structure, affecting visual impact, shading and scale of the barrier introduced. The number of bridge supports within the Ramsar site would be minimised by locating the alignment within the most westerly part of the Ramsar site, where it narrows.

5.3.41 The bored tunnel concept would avoid physical construction within the Ramsar site. Assumptions on length and depth of bore and location of the tunnel portals have been made in order to achieve this.

5.3.42 The immersed tunnel concept includes a substantial length of cut and cover structure at the southern end to locate the tunnel portal outside the Ramsar site boundary. Construction of the cut and cover structure would involve physical disturbance within the Ramsar site. After construction the ground above would be reinstated, but there would be challenges in doing this, for example the effect on the hydrological regime. The alternative of omitting the cut and cover structure and building the road at grade through the Ramsar site, saving on construction cost, was judged less likely to be acceptable. There are engineering advantages as well as noise and air quality benefits in moving the structure east, but the physical intrusion in the Ramsar site would be greater.

5.3.43 To the north of the river, in order to limit the structure lengths, and thereby costs, all concepts assume construction and siting of permanent structure within the functionally linked land (refer to Section 4.6 in Volume 2).

River Crossing - Bridge

(Refer to **Appendix 3.12** for Bridge General Arrangement Drawing)

5.3.44 At Route 2, the navigation channel is as indicated on drawings received from the PLA and generally the same width as at Route 1 (approximately 305m). For appraisal purposes an 800m span cable-stayed bridge has been assumed. The main pylon foundations would be located in shallower water depths where they would be less vulnerable to ship collision from the largest container vessels.

5.3.45 With the bridge concept assumed the total length of the bridge would be 4000m. The suspended spans would be 1440m long with 1260m and 1300m long southern and northern approach viaducts respectively. The bridge configuration is shown in **Figure 5.9**:

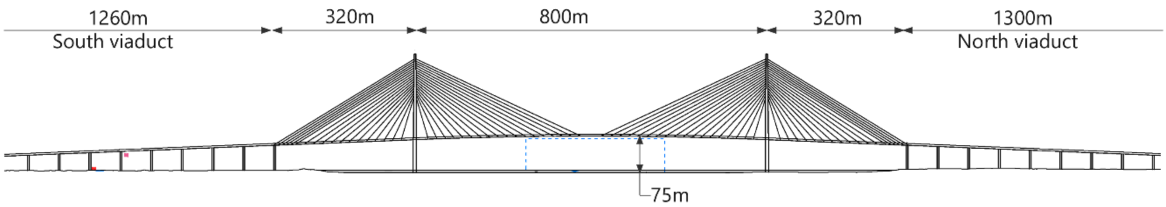

FIGURE 5.9 - BRIDGE CONFIGURATION AT LOCATION C

5.3.46 The new bridge is assumed to carry a dual two-lane all-purpose road in accordance with TD 27/05 with two 3.65m lanes northbound and southbound, 1.0m hard strips, a 2.5m central reserve and 0.6m verges.

5.3.47 Navigation clearance requirements have been based on initial information provided by PLA and discussed at meetings with them as part of the stakeholder engagement process. A minimum air draft of 75.19m AOD at this location has been adopted based on a preliminary marine traffic assessment. The final air draft to be approved by PLA, would be based on more detailed analysis, including qualitative risk analysis, should a bridge option be selected.

5.3.48 With a main span of 800m, a cable-stayed bridge is considered to be the most appropriate bridge form, and whilst a relatively long span, it remains some 300m shorter than the current longest cable-stayed bridge span in the world. A suspension bridge at this location is technically unsuitable due to the site conditions and height of the bridge.

5.3.49 The cable-stayed deck would most likely be a steel box girder as it would be aerodynamically stable which is an important consideration with a span length of 800m. Steel orthotropic box girders comprise complex welded stiffeners that, whilst they can be relatively expensive to fabricate, provide a lightweight, stiff deck that, with a closed form, provide a durable solution. The bridge deck section is shown in **Figure 5.10**:

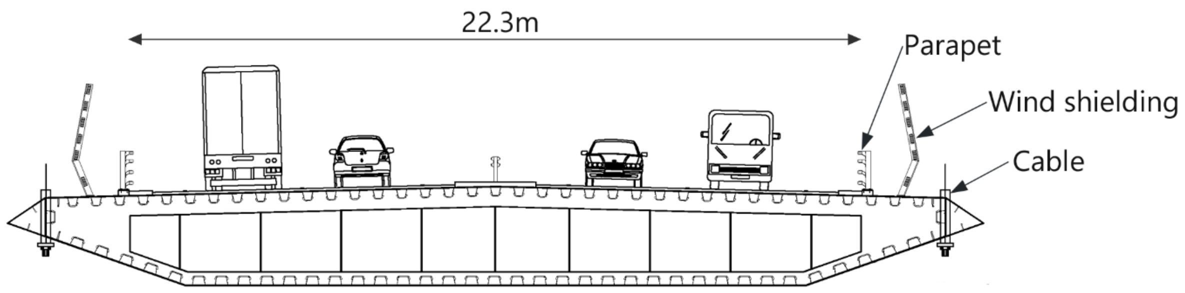

FIGURE 5.10 - BRIDGE CROSS SECTION AT LOCATION C

5.3.50 If an orthotropic steel deck plate was used, then it is most likely that the surfacing would be either mastic or epoxy asphalt or a polyurethane system.

5.3.51 The approach viaducts would comprise repetitive spans that would most likely have spans in the range of 60-100m. It is likely that concrete or steel concrete composite decks would be supported on reinforced concrete piers which in turn would be supported by spread or piled foundations.

5.3.52 Design quality is an important consideration in the development of the options. Bridges are an important component of the built environment, they are highly visible forms that have a significant impact on their locality and on the people who live there. The sketch included as **Figure 5.11** shows the illustrative bridge option proposed at Location C.

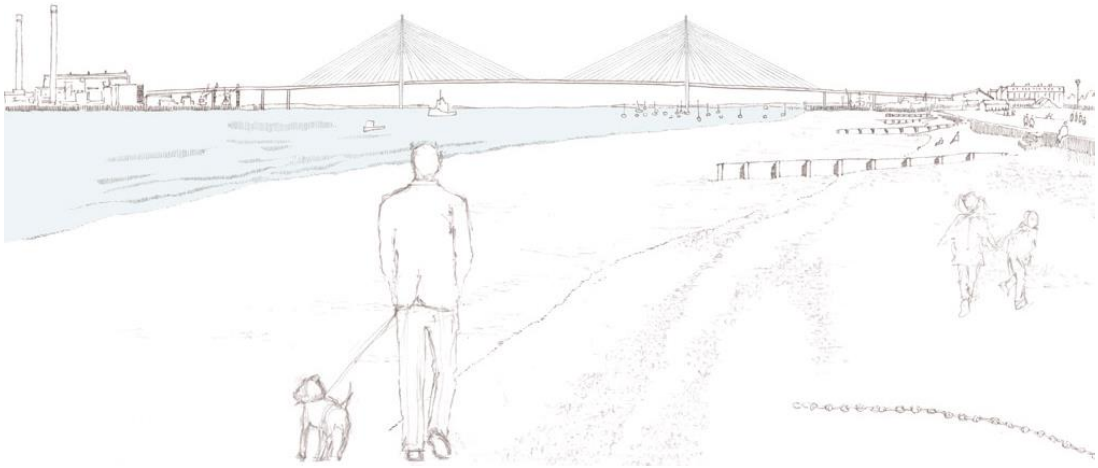

FIGURE 5.11 - VISUALISATION OF BRIDGE AT LOCATION C

River Crossing - Bored Tunnel

(Refer to **Appendix 3.13** for Bored Tunnel General Arrangement Drawing)

5.3.53 The crossing would comprise a twin-bored tunnel and a section of cut and cover tunnel at the north approach with one bore carrying northbound traffic and the other southbound traffic. Each bore of the tunnel would contain an all-purpose road designed in accordance with TD 27/05. The design speed of the crossing is 120kph. The twin bored tunnels would each contain a 7.3m wide two lane carriageway and a 1m wide emergency walkway on each side of the carriageway. The assumed bored tunnel section is shown in **Figure 5.12**:

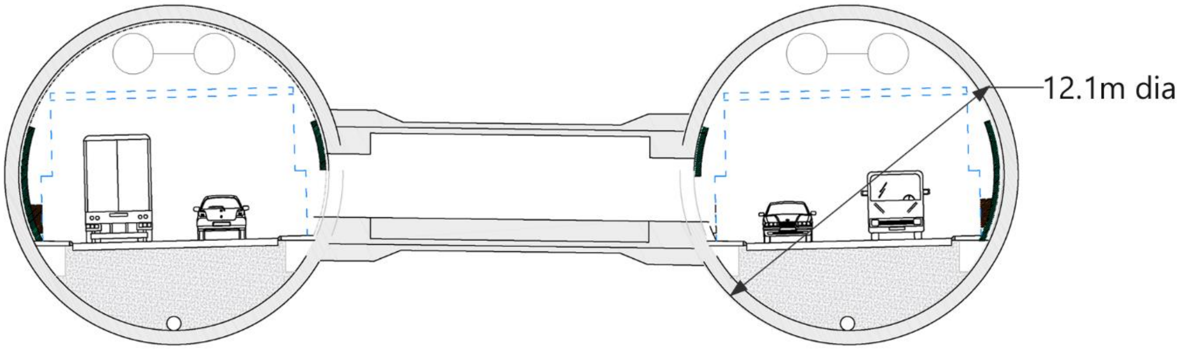

FIGURE 5.12 - BORED TUNNEL CROSS SECTION AT LOCATION C

5.3.54 The total length of the tunnels between portals would be about 3210m. The bored part of the tunnels assume a 12.1m external diameter and 11.1m internal diameter, and would be about 3040m long. Cut and cover tunnels and retained ramps would be required at the north end of the bored tunnel only with assumed lengths of about 170m and 190m respectively. Cross passages would connect both bored tunnels and cut and cover tunnels typically at 100m intervals for use in the event of an incident in the tunnel to provide an access route for emergency services interception and an escape route for tunnel users to leave the incident.

5.3.55 On the south bank of the river, the approach to the tunnel would be in deep chalk cutting. The high groundwater and permeability of the ground would likely require extensive dewatering and treatment to construct the portal and approach structures. From the portal, heading northwards, the tunnels would pass under Lower Higham Road before passing under the Ramsar site, under the North Kent railway line, under the disused canal (which is proposed to be brought back into recreational use) and under the Metropolitan Police Firing Range. The tunnels would then pass under the river bed with sufficient cover above the tunnel to counter the potential for flotation and provide structural stability.

5.3.56 On the north bank of the river, the route would pass under and through an area of current and historic landfill before emerging at the north portal. Some of the landfill is assumed to be contaminated.

5.3.57 The bored tunnels would be constructed using a continual process by first excavating with a tunnel boring machine (TBM) and lined with reinforced concrete segmental linings fitted with gaskets to ensure water tightness.

5.3.58 The approaches to the tunnels on the north bank of the river would be formed from reinforced concrete structures comprising retained ramps and cut and cover tunnels. In view of the high groundwater and permeability of the ground, extensive dewatering or treatment is expected to be required in order to facilitate construction of these and other underground structures.

5.3.59 On completion of the heavy civil engineering works associated with tunnel and approach works construction, the tunnel would be fitted out with civil works such as road construction and mechanical and electrical installations, including longitudinal ventilation using jet fans, lighting, signing, signaling, monitoring.

5.3.60 The new tunnel for Route 2 could be operated from either a local control room or a remote location.

River Crossing - Immersed Tunnel

(Refer to **Appendix 3.14** for Immersed Tunnel General Arrangement Drawing)

5.3.61 Normally immersed tunnels are relatively short in length because they can be built at shallow depths across the river and the portals can be located close to the river banks on either side. In this instance however the length of the tunnel would be extended considerably on the south side by the need to pass under the Ramsar site, the SSSI and the firing range used by the Metropolitan Police. The cut and cover method of construction proposed through these areas would allow them to be re-instated to their original level and as far as possible to their original condition on completion of the scheme. The south portal would be located on the south side of Lower Higham Road.

5.3.62 Across the river the tunnel would be constructed in separate immersed tunnel sections known as "elements." In this case ten elements (10 x 127m) are envisaged although the final number and length would be left to the contractor to determine. Each element would be constructed from separate "segments" which are temporarily stressed together to allow them to be placed.

5.3.63 The elements may be constructed in a temporary casting basin which could be located on the northern river bank. The casting basin would be a deep de-watered excavation sufficiently large to allow all ten elements to be built at the same time. Once it was flooded, each element would be towed out in turn and lowered into a trench dredged in the river bed. They would then be progressively joined together and backfilled. Over the top of the tunnel a layer of rock armour would be placed to protect the tunnel from such undesirable incidents as a dragging or a falling anchor from a passing ship. It is envisaged that the casting basin would be backfilled on completion of the scheme and the ground re-instated to its original level.

5.3.64 An alternative would be to identify an existing casting basin or dry-dock facility remote from the site. There are no suitable existing facilities in the Thames estuary. In these circumstances the elements would have to be towed for long distances in open sea conditions.

5.3.65 The level of the top of the rock layer has to be below the level established for any dredging of the river bed that PLA may need to carry out to maintain the depth for passing ships. It also has to be below the level established for any future lowering of the bed to increase the draught for shipping. For the purposes of the options appraisal a level of 12m below Chart Datum has been assumed which is approximately 2 metres below the level of the existing channel.

5.3.66 The immersed tunnel and the cut and cover tunnel elements would comprise rectangular reinforced concrete box structures which would have three separate internal ducts (or tubes). The outer ducts would accommodate the northbound and southbound carriageways and there would be a central (2m wide) dividing duct which would be split vertically by an intermediate floor. The lower part would act as an emergency escape corridor and the upper part would be used to accommodate tunnel services.

5.3.67 The outer traffic ducts would each accommodate an all-purpose road designed in accordance with TD 27/05 with two 3.65m wide traffic lanes. However, as the immersed tunnel has a rectangular cross section it would be easier to provide more space at carriageway level. For this reason the roadway would have 0.6m wide hard strips on either side of the carriageways and the respective verge widths would be 1.3m (nearside) and 0.5m (offside). The immersed tunnel section is shown in **Figure 5.13**:

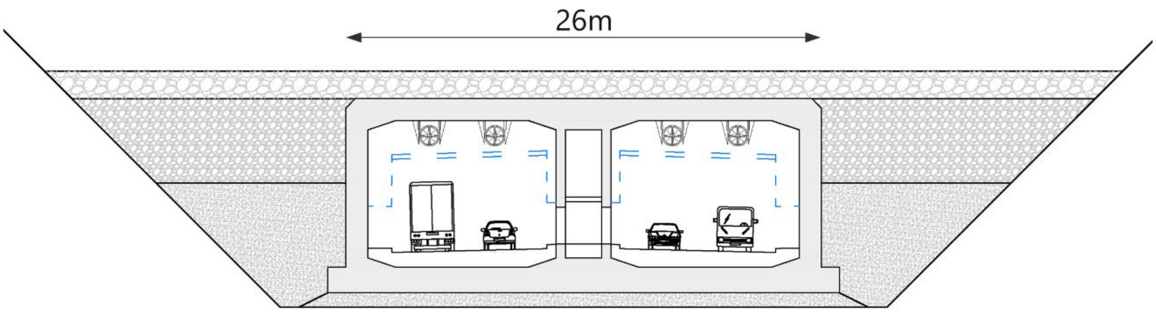

FIGURE 5.13 - IMMERSED TUNNEL CROSS SECTION AT LOCATION C

Route 2 North of River Thames - (horizontal)

5.3.68 On the north side of the river the route would go to the east of Tilbury and then turn west to go between the north of Tilbury and the south of Chadwell St Mary. The proposed route through this area has been developed to use a section of the A1089 corridor between the Chadwell bypass (B149) and the existing interchange between the A13 and the A1089.

5.3.69 This section of the A1089 is a dual carriageway and would require upgrading with the provision of two additional lanes in each direction. Where the proposed route joins the A1089 there is an existing junction which connects the A1089 and the A126. This junction would need to be modified as the new route would be the main route and the A1089 and the A126 would need to connect into the new road.

5.3.70 North of this junction the proposed route would follow the A1089 to the interchange with the A13, where a new free-flow grade-separated junction is proposed which would provide connections for all movements. To the north of the A13 the route would pass to the west of Orsett and then turn to the west and would be north of South Ockendon before connecting with the M25 between Junctions 29 and 30 via a one-way free-flow junction with north facing slip roads.

Route 2 North of River Thames – vertical alignment, bridge

5.3.71 To the north of the river the route would remain elevated across West Tilbury Marshes. To the north of Tilbury the route would be at approximate ground level before connecting into the existing A1089 to the east of Grays where the A1089 intersects with the A126. The vertical alignment would then follow the existing A1089, further assessment of the A1089 would be required to determine if this section of carriageway needs modifications, if so this could require changes to the vertical alignment.

5.3.72 The route would intersect the A13 to the south west of Orsett and there would be a junction at this location. The route would pass beneath the A13 and to the west of Orsett and would then mainly be on embankment with short sections of cutting to the east and north of South Ockendon before rising to connect with the proposed free-flow junction at the M25.

Route 2 North of River Thames – vertical alignment, bored tunnel

5.3.73 The tunnel would go beneath the railway and canal south of the river with a gradient of 1.3% and then beneath the river before rising with a gradient of 3.5% to reach ground level to the south of the LTS railway before rising on an embankment and bridge to cross the railway and pass near Coopers Shaw Road to the north east of Tilbury. The alignment would be the same from Coopers Shaw Road to the north east of Tilbury as described for the bridge option.

Route 2 North of River Thames – vertical alignment, immersed tunnel

5.3.74 North of the river the alignment would rise to existing ground level closer to the river than the bored tunnel and would then follow the same vertical alignment as the bridge and bored tunnel options.

Route 2 North of River Thames - A1089 Junction

(Refer to **Appendix 3.15** for junction drawing)

5.3.75 In order to provide a connection with the A1089 a new junction would be required which would enable the new route to be the main north/ south route and would provide a grade separated roundabout which would connect with the A1089 and the A126.

5.3.76 The proposed road alignment and junction location in this area would need to be reviewed following further discussions with Tilbury Port about the impact on London Distribution Park. Sections of the London Distribution Park are currently under construction and there could be plans for future expansion. Any future plans would need to be assessed in detail as there could be an impact from the proposed junction.

Route 2 North of River Thames - A13 Junction

(Refer to **Appendix 3.16** for junction drawing)

5.3.77 The junction with the A13, at the site of the existing junction between the A13 and A1089, is proposed to be a free-flow junction which would require a complex layout of slip roads, structures and loops in order to maintain existing and provide new traffic movements.

5.3.78 Within the proposed junction layout there would be two long link roads on embankment and viaduct. One would take the A13 eastbound traffic south onto the A1089 and the other would take traffic from the westbound A13 onto LTC northbound. The existing bridge which carries the A13 over the A1089 would be used. Both of the LTC carriageways would be fitted through this structure. In order to accommodate the new link road from the eastbound A13 to the southbound A1089 it would be necessary to re-align the existing A1013 Stanford Road. This road would be re-aligned to the south of the existing alignment with a new overbridge provided over the A1089.

5.3.79 The location of the junction would have an impact on the local road, Baker Street (B188), and properties along this road near the A13. In addition the existing junction is located within a scheduled monument.

Route 2 North of River Thames - M25

(Refer **Appendix 3.17** for junction drawing)

5.3.80 At the M25 a free-flow junction is proposed (as it is not considered that a grade separated junction is practicable and would not meet the scheme objectives). It is proposed that only north facing slip roads would be provided giving access for northbound LTC vehicles onto the northbound M25 and M25 southbound vehicles onto LTC southbound. This is because the traffic modelling indicated that there would be very little demand for the other two movements.

Route 2 North of River Thames – Highway Structures

5.3.81 The route would require the construction of a range of highway structures including crossings of the Tilbury Loop rail line, the Upminster and Grays Branch line, A126, B149, A1013, A13 and B186 and B1421. Further structures would be required at the junctions with the A1089, A13 and M25. Finally the route would require the widening of the existing A1089 along a length of approximately 2.3km to accommodate the proposed dual four-lane carriageway. All existing highway structures on this section of the A1089 would require either significant modification or demolition and replacement. The structures are summarised in **Table 5.5** below.

5.3.82 All the structure details given in this section are indicative of potential solutions and would be subject to change as the routes are developed and appraised further.

TABLE 5.5 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 2 NORTH OF RIVER THAMES

Structure Type	Mainline Structures			Junction Structures		
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A1089	A13	M25
New rail bridges	1	1	1	0	0	1
New road overbridges	2	2	2	0	0	0
New road underbridges (up to 4 spans)	6	6	6	2	5	2
New road viaducts (5 spans or more)	0	0	0	0	1	1
New footbridges	1	1	1	0	0	0
New underpasses	2	2	2	0	0	1
New main river bridges	5	5	4	2	0	0
Existing structures to be modified	2	2	2	0	0	0
Existing structures to be demolished	3	3	3	0	0	0
Total	**22**	**22**	**21**	**4**	**6**	**5**

5.3.83 The following existing structures would be affected by the route:

- B149 Wood View overbridge - a four-span reinforced concrete overbridge, which is assumed to be demolished and reconstructed.
- Terrells Heath Bridleway overbridge - a three-span prestressed box beam bridge carrying bridleway BR 112, which is assumed to be demolished and reconstructed.
- Terrells School Subway - a box underpass conveying footpath FP 108 beneath the A1089, which is assumed to require extending to the east.
- A1013 Stanford Road overbridge - a four-span reinforced concrete overbridge, which is assumed to be demolished and reconstructed.
- A13 overbridge - a four-span reinforced concrete bridge carrying the A13 over the A1089. The A1089 currently passes below the two central spans of this bridge and it is anticipated that ground retaining

or stabilisation works would be required either behind or in front of the west abutment to allow an LTC slip road to pass through the western end span.

5.3.84 The most complex structures required for this route would be those associated with the free-flow junction with the A13. In addition to the existing slip roads associated with the A1089 and A13 junction, the proposed slip roads must also cross Baker Street, Stifford Clays Road at two locations and the A1013 Stanford Road, requiring a total of five highway underbridges and one viaduct structure. It has been assumed that the viaduct would be a seven-span structure carrying two slip roads over Baker Street, the A13 main carriageway and a southbound on-slip to the A1089, with typical spans of about 55m.

5.3.85 The most significant single structure associated with this route would be the viaduct carrying the LTC westbound to M25 northbound slip road over the M25 and the Upminster and Grays Branch rail line. The length of the viaduct structure would be determined by the extent of slip road located above the height at which embankment construction is deemed economic. At this location the M25 is located on an 8m high embankment and thus the proposed slip road would be up to 17m above existing ground level, which leads to an assumed viaduct length of 810m.

5.4 Route 3

(Refer to **Appendix 3.18** for Plan and Profile drawings and **Appendix 3.6** for Typical Cross Section drawings)

5.4.1 This route would connect the A2 or M2 to the M25 between Junctions 29 and 30, near Ockendon Road. To the south of the River Thames the route has the same two alignment options as Route 2, WSL and ESL. The proposed junctions at the A2, M2 and A226 would be the same as those described for Route 2 in Section 5.3. The route is shown in **Figure 5.14**.

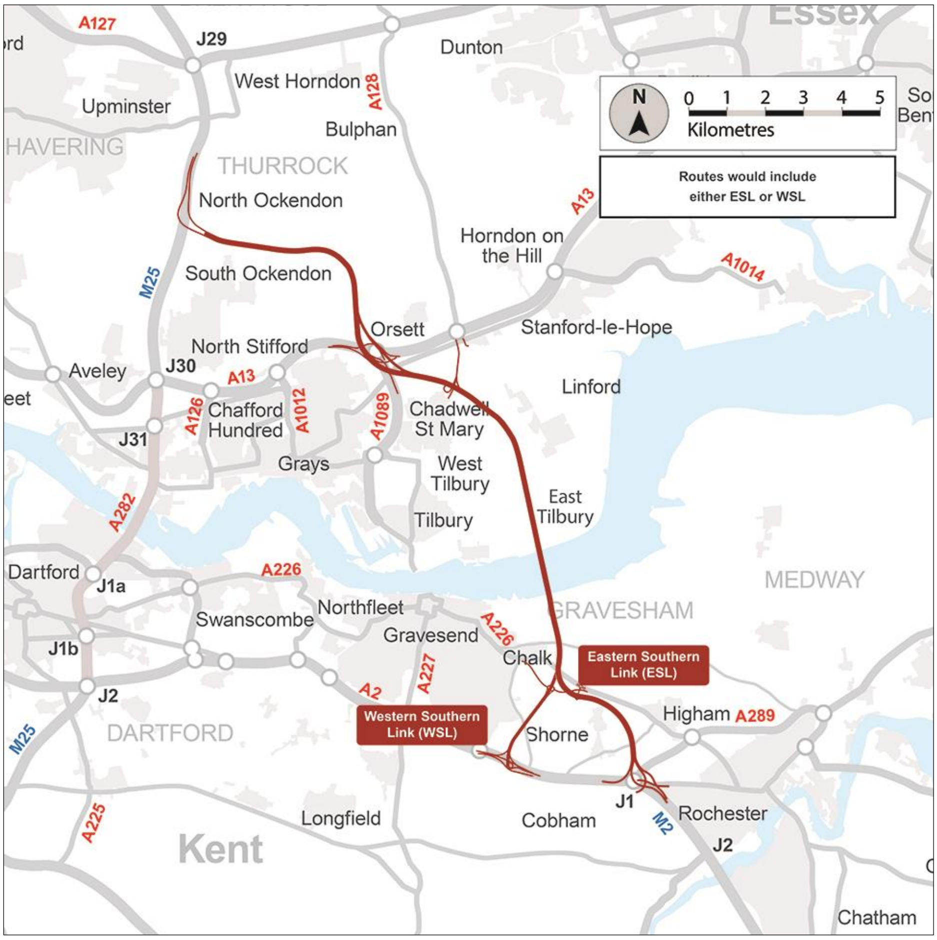

FIGURE 5.14 - ROUTE 3

5.4.2 This route also has three options for the main crossing bridge, bored tunnel and immersed tunnel. The horizontal alignment of the crossing is the same allowing the WSL and the ESL to connect into all three crossing types. The alignments south of the river would all be as described in Section 5.3 for Route 2.

5.4.3 North of the river the route would go north between West Tilbury and East Tilbury. The route would connect with the A13 at the existing A1089 and A13 junction with a spur to Orsett Cock roundabout and then the M25 near Ockendon Road.

Route 3 River Crossing

5.4.4 The crossing location and conceptual designs would all be as described in paragraphs 5.3.33 to 5.3.66 for Route 2.

Route 3 North of River Thames - Alignment (horizontal)

5.4.5 Horizontal and vertical alignments have been designed to the DMRB TD 9/93 Table 3 for highway link design. The design speed has been taken as 120kph (70mph speed limit) for a dual two-lane all-purpose road.

5.4.6 On the north side of the river the route would go to the west of East Tilbury and then between Chadwell St Mary and Linford. The route would cross the A13 to the west of Orsett at the location of the existing A13/ A1089 junction.

This is a change to the alignment of Route Option C2 detailed in the *Technical Appraisal Report*. This new alignment would simplify the works at the Orsett Cock junction.

5.4.7 North of the A13, the route follows the alignment to Route 2 and connects into the M25 via the same junction proposed for Route 2 (refer to paragraph 5.3.79).

Route 3 North of River Thames – vertical alignment, bridge

5.4.8 To the north of the river, the route would remain elevated across East Tilbury Marshes. In the area of Bowaters Farm the route would be on a small embankment or at existing ground level before rising up over Station Road and the railway line to the west of East Tilbury.

5.4.9 North of the railway, the route would alternative between short sections of cutting and embankment. Approaching the A13, the route would go below ground level in order to go beneath the A13, with the northbound and southbound carriageways splitting in order to accommodate the new slip roads.

5.4.10 North of the A13, the route would be on embankment through to the M25, with the embankment height typically around 4.5m.

Route 3 North of River Thames – vertical alignment, bored tunnel

5.4.11 To the north of the river the route would remain in cutting before rising to embankment and to the west of East Tilbury the vertical alignment would be the same as that described for the bridge.

Route 3 North of River Thames - vertical alignment, immersed tunnel

5.4.12 On the north side of the river the portal would be located close to the northern river bank. To the north of this point the vertical alignment would be the same as for the bored tunnel and bridge.

Route 3 North of River Thames - Brentwood Road Junction

(Refer to **Appendix 3.19** for junction drawing)

5.4.13 The proposal at Brentwood Road would be to provide a northbound off-slip, which would allow the north to east movement along the A13. In addition there would be an on-slip which would provide the A13 westbound to LTC southbound movement. This would also allow traffic from A1089 northbound to access LTC southbound and LTC northbound to access A1089 southbound via the A13. These movements are not catered for at the A13 junction.

5.4.14 This option would require widening the Brentwood Road between the proposed junction and the Orsett Cock Interchange, and improvements at Orsett Cock Interchange in order to accommodate the wider Brentwood Road.

5.4.15 This junction proposal removes the need to provide these movements at the proposed A13 interchange and provides a shorter route for traffic to and from the A13 east. Providing this junction would reduce the complexity of the proposed junction at the A13 and reduce the amount of land required at that junction.

Route 3 North of the River Thames - A13 Junction

(Refer to **Appendix 3.19** for junction drawing)

5.4.16 Because of the re-alignment, this junction would be significantly different to that for Route Option C2 detailed in the *Technical Appraisal Report*. The route would now connect with the A13 at the existing junction between the A1089 and the A13.

5.4.17 In order to accommodate all of the movements the main carriageways would be split and they would go beneath the existing A13. A series of link and slip-roads would be required in order to provide all the movements required.

5.4.18 The following movements would be provided at this junction:

- A13 westbound to LTC northbound
- LTC southbound to A13 eastbound
- LTC southbound to A1089 southbound
- LTC northbound to A13 westbound
- A1089 northbound to LTC northbound
- A13 eastbound to LTC southbound

Route 3 North of the River Thames - M25 Junction

5.4.19 This junction would be the same as described for Route 2 (refer to paragraph 5.3.79).

Route 3 North of the River Thames - Highway Structures

5.4.20 The route would require the construction of a range of highway structures including crossings of the Tilbury Loop rail line, the Upminster and Grays Branch rail line, A1013, A13, B186, B188 and B1421. Several structures would also be required at the A13 and M25 Junctions. The structures are summarised in **Table 5.6** below.

5.4.21 All the structure details given in this section are indicative of potential solutions and would be subject to change as the routes are developed and appraised further.

TABLE 5.6 - SUMMARY OF THE STRUCTURE TYPES AND LOCATIONS FOR ROUTE 3 NORTH OF RIVER THAMES

Structure Type	Mainline Structures			Junction Structures	
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A13	M25
New rail bridges	1	1	1	0	1
New road overbridges	7	7	7	7	0
New road underbridges (up to 4 spans)	8	8	8	1	2
New road viaducts (5 spans or more)	0	0	0	2	1

Jacked box tunnels	3	3	3	0	0
New footbridges	0	0	0	0	0
New underpasses	4	4	3	0	1
New main river bridges	3	3	3	0	0
Existing structures to be modified	0	0	0	1	0
Existing structures to be demolished	0	0	0	0	0
Total	**26**	**26**	**25**	**11**	**5**

5.4.22 The following existing structures would be affected by the route:

- A13 overbridge - a four-span reinforced concrete bridge carrying the A13 over the A1089. The A1089 currently passes below the two central spans of this bridge and it is anticipated that ground retaining or stabilisation works would be required either behind or in front of the east abutment to allow an LTC slip road to pass through the eastern end span.

5.4.23 The structures at the M25 junction are identical to those described for Route 2 in Section 5.3 (paragraph 5.3.84).

5.5 Route 4

(Refer to **Appendix 3.20** for Plan and Profile drawings and **Appendix 3.6** for Typical Cross Section drawings)

5.5.1 This route would connect the A2 or M2 to the M25 at Junction 29. To the south of the River Thames the route has the same two options as Routes 2 and 3, WSL and ESL. The proposed junctions at the A2, M2 and A226 would be the same as those described for Route 2 in Section 5.3. The route is shown in **Figure 5.15**.

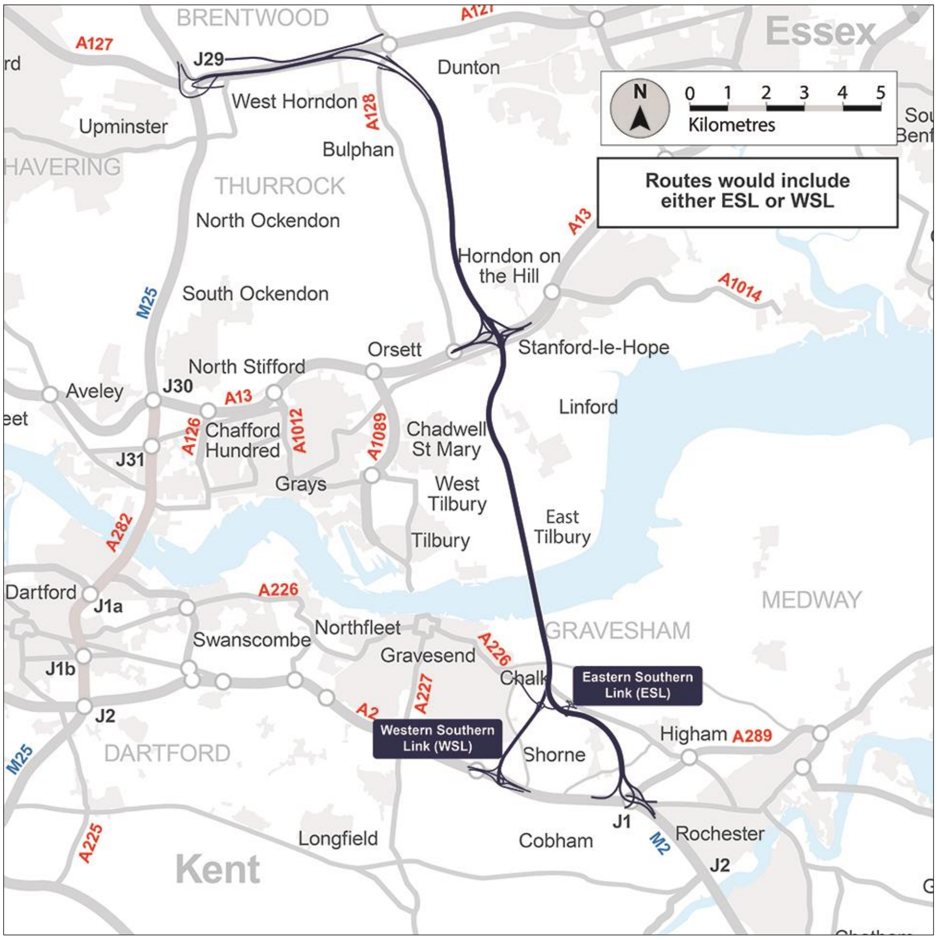

FIGURE 5.15 - ROUTE 4

5.5.2 This route also has three options for the main crossing bridge, bored tunnel and immersed tunnel. The horizontal alignment of the crossing is the same allowing the WSL and the ESL to connect into all three crossing types. The alignments south of the river would all be as described in Section 5.3 for Route 2.

5.5.3 North of the river the route would go north between West Tilbury and East Tilbury. The route would connect with the A13 to the east of the Orsett Cock Interchange and then connect with the A127 in the vicinity of the existing A127/ A128 junction. From this point it would use the A127, upgraded to dual four-lanes, to M25 Junction 29.

Route 4 River Crossing

5.5.4 The crossing location and conceptual designs would all be as described in paragraphs 5.3.33 to 5.3.66 for Route 2.

Route 4 North of River Thames - Alignment (horizontal)

5.5.5 Horizontal and vertical alignments have been designed to the DMRB TD 9/93 Table 3 for highway link design. The design speed has been taken as 120km/h (70mph speed limit) for a dual two-lane all-purpose road.

5.5.6 North of the river the route would go to the west of East Tilbury and then turn east to go north of East Tilbury and through the south east edge of a golf course. At the A13 there would be an all movement free-flow junction which would be located between Orsett Cock Interchange and the grade separated junction with the A13 and B1007/ A1014 (The Manorway).

5.5.7 To the north of the A13 the route would head north towards the A127 following an alignment parallel to and east of the A128. The LTC carriageways would connect into the A127 to the west of the A127/ A128 junction. The A127 would be widened to four lanes in each direction between the LTC/ A127 merge and M25 Junction 29.

Route 4 North of River Thames - Alignment (vertical)

5.5.8 North of the river towards the A13 the alignment would typically be on short sections of embankment and would pass over the Tilbury Loop railway line as well as Station Road and Muckingford Road. At the A13 the route would pass over the A13 on viaduct and then north of the A13 the alignment would generally be on short sections of embankment.

5.5.9 At the A127 the route would connect into the existing dual carriageway and would utilise the existing road corridor through to M25 Junction 29.

Route 4 North of River Thames - A13 Junction

(Refer to **Appendix 3.21** for junction drawing)

5.5.10 The proposed junction at the A13 would be an all movement free-flow junction located between the existing Orsett Cock Interchange and the existing grade separated junction with the A13 and B1007/ A1014 (The Manorway). The junction would have a four-level layout with a complex series of slip roads, loops and interchange links to the adjacent road network.

5.5.11 The junction layout has been developed to take account of the changes proposed as part of the Thurrock widening of this section of the A13 from dual two to dual three lanes (refer Volume 2 Section 3.10).

5.5.12 In order to locate the junction at the proposed location it would be necessary to remove the existing east facing slip roads on the Orsett Cock Interchange. This would remove the issue of weaving lengths from the existing east facing on- and off-slips at Orsett Cock to the LTC west-facing slip roads associated with this junction.

5.5.13 In order to compensate for the removal of the slip roads it would be necessary to utilise the existing road (A1013/ Stanford Road) which runs parallel with the A13 between Orsett Cock Interchange and the junction with the B1007/ A1014. Improvements on this road would be required to accommodate the additional traffic.

Route 4 North of River Thames - A127 Junction

(Refer to **Appendix 3.22** for junction drawing)

5.5.14 As described in paragraph 5.5.7 LTC would join the existing A127 west of the existing A127/ A128 junction.

5.5.15 On the westbound A127 carriageway the A127 would be maintained as lanes three and four with the LTC northbound carriageway connecting as a two lane gain as lanes one and two. These four lanes would continue to Junction 29 where lanes one and two would diverge as a two lane drop via a viaduct to the south of Junction 29, providing a free flow connection to the northbound M25. This proposed layout would minimise the weaving between A127 and LTC traffic.

5.5.16 On the eastbound A127 carriageway the A127 would be maintained as lanes three and four with the LTC southbound carriageway connecting as a two lane gain as lanes one and two from the southbound M25. These four lanes would continue towards the A127/ A128 junction, where lanes one and two would diverge as a two lane drop via a viaduct over the A127 as the southbound LTC carriageway. This proposed layout would again minimise the weaving between A127 and LTC traffic.

Route 4 North of River Thames - M25 Junction 29

(Refer to **Appendix 3.23** for junction drawing)

5.5.17 At this junction, the existing grade-separated junction would be maintained and two new link roads would be constructed directly linking the new route with the M25. There would be a link road on a viaduct southwest of the existing junction over the existing road network that would take traffic onto the northbound M25. A dedicated link road from the M25 southbound would take traffic onto the A127/ LTC eastbound. This arrangement would mean that LTC traffic would be segregated from the existing roundabout and slip roads.

5.5.18 To the east of Junction 29 on the M25 there is an existing junction between the A127 and the B186. In order to provide the merge and diverges to the proposed slip roads from and to the M25 it would be necessary to close this junction. To mitigate against this closure two new link roads are proposed that would provide the lost movements at the existing junction and retain access for properties.

5.5.19 A link road is proposed to connect from the B186 into the existing roundabout at Junction 29. This would provide access to and from the A127 onto the B186.

5.5.20 A two-way link road is proposed from the B186 to the A128 to provide traffic access from and to the B186 from the A127, via the A128 junction.

Route 4 North of River Thames - Highway Structures

5.5.21 The route would require the construction of a range of highway structures including crossings of the Tilbury Loop rail line, the Fenchurch Street and Shoeburyness rail line, the A1013, A13, A128 and B186. Structures would also be required at each of the A13, A127 and M25 junctions. Finally the route would require the widening of the existing A127 along a length of approximately 3.5km to accommodate the proposed dual four-lane carriageway, which would require the replacement of two existing highway structures. The structures required are summarised in **Table 5.7** below.

5.5.22 All the structure details given in this section are indicative of potential solutions and would be subject to change as the options are developed and appraised further.

TABLE 5.7 - SUMMARY OF THE STRUCTURE TYPES AND ROUTES FOR ROUTE 4 NORTH OF RIVER THAMES

Structure Type	Mainline Structures			Junction Structures		
	Bored Tunnel Crossing	Immersed Tunnel Crossing	Bridge Crossing	A13	A127	M25
New rail bridges	2	2	2	0	0	0
New road overbridges	5	5	5	4	0	0
New road underbridges (up to 4 spans)	9	9	9	1	0	1
New road viaducts (5 spans or more)	0	0	0	2	0	2
Jacked box highway underbridges	0	0	0	2	0	0
Cut and cover tunnel	0	0	0	3	0	0
New footbridges	4	4	4	1	0	0
New underpasses	3	3	3	0	0	0
New main river bridges	4	4	3	0	0	0
Existing structures to be modified	0	0	0	0	0	0
Existing structures to be demolished	2	2	2	1	0	0
Total	**29**	**29**	**28**	**14**	**0**	**3**

5.5.23 The following existing structures would be affected by the route:

- Saffron Garden overbridge - a four-span concrete slab bridge carrying a minor road over the A13. It is assumed that this bridge would be demolished and the bridge reconstructed in order to span over the diversion of the A1013 associated with the proposed A13 junction.
- Warley Street overbridge - a four-span prestressed beam bridge carrying the B186 over the A127, assumed to be replaced as part of the A127 widening works.
- Codham Hall access road - a three-span steel composite bridge spanning the A127 assumed to be replaced as part of the A127 widening works.

6 References

Title	Document number
DMRB - Road Geometry	TD 9/93
DMRB - Layout of Grade Separated Junctions	TD 22/06
DMRB – Cross-sections and Headroom	TD 27/05
Technical Appraisal Report - Executive Summary	HA540039-HHJ-ZZZ-REP-ZZZ-009
Technical Appraisal Report - Main Report	
Technical Appraisal Report - Appendices	

7 Abbreviations and Glossary

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
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
AMI	Advanced Motorway Indicator, with optical feedback for enforcement.
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.
AQSO	Air Quality Strategy Objective: 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.
Armour	Riprap - also known as rip rap, rip-rap, shot rock, rock armour or rubble - is rock or other material used to armour shorelines, streambeds, bridge abutments, pilings and other shoreline structures against scour, water or ice erosion.
ASC	Asset Support Contract(or)

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 Rural and Urban 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.
BCR	Benefit-Cost Ratio, 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.
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.
BMS	Bridge Management System
BR	Bridge (when used as part of a LTC shortlist route reference) otherwise Bridleway
BT	Bored tunnel
BTO	British Trust for Ornithology: an organisation founded in 1932 for the study of birds in the British Isles.
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
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(s): As defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 a Critical Drainage Area is "an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency".
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.
Chart Datum	The level of water from which charted depths displayed on a nautical chart are measured.
CKD	Combined kerb drain(s): a combined kerb and drainage system.
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
Connect Plus	Connect Plus (M25) Ltd, management company for the Dartford-Thurrock Crossing.
CRM	Customer relationship management

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
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. It is 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.
DCC	Dartford Crossing Control Centre
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.
Deneholes	An underground structure consisting of a number of small chalk caves entered by a vertical shaft.
DFFC	Dartford Free Flow Crossing (tollbooths removed)
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
DI	Distributional Impact
Disbenefit	A disadvantage or loss resulting from something.
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
DRCC	Dartford River Crossing Control Centre
DVS	DVS Property Specialists, the specialist property arm of the Valuation Office Agency (VOA).
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.
EB	eastbound
ELHAM	TfL's East London Highway Assignment Model
EMME	Equilibre Multimodal, Multimodal Equilibrium, a complete travel demand modelling system for urban, regional and national transportation forecasting.
EMMEBANK	Neue Emme Bank Vorm.Amtsersparniskasse Burgdorf

ERA	Emergency Refuge Area: on roads for use in emergency or breakdown only, located approximately every 800 metres and separated from the main carriageway.
ERT	Emergency roadside telephone(s)
ESL - Eastern Southern Link	The Eastern Southern Link (ESL) is an alternative for Routes 2, 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 any of the Routes 2, 3 and 4 north of the river utilising all of the crossing options for these route options.
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.
FP	Footpath
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
HADECS	Highways England Digital Enforcement Camera System
HAGDMS	Highways England Geotechnical Data Management System
HAM	TfL’s Highway Assignment Model
Hanson	Hanson UK, part of the HeidelbergCement Group.
HATO	Highways Agency Traffic Officer
HATRIS	Highways England journey time database
HGV	Heavy Goods Vehicle
HHJV	Halcrow Hyder Joint Venture: a joint venture between Halcrow Group Limited and Hyder Consulting Limited.
HRA	Habitats Regulations Assessment: A tool developed by the European Commission to help competent authorities (as defined in the Habitats Regulations) to carry out assessment to ensure that a project, plan or policy will not 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 projects), and to begin to identify appropriate mitigation strategies where such effects were identified.
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
IT	Immersed tunnel
ITS	Intelligent Transportation System
Jacked box tunnelling	Jacked box tunnelling is a method of construction that enables engineers to create underground space at shallow depth in a manner that avoids disruption of valuable infrastructure and reduces impact on the human environment.
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.
LATS	London Area Transport Surveys
LCS	Lane Control Signs
LDP	London Distribution Park: offers 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 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 Varaint	As for options at Locations C and A with additional widening of the A229 between the M2 and the M20.
London Gateway	A new deep-water port, able to handle the biggest container ships in the world, and part the London Gateway development on the north bank of the River Thames in Thurrock, Essex, 20 miles (32 km) east of central London.
LPER	see Paramount London
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 Southend railway
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.
MIDAS	Motorway Incident Detection and Automatic Signalling
MMO	Marine Management Organisation: 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.
MS4	The latest generation of Variable Message Signs designed to display both pictograms and text; uses internationally recognised warning symbols and provides a dual colour display matrix for amber and red coloured characters or symbols.
MTM	Medway Traffic Model
NB	northbound
NCR	National Cycle Route: a cycle route part of the National Cycle Network created by Sustrans to encourage cycling throughout Britain.
NDD	Highways England Network Development Directorate
NIA	Noise-important area(s): 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.
NMU	Non-motorised user, e.g. pedestrians, cyclists, equestrians.
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.
NO2/ NO_2	Nitrogen dioxide
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)
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.
NRTS	National Roads Telecommunications Services
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
NTS	National Transport Survey
O&M	Operations and Maintenance
OD	Origin-destination: origin-destination data (also known as flow data) includes the travel-to-work and migration patterns of individuals, cross-tabulated by variables of interest (for example occupation).
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.
Orifice plate	A device used for measuring flow rate, for reducing pressure or for restricting flow (in the latter two cases it is often called a restriction plate). Either a volumetric or mass flow rate may be determined, depending on the calculation associated with the orifice plate.
Orthotropic steel deck plate	An orthotropic bridge or orthotropic deck is one whose deck typically comprises a structural steel deck plate stiffened either longitudinally or transversely, or in both directions. This allows the deck both to directly bear vehicular loads and to contribute to the bridge structure's overall load-bearing behaviour. The orthotropic deck may be integral with or supported on a grid of deck framing members such as floor beams and girders.
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.
PA metrics	Production and attraction metrics
Paramount Park, London	London Paramount Entertainment Resort (LPER). A proposed theme park and entertainment precinct on the Swanscombe peninsula, Kent. Construction could begin in autumn 2016 with the opening estimated for Easter 2021.
PCF	Highways England Project Control Framework process.
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.

Penstock	A sluice or gate or intake structure that controls water flow, or an enclosed pipe that delivers water to hydro turbines and sewerage systems. It is a term that has been inherited from the earlier technology of mill ponds and watermills.
PIA	Personal Injury(ies) Accident(s)
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).
PRoW	Public Right of Way: A right possessed by the public, to pass along routes over land at all times. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. The mode of transport allowed differs according to the type of public right of way which consist of footpaths, bridleways and open and restricted byways.
pSPA	Potential Special Protection Area: Sites which are approved by Government that are in the process of being classified as Special Protection Areas.
PSSR	Preliminary Sources Study Report
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.
RADAR	Radar is an object-detection system that uses radio waves to determine the range, angle, or velocity of objects, including motor vehicles.
Ramsar site	A wetland of international importance, designated under the Ramsar convention.
RCC	Regional Control Centre
RET	Range Estimation Tool
RFID	Radio-frequency identification, the wireless use of electromagnetic fields to transfer data, for the purposes of automatically identifying and tracking tags attached to objects. The tags contain electronically stored information.
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.
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.
RTMC	Regional Technology Maintenance Contract(or)
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 project; bi-lateral meetings with SAP members have also been held.
SAR	HHJV's Pre-Consultation Scheme Assessment Report of the Lower Thames Crossing.
SATURN	Simulation and Assignment of Traffic to Urban Road Networks, Transport Model
SCADA	Supervisory Control and Data Acquisition
S-CGE	Spatial Compatible General Equilibrium
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 project.
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.'
SGAR	Stage Gateway Assessment Review: part of Highways England Project Control Framework (PCF) process.
Shortlist Route 1	A new trunk road connecting M25 Junction 2 to M25 Junction 30, with a new 4 lane bridge crossing or a 4 lane twin-bored tunnel 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).
Shortlist Route 2	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.
Shortlist Route 3	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 option of a bridge / twin-bored tunnel / immersed tunnel. 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.
Shortlist Route 4	A new trunk road connecting A2 (2 km east of Gravesend) to M25 at Junction 29, using A127 (upgrading), with dual 2 lane crossing option of a bridge / twin-bored tunnel / immersed tunnel. Single carriageway road provided from B186 to A128 parallel with the A127. See also Eastern Southern Link and Western Southern Link.
SIA	Social Impact Appraisal
Skills Level 4	Equates to a Certificate of Higher Education, Key Skills Level 4, NVQ Level 4, BTEC Professional award, certificate and diploma Level 4, and HNC.
Smart motorway	Term for a range of types of actively controlled motorway, using technology to optimise use of the carriageway including the hard shoulder.
SPA	Special Protection Area: A designation under the European Union Directive on the Conservation of Wild Birds.
SPECS	Average Speed Enforcement Camera System

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.
SuDS	A sustainable drainage system designed to reduce the potential impact of new and existing developments with respect to surface water drainage discharges.
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.
TAG	Transport Analysis Guidance: national guidance document produced by the Department for Transport.
TAR	HHJV's Technical Appraisal Report of the Lower Thames Crossing.
TBM	Tunnel boring machine, machine used to excavate tunnels with a circular cross section.
TDSCG	Tunnel Design and Safety Consultation Group: formed to ensure effective design, construction and operation within the context of safety.
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)
TfL	Transport for London: created in 2000, the integrated body responsible for London's transport system.
TM	Highways England's Traffic Management (directorate)
TMC	Traffic Management Cell
TRADS	Traffic Flow Data System (holds information on traffic flows at sites on the network)
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.
TTMS	Temporary Traffic Management Signs
TUBA	Transport Users Benefit Appraisal (DfT economic appraisal software tool)
UPS	Uninterruptible power supply
Urban All Purpose	A road in an urban area designed for all types of traffic in accordance to the relevant DMRB Standards.
V/C	Volume over Capacity (volume/capacity)
VMS	Variable Message Sign, typically mounted on a portal gantry.
VMSL	Variable Mandatory Speed Limits
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.
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.
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.
WI	Wider Impacts, 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.
WSL - Western Southern Link	The Western Southern Link (WSL) is an alternative for Routes 2, 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 any of the Routes 2, 3 and 4 north of the river utilising all of the crossing options for these route options.

8 Appendices

	Title
Appendix 3.1	Route 1 Plan and Profile Drawings
Appendix 3.2	Route 1 Typical Cross Section Drawings
Appendix 3.3	Route 1 Bridge General Arrangement Drawing
Appendix 3.4	Route 1 Bored Tunnel General Arrangement
Appendix 3.5	Route 2 Plan and Profile Drawings
Appendix 3.6	Routes 2, 3 and 4 Typical Cross Sections
Appendix 3.7	WSL Plan and Profile Drawings
Appendix 3.8	WSL A2 Junction Drawing
Appendix 3.9	WSL A226 Junction Drawings
Appendix 3.10	ESL M2 Junction 1 Drawing
Appendix 3.11	ESL A226 Junction Drawings
Appendix 3.12	Routes 2, 3 and 4 Bridge General Arrangement Drawing
Appendix 3.13	Routes 2, 3 and 4 Bored Tunnel General Arrangement Drawings
Appendix 3.14	Routes 2, 3 and 4 Immersed Tunnel General Arrangement Drawings
Appendix 3.15	Route 2 A1089 Junction Drawing
Appendix 3.16	Route 2 A13 Junction Drawing
Appendix 3.17	Route 2 M25 Junction Drawing
Appendix 3.18	Route 3 Plan and Profile Drawings
Appendix 3.19	Route 3 Brentwood Road Junction and A13 Junction Drawing
Appendix 3.20	Route 4 Plan and Profile Drawings
Appendix 3.21	Route 4 A13 Junction Drawing
Appendix 3.22	Route 4 A127 Junction Drawing
Appendix 3.23	Route 4 M25 Junction 29 Drawing

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The Pre-Consultation Scheme Assessment Report details the assessment of options leading up to consultation. A final Scheme Assessment Report will be published post consultation.