highways england

Lower Thames Crossing

Pre-Consultation Scheme Assessment Report

Volume 1: Executive Summary

Volume 1

Lower Thames Crossing
Route Consultation 2016

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1.1 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.

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 solution.

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 taking account of the comments received. It will also include the report on public consultation, and the recommended scheme.

1.2 Structure of Executive Summary

1.2.1 This Executive Summary provides an overview of the SAR as follows:

- Section 2 - The Need for Improvement
- Section 3 - Scheme Objectives and Appraisal
- Section 4 - Location A
- Section 5 - Location C Routes north of the River Thames
- Section 6 - Location C River Crossing
- Section 7 - Location C Routes south of the River Thames
- Section 8 - The Proposed Scheme at Location C - Route 3, bored tunnel and Eastern Southern Link
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2 The Need for Improvement

2.1 Summary of existing problems at Dartford

2.1.1 The Dartford Crossing is one of the most strategically important parts of road network in the UK, carrying traffic of international and national importance, as well as catering for regional and local movements. It is the only river crossing on the strategic road network to the east of London. This section provides a summary of the key problems at Dartford.

2.2 Congestion

2.2.1 Analysis of traffic data shows that traffic demand at Dartford has responded in step with capacity; such that whenever new capacity has been provided, it has filled up and created the need for more capacity. This has been a recurring pattern since the second tunnel was opened at Dartford in 1980 and then the QEII Bridge in 1991. Today there is insufficient capacity to cater for current and future traffic demand.

2.2.2 Congestion results from constraints both at the crossing and the approaches which limit capacity, including:

- The existing 50 mph speed limit with constrained horizontal and vertical geometry at the tunnels and approaches
- Closely spaced junctions leading to extensive weaving of traffic
- Operating restrictions relating to the existing tunnels

2.2.3 The crossing remains heavily congested today and is predicted to become increasingly congested for larger parts of the day in the future. By 2025, the northbound crossing will be operating at capacity during the peak and inter-peak periods; by 2041 this will also be the case for the southbound crossing.

2.2.4 Dart Charge, a free-flow charging system introduced in November 2014, has led to some improvement in journey times at the crossing, but will not provide a long term solution to congestion problems at Dartford. It does not significantly increase crossing capacity, nor address the constraints at the crossing and along the A282 approaches. The crossing is likely to have similar traffic conditions in 2025 to those observed before Dart Charge was implemented.

2.3 Resilience and reliability

2.3.1 Operational resilience is poor and incidents have a disproportionate effect on reliability of the strategic and local road networks. The poor quality of the northbound infrastructure and the incremental development of the road network in the corridor have led to a network prone to frequent incidents which increase the likelihood of congestion, not only at the crossing but also on the wider road network.

2.3.2 There are over 300 unplanned closures per annum with an average duration of around 30 minutes. In the event of closures, the local road network becomes very badly congested and users have no suitable alternative routes.

2.3.3 The Dartford Crossing is one of the least reliable sections for users of the strategic road network. With increasing congestion in the future, the likelihood of incidents will lead to greater unreliability.

2.4 Development and Economic Growth

2.4.1 Congestion at the crossing leads to wasted time for people and industry, and affects economic productivity. Constrained capacity limits growth in productivity, output, investment and employment. The local economies have a comparatively low productivity as measured by gross value added. This has impacted on local house prices and the willingness of developers and businesses to invest.

2.4.2 Regional and local development plans are focussed on economic growth with targets for new jobs and new homes. There are significant development plans for new housing and employment in the area, which include London Gateway Port, Port of Tilbury, Ebbsfleet Garden City, Paramount London and Lakeside and Bluewater Shopping Centres. Further development will generate more demand for cross-Thames travel.

2.4.3 Congestion, lack of capacity, lack of network resilience, poor connectivity between Kent and Essex and unreliability of journey times act as constraints on economic growth and will slow down the rate of investment. This is confirmed through engagement with business stakeholders, including a recent business survey.

2.5 Environment and Safety

2.5.1 The existing environmental problems at Dartford have an adverse impact on the local community. The traffic congestion at the crossing and on the surrounding road network affects both air quality and noise experienced by local residents. The A282 south of the crossing is both an Air Quality Management Area and a Noise Important Area with people close to the road exposed to high levels of air pollution and noise.

2.5.2 With increasing congestion at Dartford Crossing and on the local road network around Dartford, there will continue to be problems with air quality, despite improvements in vehicle emission standards. Noise levels are also likely to increase with increasing congestion.

2.5.3 The existing road safety record for the A282 corridor is poor, with a significantly higher existing accident rate than the national average, both along the main route and at junctions on the route.

3 Scheme Objectives and Appraisal

3.1 Previous Studies

3.1.1 In 2009 the Department for Transport examined five locations where an additional crossing could be built. The most easterly of these (Locations D and E) were found to be too far from the existing crossing to ease the problems at Dartford and were eliminated from further consideration.

3.1.2 In 2013 further analysis of the three remaining options (Locations A, B and C) together with an option known as C Variant (which would involve widening of the A229 between the M2 and M20) was carried out.

3.1.3 In 2013 the Department ran a public consultation on the need for a new crossing and invited views on:

- Location A (at the existing crossing)
- Location B (connecting the A2 and the Swanscombe Peninsula with the A1089)
- Location C (east of Gravesend and Tilbury)
- C Variant (widening of the A229 between the M2 and M20)

3.1.4 Later that year the Government announced its decision not to proceed with Location B due to limited public support, the potential impact on local development plans and limited transport benefits.

3.1.5 In 2014, the Government published its response to the consultation, confirming the need for an additional crossing between Kent and Essex. The response acknowledged that there was no preference at that stage on location, and that further work would be carried out to develop and appraise route options for both Location A and C before choosing where to site a new crossing.

3.2 Scheme Objectives

3.2.1 The scheme objectives against which all route options are appraised are shown in **Table 3.1**. They are presented in three principal categories: economic, transport, and environment and community objectives.

3.2.2 These scheme objectives were agreed between Highways England and the Department for Transport, and are recorded in the Client Scheme Requirements.

TABLE 3.1 - SCHEME OBJECTIVES

Scheme Objectives	
Economic	• To support sustainable local development, regional economic growth in medium to long-term • To be affordable to government and users • To achieve value for money
Environment and Community	• To minimise adverse impacts on health and the environment
Transport	• To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free-flowing north-south capacity • To improve resilience of the Thames crossings and major road network • To improve safety

3.3 Scheme Assumptions

3.3.1 In order to appraise the options against the scheme objectives on a comparable basis, a number of key assumptions have been made which are summarised in **Table 3.2**.

TABLE 3.2 - KEY ASSUMPTIONS IN APPRAISAL OF OPTIONS

Assumption	
User Charges	In the traffic modelling, user charges equal to existing charges are applied at Location A and C crossings to allow for comparison on an equal basis. For the purpose of the appraisal of options, charges are assumed to remain constant in real terms with no change in vehicle classification.
Oversize crossing structure at Location C	In order to allow for future expansion from a dual two lane road to dual three lane, an oversized crossing structure would be constructed at Location C. Capital costs quoted reflect this assumption.
Traffic and revenue forecasts	All traffic forecasts, unless stated otherwise, are based on a core growth traffic scenario, as defined by WebTAG guidance.
Programme	The scheme development timetable assumes authorisation by way of the Development Consent Order process and delivery using a design and build model with public funding.

3.4 Study Area

3.4.1 The Study Area for the identification and appraisal of options at Locations A and C is shown in **Figure 3.1**.

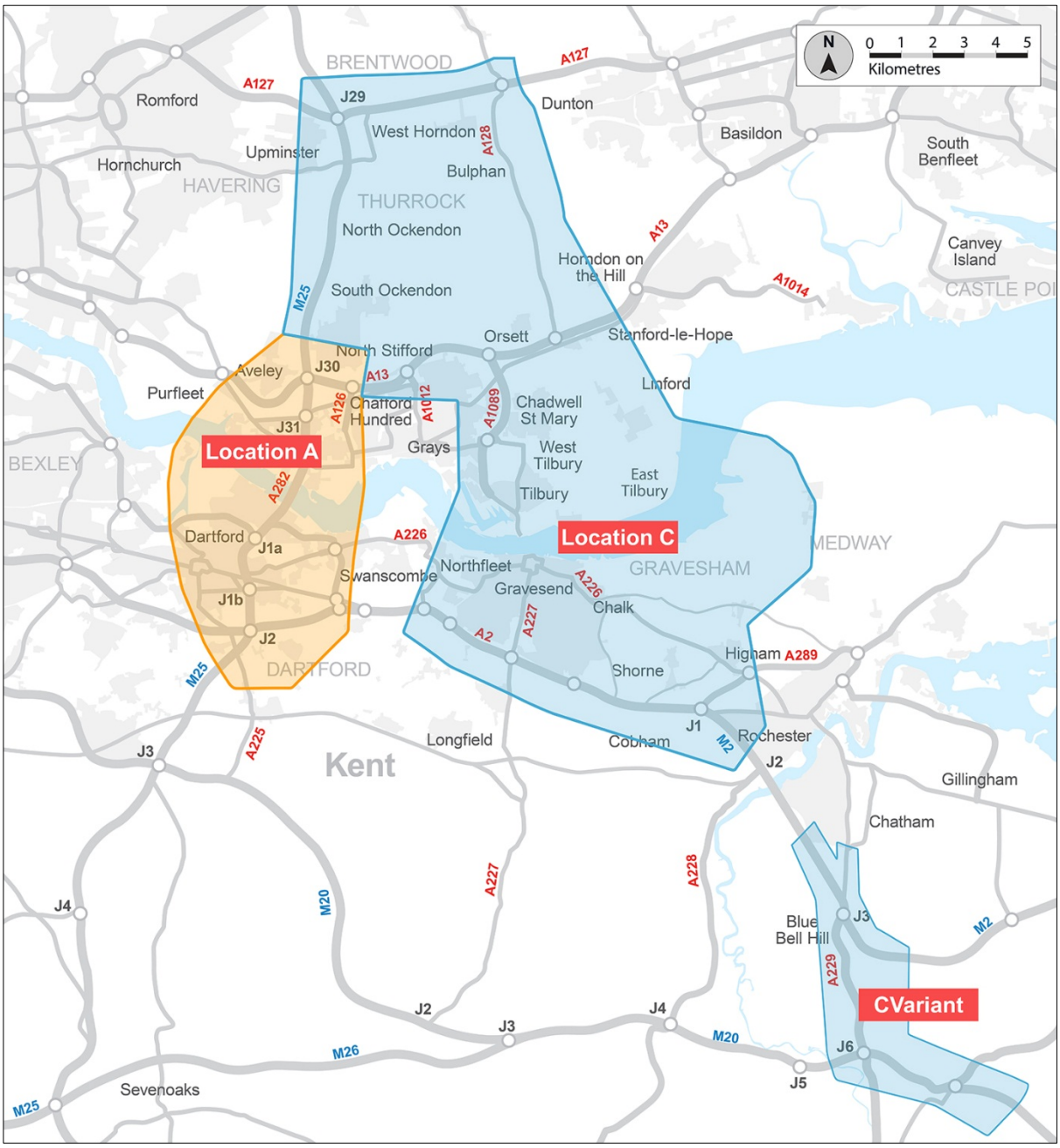

FIGURE 3.1 - STUDY AREA

3.5 Option Identification, Development and Selection

3.5.1 The approach taken to identifying, developing and selecting routes for public consultation is shown in **Figure 3.2** below. The red arrow indicates the current stage i.e. prior to public consultation.

FIGURE 3.2 - OVERVIEW OF APPROACH TO IDENTIFYING, DEVELOPING AND SELECTING ROUTES FOR PUBLIC CONSULTATION

3.5.2 The key stages in identifying, developing and selecting routes for public consultation are presented below:

a) **Viability Check.** A list of route options was developed for Locations A and C. Route options which performed poorly against 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 appraisal of the longlist options was 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 this Pre-Consultation Scheme Assessment Report.

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 recommended scheme will be determined taking account of this appraisal and the responses to the public consultation.

3.6 Longlist Routes

3.6.1 The longlist options at Location A, Location C and C Variant are shown in **Figure 3.3**. 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)

3.6.2 Following this first stage appraisal three route options at Location A were not considered to be viable. The section of Option C3 between the A226 and the A2 was also not considered viable due to environmental impacts, and Option C3 was amended to have a similar alignment to Option C2.

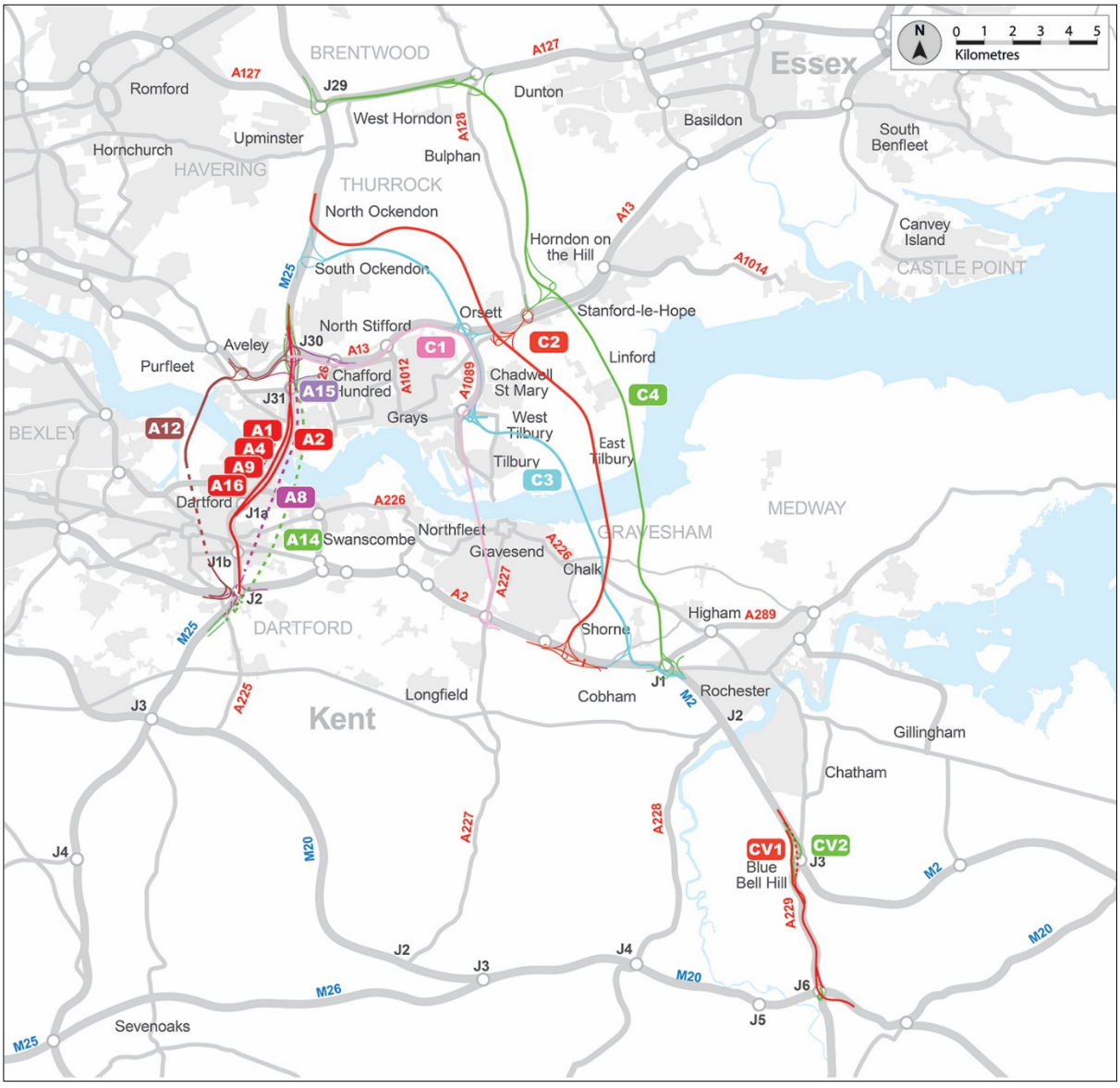

FIGURE 3.3 - PLAN OF LONGLIST ROUTES

3.6.3 The remaining route options could not be differentiated on the basis of the limited criteria set out in paragraph 3.6.1. 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 3.3**.

TABLE 3.3 - LONGLIST SECOND STAGE APPRAISAL CRITERIA

Main Criteria	Sub-Criteria
Strategic	Fit with wider transport, government and other (regional) objectives
Economic	Travel time savings, congestion, resilience, accident benefits, wider economic benefits, impact on current/ future planned infrastructure
Environmental	Carbon emissions, historic environment, biodiversity, landscape and townscape, air quality, noise, water environment, construction disruption
Management	Implementation timetable, practical feasibility
Financial	Capital cost, operational and maintenance cost
Commercial	Revenue costs

3.6.4 Following this second stage of appraisal, the options taken forward to the shortlist were: A1, A4, C2, C3, C9 and C19.

3.6.5 These options have then been simplified, as shown in **Table 3.4,** and carried forward into the shortlist as four principal routes: Route 1, Route 2, Route 3 and Route 4.

TABLE 3.4 - DEVELOPMENT OF SHORTLIST ROUTES FROM ROUTES IN THE TECHNICAL APPRAISAL REPORT

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

TAR Reference	Shortlist Route
C2 (IT)	Route 3 with Western Southern Link and Immersed Tunnel
C2 (BR) and C19	Route 3 with Eastern Southern Link and Bridge
C2 (BT) and C19	Route 3 with Eastern Southern Link and Bored Tunnel
C2 (IT) and C19	Route 3 with Eastern Southern Link and Immersed Tunnel
C9 (BR)	Route 4 with Western Southern Link and Bridge
C9 (BT)	Route 4 with Western Southern Link and Bored Tunnel
C9 (IT)	Route 4 with Western Southern Link and Immersed Tunnel
C9 (BR) and C19	Route 4 with Eastern Southern Link and Bridge
C9 (BT) and C19	Route 4 with Eastern Southern Link and Bored Tunnel
C9 (IT) and C19	Route 4 with Eastern Southern Link and Immersed Tunnel

BR - Bridge, BT - Bored tunnel, IT - Immersed tunnel

3.7 C Variant

3.7.1 As part of the detailed analysis, the widening of the A229 between the M2 and the M20 was considered, refer to **Figures 3.1 and 3.3**. C Variant was identified as part of the 2013 DfT study.

3.7.2 If upgraded, the A229 would provide a relatively short connection between the M2 and M20 and could therefore influence route choice between a new crossing at Location C and the existing Dartford Crossing, particularly for trips heading towards the Channel Tunnel and Ashford.

3.7.3 Traffic modelling has shown that route choice between the two Thames crossings is not influenced directly by an upgraded A229, and that C Variant would do little to help transfer traffic from the existing Dartford crossing on to the new route at Location C.

3.7.4 Improvements to the A229 are estimated to cost an additional £500m and it would have a significant environmental impact including on an Area of Outstanding Natural Beauty (AONB), where there is a presumption against development.

3.7.5 The assessment concluded that C Variant would have limited transport benefit for a new Lower Thames crossing, and would have a high environmental impact, and high cost. C Variant would not be essential to the new crossing scheme.

3.7.6 On this basis the decision was taken not to progress C Variant any further beyond the shortlisting stage. Further consideration of the potential to upgrade the A229 will be given as part of Highway England's ongoing route planning.

3.8 Shortlist Routes

3.8.1 The shortlist routes are shown in **Figure 3.4.** The Location C Routes (2, 3 and 4) share a common crossing location, and include either the Eastern Southern Link (ESL) or Western Southern Link (WSL).

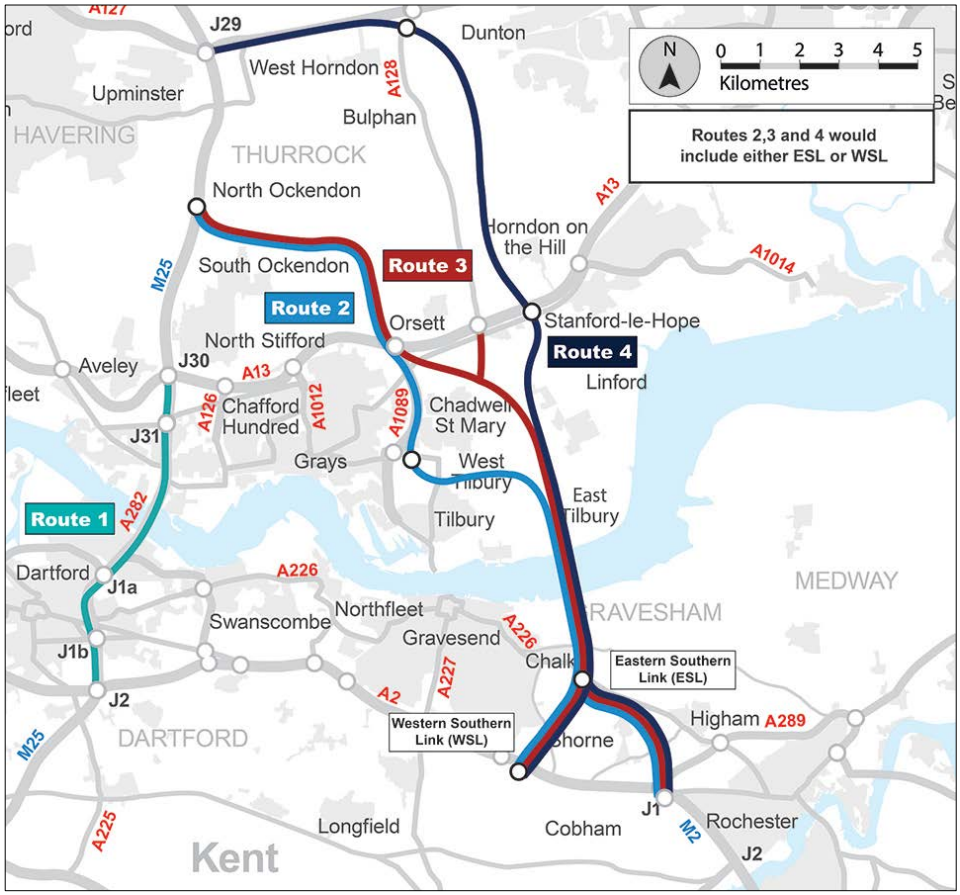

FIGURE 3.4 - SHORTLIST ROUTES

3.8.2 **Table 3.5** shows the four shortlist routes with the river crossing options and southern link options.

TABLE 3.5 - SHORTLIST ROUTES AND CROSSING/ LINK OPTIONS

Route	Crossing Options	Description of Route
Route 1	BR, BT	On line widening along the existing M25/ A282 corridor
Route 2	BR, BT, IT	North of the river – from the crossing following a westerly route via the existing A1089 to the M25 between J30 and J29 South of the river - using either a Western Southern Link from the A2 or an Eastern Southern Link from the M2.
Route 3		North of the river – from the crossing passing to the east of Chadwell St Mary, to the M25 between J30 and J29 South of the river - using either a Western Southern Link from the A2 or an Eastern Southern Link from the M2.
Route 4		North of the river - from the crossing following an easterly route via the existing A127 to the M25 at J29 South of the river - using either a Western Southern Link from the A2 or an Eastern Southern Link from the M2.

3.9 Appraisal of the Shortlist Routes

3.9.1 Each of the four routes has been assessed against the scheme objectives, in order to determine the extent to which all elements of the shortlist alternatives meet the scheme objectives, shown in **Table 3.1**.

3.9.2 Appraisal of the shortlist routes has required:

- Development of engineering designs of feasible crossing types.
- Design of alignments for highways and junctions.
- Estimating construction and operation and maintenance costs.
- Traffic forecasting using the V2 LTC traffic model (SATURN), taking into account planned housing and commercial developments.
- Undertaking economic appraisal of each option in accordance with WebTAG guidance using outputs from the V2 LTC traffic model.
- Assessing the impact on people and property.
- Appraisal of the environmental impacts both long term and during construction.

3.9.3 The appraisal has been undertaken as follows:

- Location A (Route1) including river crossing structure
- Location C (Route 2, 3 and 4) options north of the River Thames
- Location C river crossing structure
- Location C routes south of the River Thames
- Proposed scheme at Location C

4 Location A

4.1 Introduction

4.1.1 This section presents a summary of the detailed appraisal of Route 1 at Location A against the Scheme Objectives. Route 1 provides an additional two lanes in each direction at the Dartford crossing, with a bridge or a bored tunnel crossing solution (refer to **Figure 4.1**). An immersed tunnel solution was also considered as part of the longlist, but was not considered to be a viable route, and therefore was not taken forward to the shortlist.

FIGURE 4.1 - LOCATION A - ROUTE 1

4.1.2 A new bridge crossing would be similar to the existing QEII bridge, with the need to satisfy river navigation clearances. The bored tunnel crossing would be a twin bore arrangement, with the length of the tunnel determined by the depth required below the river bed to provide suitable ground cover over the structure. Both options would impact on the site of an aggregate and cement works on the north side of the river.

4.1.3 On the south bank of the river, both Route 1 options would pass through the area where the Dartford Control Centre and the Traffic Management Cell for the Dartford crossing are located. In order to accommodate the new crossing, these facilities would be demolished and replaced elsewhere. This work would need to be undertaken as an advanced phase of construction, in order to ensure these facilities are operational at all times. The existing and new crossings would be controlled from an integrated control centre.

4.1.4 A new bridge or tunnel would be designed to allow unrestricted passage of HGVs. This combined with reconfiguration of the existing tunnels for light goods vehicles and cars only would allow better use of these assets, although the Traffic Management Cell would have to be retained to ensure restricted vehicles do not enter the existing northbound tunnels.

4.2 Appraisal of Location A

4.2.1 Route 1 is an on-line widening scheme. It would provide journey time benefits but limited wider economic value as it does not connect new communities to the network. It would increase capacity in vehicles per hour at the crossing by 60% in the opening year (2025) and improve journey times in the opening year by 5 minutes at peak times.

4.2.2 As a result of constructing additional capacity, traffic would be attracted to the A282 corridor, partly as a result of releasing additional suppressed traffic growth which is constrained by the existing crossing capacity. Additional traffic has a number of impacts. Firstly, by drawing in additional traffic into the existing corridor, the key arterial routes of the A2 and A13 would become congested within the design life of the new crossing. Secondly, additional traffic in the A282 corridor would still cause long delays and severe congestion to local roads. This will be particularly the case around Dartford in the event there is an incident between Junction 2 and Junction 29, as there will remain a single crossing point with shared approach roads.

4.2.3 The existing infrastructure imposes constraints on the design speed such that it is not possible to increase the speed above 50 mph even with the proposed improvements. The new crossing does not change the experience for road users. Despite the improvements, the A282 will remain a 50 mph corridor with the same closely spaced junctions and existing tunnels, but with a more complex driving environment due to multiple lanes and signage.

4.2.4 Because of the physical constraints and high volumes of traffic, the existing A282 could not be transformed into a free-flowing 70mph route.

4.2.5 Both bridge or tunnel solution would generate economic benefits through journey travel-time savings. The capital and O&M costs, together with the Benefit Cost Ratios (BCRs) are shown in **Table 4.1**. BCR values for a tunnel are lower due to higher construction and maintenance costs.

TABLE 4.1 – COSTS AND BENEFIT COST RATIOS FOR LOCATION A

		Route 1 Bridge	Route 1 Bored Tunnel
Capital Cost Range (P50/ P90 Out-turn)		£3,365m – £4,909m	£3,560m – £5,151m
O&M Costs over 60 years		£241m	£351m
Value for Money	Initial BCR	1.6 to 1.0	1.5 to 0.9
	Adjusted BCR	2.3 to 1.4	2.2 to 1.3

4.2.6 In terms of construction impacts, building either a tunnel or a bridge at Route 1 would have significant impacts for road users, with a projected 80 months of construction including an advanced works construction stage of 20 months.

4.2.7 Traffic management will be required throughout the construction phase, with a temporary speed restriction of 40 mph and substantial periods of contraflow working. Delays to users also has an economic cost through delayed journeys. Capacity at the existing crossing would be reduced during construction for a prolonged period imposing delays on existing users of the crossing, and in effect negating some of the time benefits realised through the introduction of Dart Charge. The economic disbenefits of time lost due to delays during construction is estimated to be around £300m (PVB) which reduces the overall scheme BCR.

4.2.8 The complexity of the works and the constraints imposed by working within the existing M25/ A282 corridor would mean that some work would need to be carried out at night. However, working at night close to existing properties along the A282 would be constrained by restrictions on noise and vibration, the requirements for which would need to be developed in detail with the local environmental health officers. Road closures of the A282/ M25 would be required to demolish existing structures, during which diversion routes would be required.

4.2.9 Route 1 provides additional crossing resilience but will not improve the resilience of the wider road network. In the event, for example, that one of the crossing structures had to close, as recently happened to the Forth Bridge, it is reasonable to assume that either the existing tunnels or new bridge would remain open to traffic. Higher flows in the A282 corridor increase dependency on this key arterial route and does not increase network resilience, as would be the case with an alternative crossing location. Route 1 increases the dependency on the A282 corridor but with much higher traffic flows. Therefore Route 1 would not meet the scheme objectives particularly in terms of network resilience.

4.2.10 Route 1 also perform poorly against the safety objective. Safety for road users is predicted to be worse with Route 1 compared to the Without Scheme scenario, with the accident rate, as measured by the Fatalities and Weighted Injuries rate, predicted to increase with Route 1.

4.2.11 There would be environmental issues with Route 1. Modelling undertaken for air quality and noise has demonstrated that existing problems would be exacerbated with Route 1. South of the crossing, there would be additional exceedances of air quality EU limit values for NO_2, and there would be a worsening of noise in a location which already experiences high levels of noise.

4.3 Conclusions

4.3.1 A new crossing at Location A (Route 1) performs poorly against the traffic-related scheme objectives. Route 1 does not provide an alternative route, and therefore traffic would still be funnelled through the existing corridor from Junctions 2 to 29 and incidents at Dartford would potentially still cause long delays and severe congestion on local roads. Route 1 would provide asset resilience associated with availability of additional lanes at the crossing but does not provide network resilience.

4.3.2 Route 1 would not provide additional connections to local roads and by attracting more traffic to the existing corridor, congestion on the adjacent A2 and A13 would also increase.

4.3.3 Construction would take at least six years and would cause considerable disruption to traffic using the existing Dartford Crossing with 40mph average speed restrictions and complex traffic management affecting millions of journeys. Even when the scheme is complete, there would be limited improvement for drivers as the current 50mph speed limit and closely spaced junctions would remain.

4.3.4 A crossing at Location A would offer poor value for money and would perform poorly against other scheme objectives (safety, noise & air quality).

4.3.5 A new crossing at Location A would not meet the transport and economic objectives and should not therefore be taken forward for public consultation.

5 Location C Routes north of the River Thames

5.1 Introduction

5.1.1 This section presents a summary of the appraisal of the route choice at Location C to the north of the River Thames against the Scheme Objectives. The three routes appraised (Routes 2, 3 and 4) have been developed through engagement with local authorities (refer to **Figure 5.1**).

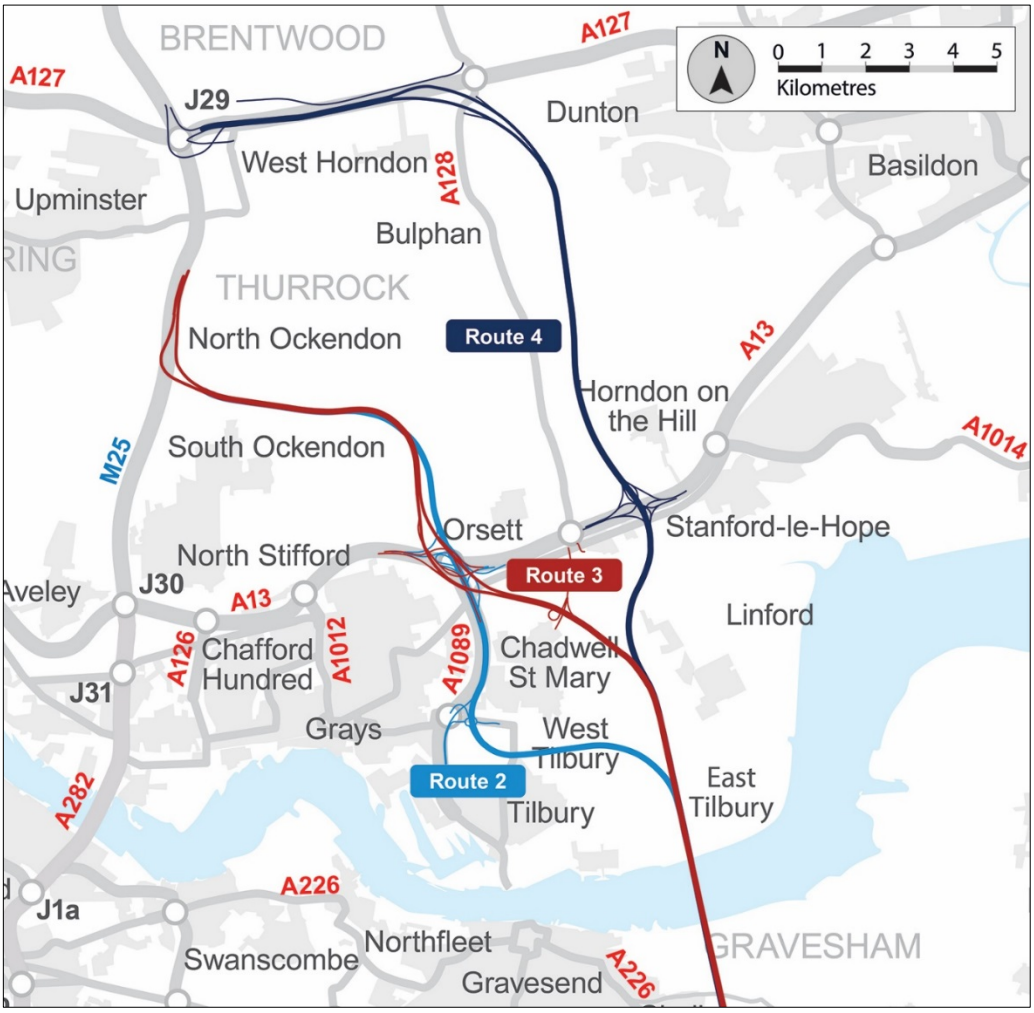

FIGURE 5.1 - CHOICE OF ROUTE 2 OR ROUTE 3 OR ROUTE 4 AT LOCATION C

5.2 Appraisal

5.2.1 All alternatives perform similarly in terms of solving the transport challenges and unlocking economic potential. All three routes pass through greenbelt land in Essex and would have a significant impact on the landscape character.

Route 2

5.2.2 Route 2 is closest to existing urban areas and therefore has greater noise and air quality impacts. It also has greater heritage impacts and affects an Environment Agency flood compensation area. It also uses the existing road network (the A1089 which connects Tilbury Port to the A13); the quality of the solution is constrained and would not provide a fully modern high quality new route. There would also be disruption to the A1089 during construction which would affect HGV traffic to the port. Route 2 has environmental impacts similar in scale to Routes 3 and 4.

Route 3

5.2.3 The choice between Routes 3 and 4 is finely balanced. Route 3 is preferred as it is a shorter, lower cost option than Route 4, and would provide a completely new 70mph road, therefore providing the highest quality of solution of the three routes. Routes 2 and 3 have a similar capital cost.

5.2.4 Route 3 has the lowest overall environmental impact, although a substantial part of the route is within designated greenbelt land.

Route 4

5.2.5 Route 4 would require upgrading the A127 and an upgraded junction where the A127 joins the M25, which would affect ancient woodland and a registered park and garden. The overall route is longer and more expensive as a result, but provides a high quality 70mph solution. This option would support future development in the area, including the possible housing development proposals being considered jointly by Basildon and Brentwood at Dunton Garden Suburb.

5.2.6 All three routes generate similar levels of economic benefits with Route 3 generating the highest at £3.9bn (PVB) in direct benefits compared to £3.8bn (PVB) for Route 4 and £3.7bn (PVB) for Route 3 (all with ESL). Similar levels of economic benefit are generated because all three routes have broadly the same congestion relief impact at the existing Dartford Crossing with differences accounted for by the impact on arterial routes such as the A13 and A127.

5.2.7 The capital and O&M costs, together with the Benefit Cost Ratios (BCRs) are shown in **Table 5.1** (based on Routes 2, 3 and 4 with a bored tunnel river crossing and ESL).

TABLE 5.1 - COSTS AND BENEFIT COST RATIOS FOR ROUTES 2, 3 AND 4

		Route 2	Route 3	Route 4
		(With Bored Tunnel and ESL)		
Capital Cost Range (P50/P90 Out-turn)		£4,294m to £5,981m	£4,279m to £5,937m	£4,620m to £6,390m
O&M Costs over 60 years		£553m	£586m	£607m
Value for Money	Initial BCR	2.2 to 1.6	2.3 to 1.7	2.1 to 1.5
	Adjusted BCR	3.3 to 2.4	3.4 to 2.5	3.1 to 2.2

Environmental Impacts

5.2.8 In respect of air quality, properties within the vicinity of Routes 2, 3 and 4 would not experience exceedances or a risk of exceedances as they are predicted to be well within EU limits. Generally levels at the properties that are closest to Routes 2, 3 and 4 are in the order of 20 µg/m³ in the Without Scheme scenario and in the With Scheme scenario levels decrease or increase by only 1 µg/m³ (recognising that the EU limit value is 40 µg/m³).

5.2.9 The noise appraisal used a study area that was confined to main roads within the vicinity of Routes 1, 2, 3 and 4. From all of the roads considered, properties within 600m were modelled to determine whether there would be an improvement or a deterioration in noise level. The modelling has demonstrated that there would be a net noise benefit with Routes 2, 3 and 4. Overall Route 4 provides the largest benefit, followed by Route 3, and then Route 2.

5.2.10 Within the vicinity of each of the routes there would be properties experiencing an increase in noise as a result of new traffic or increases in traffic on some existing roads whereas there would be reductions in traffic and therefore noise levels on other roads, including the A282 at Dartford and the A2.

5.3 Conclusions

5.3.1 Route 3 would provide the shortest route, the greatest improvement to journey time and, being an entirely new road, would deliver a modern high quality road. It would also have the lowest environmental impact of the three options.

5.3.2 It is recognised that all three routes have the potential to unlock opportunities for housing and jobs and all offer high value for money. They each meet the transport objectives, although they offer different opportunities to connect with local roads. While there are important differences in the local and environmental impacts of each option, it is considered that all three routes are viable, and should be taken forward to public consultation.

6 Location C Crossings

6.1 Introduction

6.1.1 This section presents a summary of the appraisal of the different crossing types at Location C against the Scheme Objectives and explains the choice which will be taken forward in the consultation.

6.1.2 The location for a crossing structure is dictated by physical and environmental constraints (refer to **Figure 6.1**). These result in a narrow corridor for the crossing, bounded by Gravesend to the west and environmentally sensitive sites to the east. A crossing west of this point would impact on residents and property, whilst moving further east would impact on these sensitive sites.

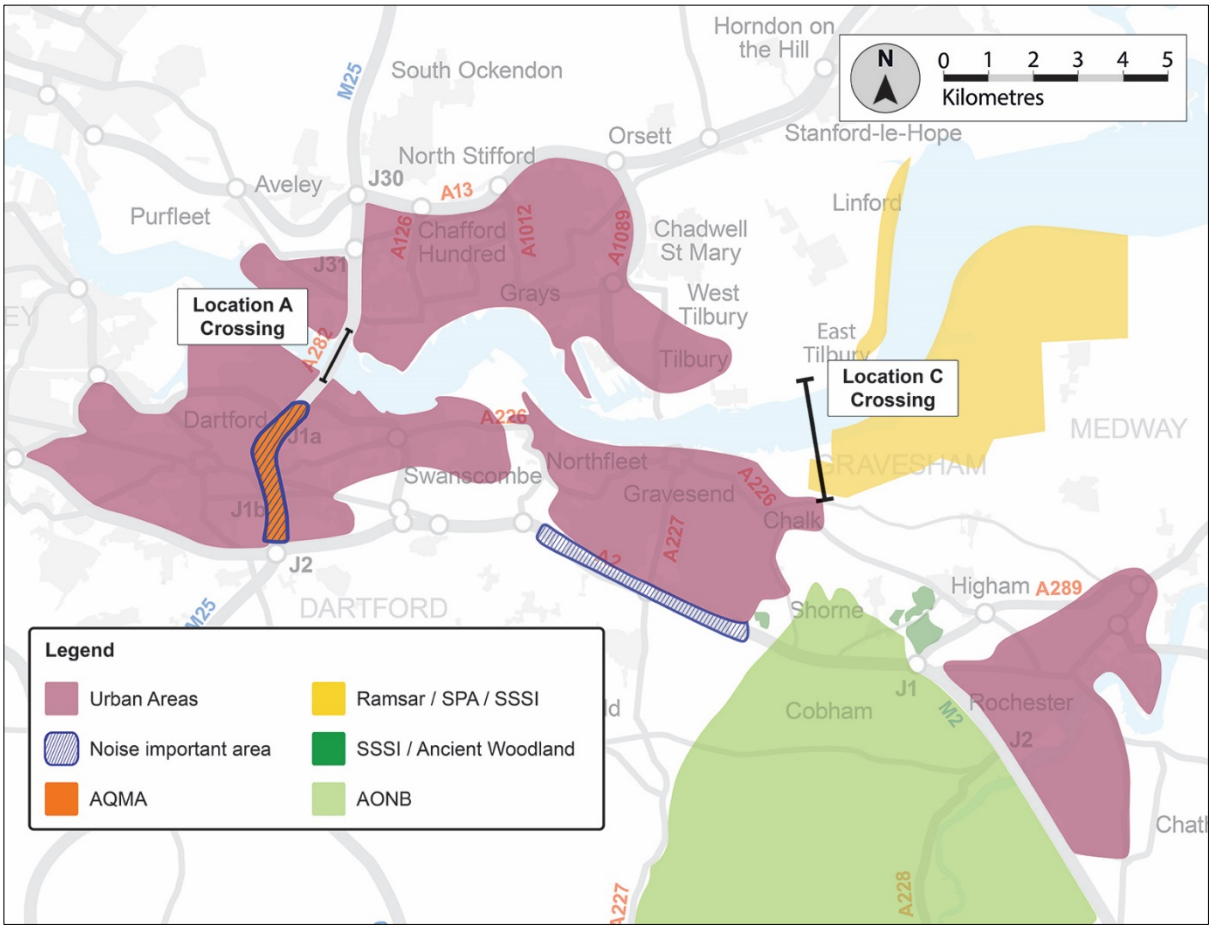

FIGURE 6.1 - CROSSING LOCATION SHOWING URBAN AND ENVIRONMENTAL CONSTRAINTS

6.1.3 The protected sites include the Thames Estuary and Marshes Ramsar site and Thames Estuary and Marshes Special Protection Area (SPA). These are sites of European value and are given the highest level of protection in UK law under the Habitats Regulations.

6.1.4 The choice of crossing type at Location C is determined by potential direct or indirect impacts on the protected sites; this is the overriding consideration (refer to SAR Volume 6, Section 5). Other factors such as construction costs

and economic benefits are all broadly similar and are not sufficiently material to influence the final choice (refer to **Table 6.1**).

TABLE 6.1 - COSTS AND BENEFIT COST RATIOS FOR LOCATION C RIVER CROSSINGS

		Bridge	Bored Tunnel	Immersed Tunnel
		(With Route 3 and ESL)		
Capital Cost Range (P50/P90 out-turn)		£4,240m to £5,458m	£4,279m to £5,937m	£4,438m to £6,063m
O&M Costs over 60 years		£344m	£586m	£563m
Value for Money	Initial BCR	2.4 to 1.8	2.3 to 1.7	2.3 to 1.6
	Adjusted BCR	3.5 to 2.7	3.4 to 2.5	3.3 to 2.4

6.1.5 Within the Location C crossing corridor three crossing types are all technically feasible (refer to SAR Volume 4):

- Bridge
- Bored tunnel
- Immersed tunnel

6.1.6 Under the Habitats Regulations, the consideration of alternatives is a prerequisite in the event of significant adverse effects on a European Site being likely. A scheme may only be granted consent in the absence of alternative solutions that would achieve the scheme objectives with lesser impacts on the European Site.

6.1.7 Counsel advice has been obtained and has been incorporated in the appraisal at the appropriate points below.

6.2 Appraisal of a bridge

6.2.1 The construction of a bridge at the western extents of the Ramsar/ South Thames Estuary and Marshes SPA could cause a number of negative impacts which may not be easily mitigated. These include habitat loss/ deterioration of coastal grazing marsh and intertidal mudflats, shading and disturbance/ mortality of SPA qualifying species (e.g. through collision with a new bridge structure and moving vehicles). In addition a bridge would also create a barrier effect, discouraging access to land further west that is currently used by SPA species.

6.2.2 It should also be noted that both freshwater habitats and intertidal mudflat habitat are difficult to replace and compensate for and may take a long time to become effective.

6.2.3 The new bridge crossing would pass through the western extent of the site, which is currently agricultural land (although habitat improvement is currently taking place through a grazing regime at Higham Marsh, which is being managed as an RSPB reserve and is therefore likely to improve in quality).

6.2.4 There would be a direct impact on the Canal and Grazing Marsh Higham Local Wildlife Site (LWS) and on the rMCZ and its associated habitats and species due to habitat loss/ deterioration and disturbance.

6.2.5 There would be a direct effect on Goshems Farm Local Wildlife Site which is an important site for rare Thames Terrace invertebrates and may provide important high tide roosting habitat for SPA interest features. If a bridge were to be considered further it will be necessary to undertake surveys to better understand the level of risk associated with the wildlife site and its role as functional habitat to the European Sites.

6.2.6 There is a significant risk of a bridge not being permissible under the Habitats Assessment because a less damaging alternative exists (refer to bored tunnel below). Counsel has confirmed that a bridge option would be very unlikely to be deliverable in this location.

6.3 Appraisal of a bored tunnel

6.3.1 A bored tunnel would not impact the marine environment and the coastal/ terrestrial impacts would be greatly reduced in comparison to the construction of a bridge (where permanent effects for example from loss of habitat and shading effects could occur) or immersed tunnel (with very large impacts on habitats and species during construction).

6.3.2 The location of the northern tunnel portal and its works area, would impact on an area of historic coastal grazing marsh and LWS (Goshems Farm). These support a diverse range of Red Data Book invertebrates and may also provide important functionally linked land for the SPA designated species (e.g. high tide roost).

6.3.3 There would be no direct impact on the Ramsar site and the tunnel portal location has been selected to minimise biodiversity effects.

6.3.4 The provision of a new bored tunnel crossing presents lower consenting risks from a Habitats Regulations perspective as it offers a less damaging alternative to either a bridge or immersed tunnel crossing. Counsel has confirmed this position.

6.3.5 Of the three crossing types, a bored tunnel has the highest construction risk profile because of the uncertainty of ground conditions which have not yet been surveyed. Good understanding exists of the risks associated with driving tunnels in this location as a result of High Speed 1 (2001) and cable tunnels (2007). The risk profile for tunnelling at location C will be in line with other tunnelling works in east London (refer to SAR Volume 4, Section 6).

6.3.6 A bored tunnel is a more complicated and expensive solution to own, operate and maintain (refer to SAR Volume 4, Section 5). The cost comparisons for the crossing types are set out in **Table 6.1**.

6.4 Appraisal of an immersed tunnel

6.4.1 The construction of an immersed tunnel has the potential for large adverse impacts on the Thames Estuary rMCZ and its associated species and habitats due to habitat loss/ deterioration and disturbance. Whilst the significance of the potential hydrodynamic effects is uncertain, the effects are estimated to extend beyond 6km upstream or downstream of the crossing. However, the size of the rMCZ is such that it is unlikely that the integrity of the site would be affected by an immersed tunnel, assuming appropriate levels of avoidance, mitigation and compensation were put in place.

6.4.2 Significant impacts on the Thames Estuary and Marshes Ramsar and South Thames Estuary and Marshes SPA may be caused by the cut and cover for the southern section of the tunnel. This is due to potential changes in hydrology, which could have significant impacts on this area of wetland habitat and species that it supports (including SPA qualifying species). Impacts on freshwater and intertidal habitats would be difficult to mitigate for. Disturbance to SPA qualifying species during construction is also likely to be significant (given the proximity of the crossing to the SPA boundary).

6.4.3 The location of the north portal currently could have a significant impact on an area of historic coastal grazing marsh and Goshems Farm Local Wildlife Site, which supports a diverse range of Red Data Book invertebrates and may be also provide important functionally linked land for the SPA designated species (e.g. high tide roost).

6.4.4 The provision of a new immersed tunnel crossing could potentially have consenting risks from a Habitat Regulations Assessment perspective as a less damaging alternative exists (refer to bored tunnel). Counsel has confirmed that an immersed tunnel option would be very unlikely to be deliverable in this location.

6.5 Conclusions

6.5.1 The appraisal has demonstrated the risk of significant effects to European Sites with both the bridge and the immersed tunnel options.

6.5.2 In this case a **bored tunnel** is the only viable alternative as it meets the scheme objectives and is the least damaging alternative. This conclusion has been supported by advice provided by Counsel.

7 Location C Routes south of the River Thames

7.1 Introduction

7.1.1 This section presents a summary of the appraisal of the different routes to the south of a crossing at Location C against the Scheme Objectives and provides a recommendation as to the way forward.

7.1.2 At Location C there are two alternative route options south of the river in Kent, the Western Southern Link (WSL) and the Eastern Southern Link (ESL). These would both have an impact on existing communities and protected sites, but differ in terms of impact on transport and economics.

7.1.3 A Western Southern Link (refer to **Figure 7.1**) would connect to a new junction on the A2, along the urban boundary of Gravesend. This would be constrained by the High Speed 1 rail line and existing development. Due to the constrained site the junction would need to be of compact design and, as such, link road design speeds would be limited to 30-50 mph, and would not provide a “motorway-to-motorway” connection.

FIGURE 7.1 - WESTERN SOUTHERN LINK

7.1.4 An Eastern Southern Link (refer to **Figure 7.2**) would provide a direct connection from the M2 to the M25 north of the river. This would create a “motorway-to-motorway” connection and, in conjunction with Route 3 north of the river, create a high quality 70mph road along its entire length.

FIGURE 7.2 - EASTERN SOUTHERN LINK

7.2 Appraisal

7.2.1 Both links have a similar impact in respect of their effect on the existing Dartford Crossing by attracting similar volumes of traffic to the new crossing location and providing similar levels of congestion relief. In traffic terms, the WSL routes more traffic onto the A2, some sections of which are already congested.

7.2.2 In economic terms the ESL generates greater benefits than the WSL. The ESL provides a direct connection between the M2 and the M25 generating an estimated £560m in benefits for an additional cost of £200m. Refer to **Table 7.1** for costs and BCRs.

TABLE 7.1 - COSTS AND BENEFIT COST RATIOS FOR LOCATIONS SOUTH OF THE RIVER THAMES

		WSL	ESL
		(with Route 3 and bored tunnel)	
Capital Cost Range (P50/P90 Out-turn)		£4,078m to £5,723m	£4,279m to £5,937m
O&M Costs over 60 years		£569m	£586m
Value for Money	Initial BCR	2.1 to 1.5	2.3 to 1.7
	Adjusted BCR	3.1 to 2.2	3.4 to 2.5

7.2.3 ESL provides a more direct route for the dominant traffic flow between Kent and Essex, saving a detour of 3.2 miles. In contrast very little traffic is anticipated to divert from the M25, via Location C, to re-join the M25 avoiding congestion at the Dartford Crossing. The WSL requires traffic to access the M2 via the A2, compared with the direct connection to the M2 provided by the ESL.

7.2.4 Both links would have an environmental impact. The ESL would have an impact on local communities as well as cultural heritage and landscape. These include areas of the Kent Downs Area of Outstanding Natural Beauty and areas of ancient woodland.

7.2.5 The WSL affects Claylane Wood ancient woodland and Shorne and Ashenbank Woods SSSI but has less overall impact than ESL. The ESL would impact upon areas of ancient woodland and local wildlife sites east of Shorne and Great Crabbles Wood SSSI. The WSL would have less impact on the Kent Downs Area of Outstanding Natural Beauty than the ESL.

7.2.6 Both the ESL and WSL would have limited impact on air quality immediately adjacent to the routes. Generally levels at the properties that are closest to these routes are in the order of 20 µg/m³ in the Without Scheme scenario and in the With Scheme scenario levels decrease or increase by only 1 µg/m³ (recognising that the EU limit value is 40 µg/m³).

7.2.7 Within the vicinity of each of the routes there would be properties experiencing an increase in noise as a result of new traffic or increases in traffic on some existing roads, this would be offset by reductions in traffic on other roads, including the A282 at Dartford and the A2.

7.2.8 The WSL and ESL both potentially impact the setting of listed buildings. The WSL is close to the conservation area of Thong, whereas the ESL is close to the conservation area of Shorne. The WSL involves less potential property demolition than the ESL.

7.3 Conclusions

7.3.1 The ESL is identified as the option which best meets the scheme objectives. It creates a “motorway-to-motorway” link, provides the greatest improvement in journey times and would generate significantly better economic benefits, as a more direct route between the M2 and M25.

7.3.2 While there are important differences in the local and environmental impacts of each option, it is considered that both routes are viable, and should be taken forward to public consultation.

8 Proposed Scheme

8.1 Introduction

8.1.1 This section presents the summary of the detailed appraisal of the proposed scheme (refer to **Figure 8.1**), developed from the conclusions made in Sections 5, 6 and 7:

- Section 5 - Route 3 as the northern link
- Section 6 - Bored tunnel crossing
- Section 7 - Eastern Southern Link as the southern link.

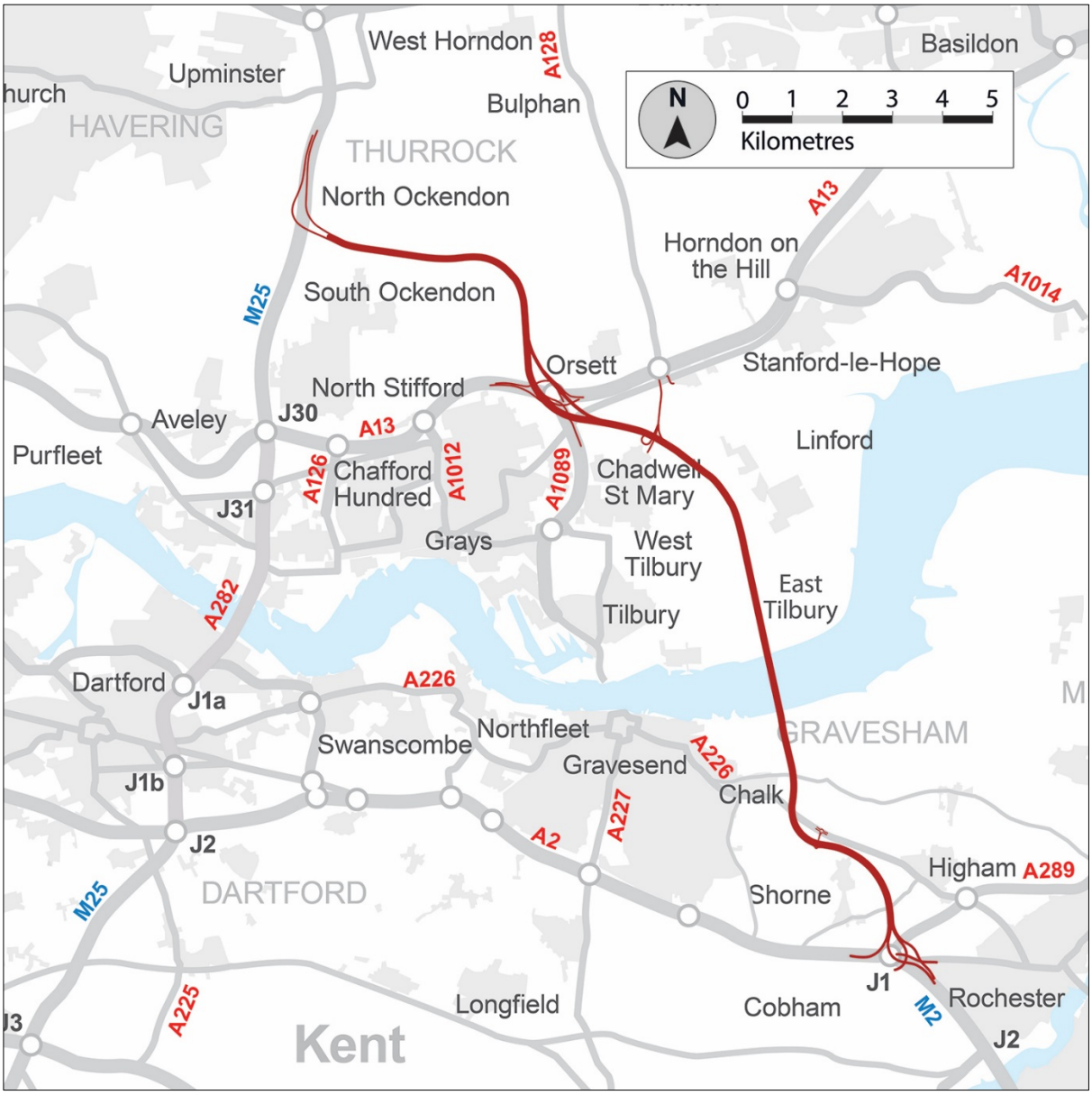

FIGURE 8.1 - PROPOSED SCHEME

8.1.2 In transport terms, Location C (Route 3) is a new network connection, linking key areas of Ebbsfleet and Swanscombe in the south and Tilbury, London Gateway Port and Thurrock in the north, and enabling significant economic growth in these areas. Importantly, it provides network resilience by avoiding the existing Dartford crossing by leaving the M25 between Junction 30 and Junction 29, and re-joining the M2 at Junction 1.

8.1.3 Free-flow junctions at the M25 and M2 will ensure that the new road has a "motorway-to-motorway" experience.

8.2 Appraisal

8.2.1 As a direct connection between the M2 and M25, bypassing the existing Dartford crossing, Location C provides congestion relief to the existing crossing. Location C would draw 14% of existing traffic away from Dartford, improving journey times on the existing crossing by up to 5 minutes in peak time, and improving journey times from Kent to the M25 by up to 12 minutes using the new crossing.

8.2.2 Lower traffic volumes using the A282 would reduce the impact on Dartford and Thurrock if there is an incident or closure of a section of the A282 since there would be an alternative route for traffic, improving overall network resilience.

8.2.3 Location C would provide a high quality modern route with safer journeys on a 70mph road. North-south crossing capacity of the river Thames, east of London, would increase by 70% in the opening year and, as a new route constructed separately from the existing crossing, it would minimise impacts to the existing Dartford corridor.

8.2.4 Location C would unlock significant economic growth and offers higher transport performance in terms of safety, capacity and resilience. Significant growth and regeneration would be enabled, improving access to jobs and services and providing opportunities for businesses.

8.2.5 The capital and O&M costs and Benefit Cost Ratios of the proposed scheme are presented in **Table 8.1**.

TABLE 8.1 - COSTS AND BCR LOCATION C, ROUTE 3, BORED TUNNEL AND ESL

		Location C, Route 3, Bored Tunnel and ESL
Out-turn Capital Cost Range P50/ P90 (£m)		£4,279m to £5,937m
O&M Costs over 60 years (£m)		£586m
Value for Money	Initial BCR	2.3 to 1.7
	Adjusted BCR	3.4 to 2.5

8.2.6 Another important consideration is that construction of the proposed scheme could be undertaken without impacting the already congested Dartford corridor, as well as being constructed largely off-line.

8.2.7 There are important environmental considerations with the proposed scheme at Location C. Route 3 north of the River Thames would have impacts on the greenbelt and would affect the landscape character. It will also affect a scheduled ancient monument and two Grade II listed buildings. In respect of air quality the reduction in traffic as a result of the proposed scheme would improve air quality around the A282 which is already at risk of exceeding Air Quality Strategy Objectives (AQSO) targets.

8.2.8 Similarly in respect of noise impacts the proposed scheme would reduce noise around the A282 due to lower traffic volumes. However, within the vicinity of the proposed scheme there would be properties experiencing increases in noise as a result of new traffic or increases in traffic on existing roads.

8.2.9 The environmental issues with the proposed bored tunnel at Location C have been outlined in detail in Section 6. In summary, there are environmentally sensitive sites south of the river which are valuable wetland habitats, the Thames Estuary and Marshes Ramsar site and the Thames Estuary and Marshes Specially Protected Area. These are recognised internationally and protected by law. While a bridge, immersed tunnel or bored tunnel are all feasible, only a bored tunnel would generate the least noise and visual impact, and would have the least impact on the protected habitats and species by minimising disturbance over much of its length.

8.2.10 South of the river the proposed scheme would impact Shorne Village, would have a greater impact on ancient woodland, the Kent Downs Area of Outstanding Natural Beauty and would affect a Site of Special Scientific Interest (SSSI) Great Crabbies Wood. As for the proposed scheme north of the River Thames there would also be noise and air quality impacts. However, properties within the vicinity of the proposed scheme would not experience exceedances in respect of air quality. Generally levels at the properties that are closest to Location C (Route 3) are in the order of 20 µg/m^3 in the Without Scheme scenario and in the With Scheme scenario levels decrease or increase by only 1 µg/m^3 (recognising that the EU limit value is 40 µg/m^3).

8.2.11 For noise, properties within the vicinity of the proposed scheme would experience an increase in road noise as a result of increased traffic on new and existing roads. It would also require the potential demolition of a number of properties.

8.3 Conclusions

8.3.1 The Options Selection process has concluded that a new river crossing at Location C incorporating Route 3 with a bored tunnel and the Eastern Southern Link best meets the scheme objectives and balances the needs of road users, the community, the environment and business. It is recommended on the grounds that it:

- Provides the best economic benefits of all the shortlist routes evaluated and reduces traffic at Dartford and therefore reduces congestion.
- Can be constructed largely off-line avoiding the disruption caused by on-line works at Location A.
- Provides network resilience through a second independent crossing of the Thames.
- Provides a “motorway-to-motorway” experience for drivers.
- Reduces the air and noise pollution along the existing A282 corridor at Dartford, whilst recognising that there are environmental and community impacts in the vicinity of the new scheme, including noise and air quality on communities alongside the proposed scheme.
- Will provide a new strategic link to the local, regional and strategic road network, increasing resilience and addressing future increases in traffic demand.

8.3.2 This scheme has been confirmed as being Highways England’s proposed scheme for a new crossing of the Lower Thames and will be taken forward for further public consultation.

8.4 Highways England’s Proposed Scheme

In Summary…

8.4.1 The proposed scheme would consist of a 70mph dual carriageway leaving Junction 1 of the M2 motorway in north Kent close to the edge of Rochester, via the Eastern Southern Link, crossing the River Thames in a bored tunnel, and joining the M25 between Junctions 29 and 30 near South Ockendon.

8.4.2 The new road would be 15 miles long and consist of a 2-mile twin bored tunnel. During development of the design, consideration will be given to the provision of an additional lane in each direction of the tunnel to allow for future-proofing.

8.4.3 The estimated construction cost of Route 3 with the Eastern Southern Link and a bored tunnel is £4.3bn - £5.9bn.

8.4.4 **Figures 8.2** and **8.3** show the tunnel portals south and north of the Thames.

FIGURE 8.2 - TUNNEL PORTAL SOUTH OF THE RIVER

FIGURE 8.3 - TUNNEL PORTAL NORTH OF THE RIVER

Improved access - Channel Tunnel and Port of Dover

8.4.5 A proportion of the existing traffic using the existing Dartford crossing has an origin or destination at the Channel Tunnel and the Port of Dover. The proposed scheme would provide drivers with an improved route avoiding the current congestion problems of Dartford and better more reliable journeys.

8.4.6 Drivers using the new crossing would save almost 14 minutes between Essex and north Kent compared to using the existing Dartford crossing. Removal of long distance traffic from the Dartford Crossing also provides benefits by freeing up capacity and relieving congestion, giving a 5 minute time saving for drivers who continue to use the crossing.

Better Driver Experience

8.4.7 The proposed scheme would provide a fundamentally different experience from today. It would be built to the modern design standards and provide a high quality “motorway-to-motorway” experience for road users with direct connections to the M25 and M2. Drivers would leave the M2 via dedicated slip roads and re-join the M25 between Junction 29 and Junction 30, also via dedicated slip roads.

Improved Network Resilience

8.4.8 Analysis shows that resilience of the motorway network is of critical importance to drivers using the M25. Journeys through the existing Dartford crossing can be disrupted for a number of reasons often leading to very long delays with the crossing taking, in some cases, all day to recover to normal traffic conditions. The proposed scheme, incorporating a new crossing, would reduce dependence on the smooth running of the existing crossing and connecting roads leading to an overall increase in network resilience.

Supporting Economic Growth

8.4.9 The proposed scheme would generate significant economic benefits as it provides congestion relief to the existing Dartford Crossing, and it also provides congestion relief to other important roads, such as the A2, the M20 and the A13, which are all significant for the economies of Essex and Kent.

High Value for Money

8.4.10 The proposed scheme is the shortest route and generates the largest economic benefits of the three routes at Location C. It has a benefit to cost ratio range of 2.3 (initial) and 3.4 (adjusted) representing high value for money and generates more revenue from user charges compared to a solution at Location A.

8.4.11 Total traffic across the Thames with the proposed scheme is higher by 20,000 vehicles in 2025 compared to Location A supporting jobs and growth.

User Charges for Lower Thames

8.4.12 In line with government policy a user charge at the existing Dartford Crossing would be retained and the two crossings managed together to ensure the best use of capacity. The precise charging strategy will be developed at a later phase of the project.

Environmental Impact

8.4.13 Where possible environmental impacts of the new route will be mitigated. At the crossing location, it is recognised there are specially protected wildlife habitats. For this reason a bored tunnel is proposed to avoid any direct impacts.

9 Routes for Public Consultation

9.1 Summary

9.1.1 Having taken into account the existing conditions, the nature of the problems at Dartford and the needs and plans for the area, it is recommended that a scheme at Location C, following Route 3, with bored tunnel crossing and an Eastern Southern Link best matches the scheme objectives and balances the needs of road users, the community, the environment and business.

9.1.2 The detailed scheme appraisal presented in the SAR has shown that a crossing at Location A would not solve the traffic problem at Dartford and would do little for the economy locally, regionally or nationally.

9.1.3 The scheme appraisal of the shortlist routes also concluded that northern Routes 2, 3 and 4 together with the Eastern Southern Link and the Western Southern Link are viable and meet the scheme objectives. These are the routes that will be taken forward to consultation (refer to **Figure 9.1**).

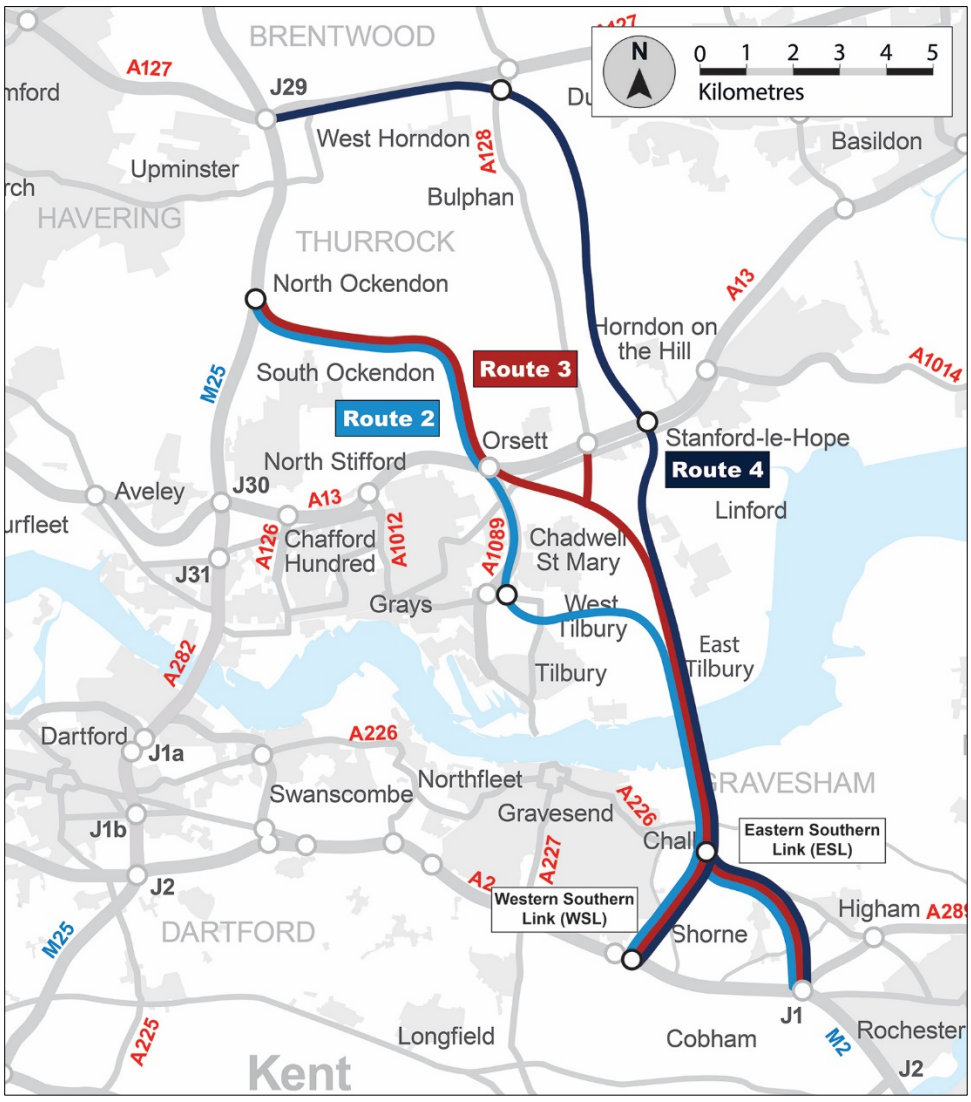

FIGURE 9.1 - ROUTES FOR CONSULTATION

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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.