



# Lower Thames Crossing

Technical Appraisal Report  
Volume 1: Executive Summary

Report no HA540039- HHJ-ZZZ-REP-ZZZ-009

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Working on behalf of Highways England

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## Technical Check

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## Approval

Role	Name	Signature	Date
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This report has been prepared for Highways England in accordance with the terms and conditions of appointment stated in the PSF Framework Agreement (Lot 1, 2 and 5 award letters dated 6 April 2011). Halcrow Hyder JV cannot accept any responsibility for any use of or reliance on the contents of this report by any third party.

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The designs shown and described in this Technical Appraisal Report have been developed for the initial appraisal of options as part of the options phase, and may be subject to change in later stages of the scheme development.

## 1 Purpose of the Technical Appraisal Report

This Technical Appraisal Report (TAR) reports on the existing problems at the Dartford Crossing and the need for a new crossing. It builds on earlier work undertaken in looking at alternative solutions, and summarises the traffic, economic, safety and environmental appraisal of a longlist of options and recommends the shortlist of options to be appraised in more detail. The appraisal of the shortlist of options will be reported in the Pre-Consultation Scheme Assessment Report.

The TAR is produced as part of Highways England Project Control Framework (PCF) process during Stage 1 (Option Identification) and included in the documentation reviewed at Stage Gateway Assessment Review 1 (SGAR 1).

## 2 Previous studies

In 2009 the Department for Transport (DfT) commissioned consultants Parsons Brinckerhoff to carry out a study to look at options to relieve congestion at the Dartford-Thurrock river crossing.<sup>1</sup> The study identified five possible option locations, and concluded that two options (D and E) should be rejected and three options (A, B and C) offered the greatest benefits in terms of relieving congestion at the existing crossing and should be assessed further. In 2012 the DfT appointed consultants AECOM to appraise the three option locations A, B and C for a new Lower Thames Crossing. Following this appraisal and a consultation period, the DfT announced in December 2013 that there were sufficient grounds to disregard Option B.<sup>2</sup>

On 15 July 2014, the Secretary of State for Transport confirmed there was a need for a new crossing, but there was then no clear preference on its location, and that further work needed to be carried out to develop and appraise route options at locations A and C, including C Variant. Location A is at, or close to, the existing crossing and Location C is a new link connecting the A2/ M2 near Gravesend with the M25 north of the Thames. C Variant is an improvement to the A229 connecting the M2 and M20, which can be combined with an option at either Location A or C. The Secretary of State response also stated that consultation on a proposed solution was expected to take place in late 2015 or early 2016, and that a new crossing is expected to be opened in 2025 if publicly funded.

In May 2014, DfT handed over the scheme to the Highways Agency (now Highways England) to develop the scheme through the options phase, including identification and appraisal of route options at Locations A and C (including C<sub>variant</sub>), and development of a proposed scheme. Halcrow Hyder Joint Venture (HHJV) was appointed as technical adviser by Highways England in June 2014. **Figure 1** shows the timeline of the previous studies undertaken.

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<sup>1</sup> Dartford River Crossing Study into Capacity Requirement: <http://webarchive.nationalarchives.gov.uk/+http://www.dft.gov.uk/about/strategy/capacityrequirements/dartfordrivercrossing/>

<sup>2</sup> Options for a New Lower Thames Crossing Consultation Document: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/210750/consultation-document.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/210750/consultation-document.pdf)

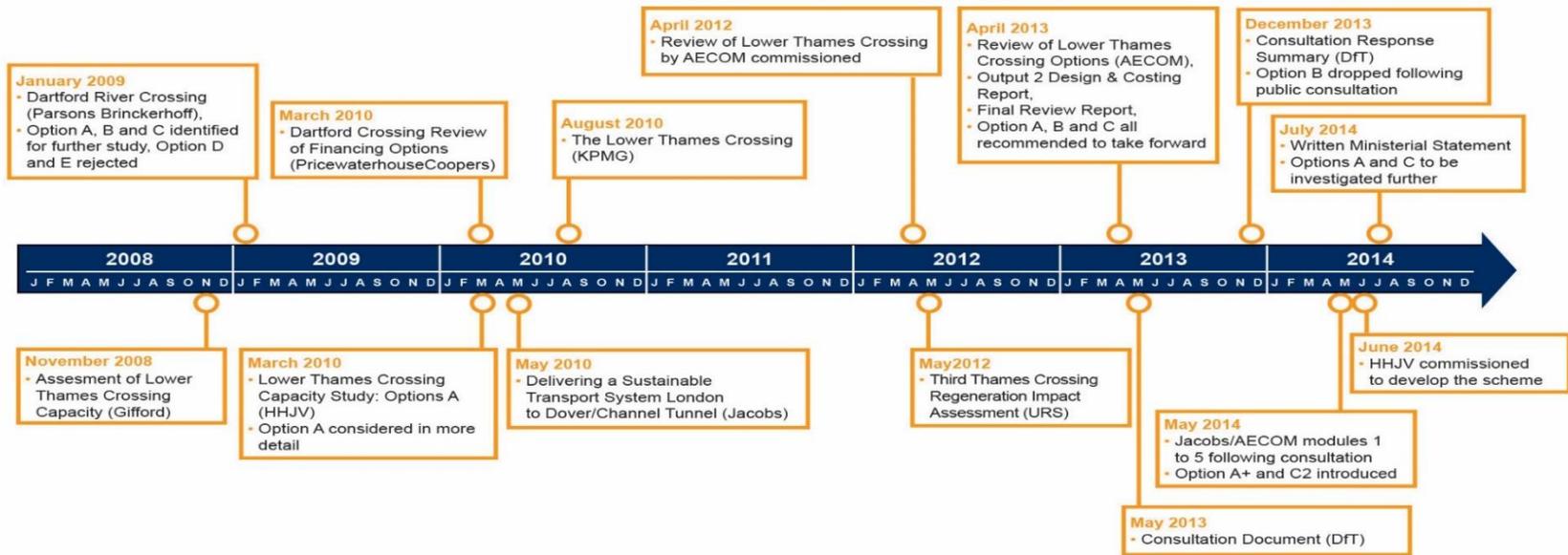


Figure 1: Timeline of Previous Studies

### 3 Existing conditions

Figure 2 shows the location of the existing Dartford Crossing. Figure 3 shows the study area for the options identification work.

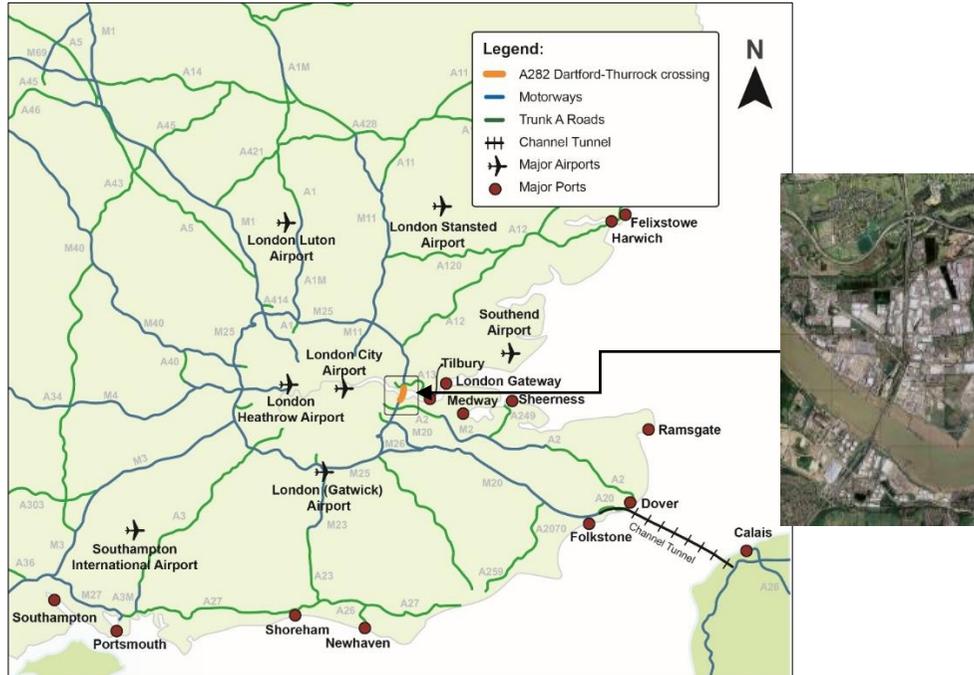


Figure 2: Location of scheme

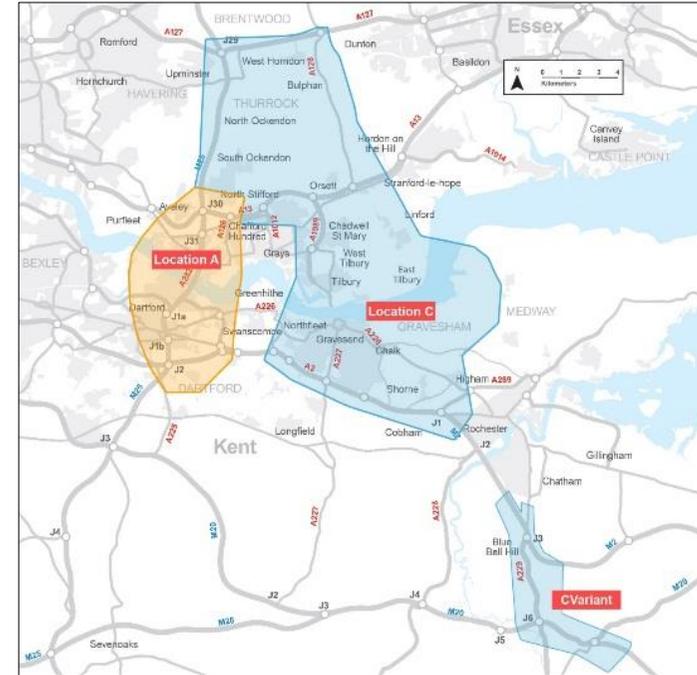


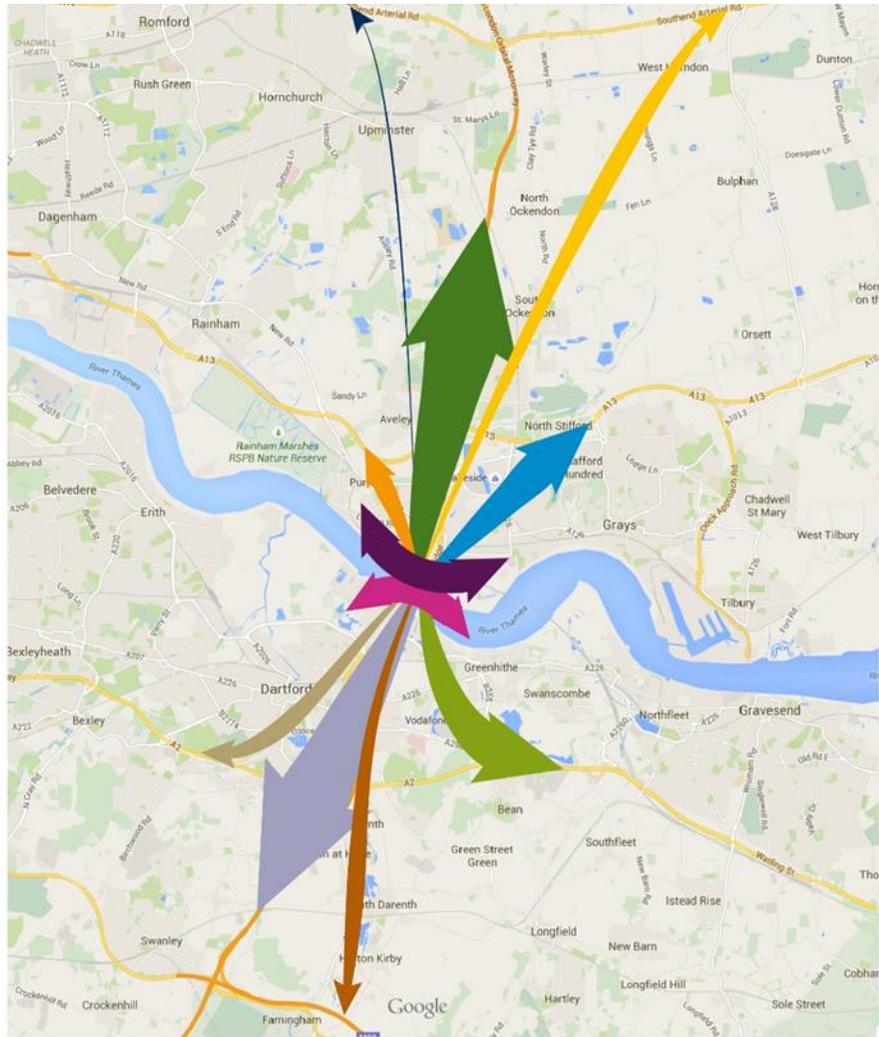
Figure 3: Study Area

### 3.1 Traffic conditions

Since 1963, The Dartford-Thurrock crossing (A282) has provided a vital connection between the north and south of the river. It is the only crossing of the Thames on the Strategic Road Network east of London. The original single tunnel Dartford-Thurrock river crossing was opened in 1963 with an additional tunnel added in 1980. In 1991 the Queen Elizabeth II (QEII) Bridge was opened, with northbound traffic using the tunnels and southbound traffic using the bridge. This arrangement provides four lanes of traffic flow in each direction.

The crossing is a major national and international route, serving traffic travelling to and from north of the River Thames to South London, Kent, Sussex and continental Europe via the Kent ports and the Channel Tunnel. It is also part of the Trans European Road Network. Road freight from Europe passes through Dover and the Channel Tunnel and needs to use the crossing to access the rest of the UK. In addition, large volumes of traffic use the A282/ M25 for relatively short journeys. The existing Dartford Crossing has over 50 million users per year, with typical daily traffic flows of 140,000, which is in excess of the design capacity of 135,000. Regional traffic has continued to grow whilst the cross river traffic is constrained by the Dartford Crossing capacity. Congestion has become more frequent resulting in more incidents and less reliable journey times. Currently up to 19% of the traffic is made up of HGVs, including those that connect the ports and distribution centres in the South East with the Midlands and the North. **Figure 4** shows the split of traffic using the crossing by destination.

Demand for crossing the Thames is forecast to continue to increase leading to even more congestion and longer and less reliable journey times. Nationally road traffic on strategic roads is forecast to increase by over 37% between 2015 and 2040; traffic levels at the Dartford crossing would be expected to replicate the increases in national traffic levels if not constrained by the current crossing capacity. South East England is forecast to experience higher population growth than the rest of the country and this could also produce significant demand for enhanced river crossing capacity.



2041 without scheme - TRAFFIC FLOW PATTERNS USING THE DARTFORD CROSSING (average of AM/PM Peak)

average number/hour

- 1,657  M25 J31 (Local traffic)
- 641  A13 West
- 1,277  A13 East, and its other east junctions
- 72  A127 West
- 588  A127 East and its east junctions
- 2,466  M25 Northbound
- 1,526  A2 East and M2
- 220  A2 West
- 586  M20
- 2,522  M25 Southbound
- 1,951  M25 J1A. 1B – Local traffic

Figure 4: Traffic using the existing crossing by destination

## **3.2 Reliability, Resilience and operational constraints**

### ***Unreliable journey times***

Reliability of journey times is poor due to a combination of configuration and infrastructure constraints. As delays and congestion are the norm, many businesses now allocate more time to getting across the river at Dartford. This 'slack time' has economic repercussions and an impact on productivity.

### ***Impact of incidents and unplanned events***

In 2014 there were 25 unplanned closures due to incidents of between 1 and 3 hours, and 350 unplanned closures of up to an hour. In high winds, the QEII Bridge has to be closed. Incidents and unplanned events at the crossing and its approaches can have a significant impact over a wide area of the network.

### ***Existing northbound tunnel restrictions***

Poor geometry restricts speeds locally to 30mph. The existing west tunnel has a height restriction of 4.8m. Vehicles carrying hazardous substances require escorting through the tunnels. There are on average 800-900 vehicle escorts per week; each can hold up traffic for 2 minutes; full closures of up to 10 minutes are sometimes required. All of these restrictions cause a capacity bottleneck for northbound traffic.

### ***Existing design speed and weaving of traffic***

The existing design speed between Junction 1b and Junction 31 is generally 50mph which is the posted speed limit, and there is substantial weaving of traffic due to the closely spaced junctions and segregation of traffic due to the existing tunnels.

### 3.3 Safety for road users

The Dartford Crossing including its approaches has a poor safety record. The injury accident rate in the vicinity of the crossing is twice the national average for a route of this type.

### 3.4 Recent Improvements to the network

The congestion problem at the Dartford Crossing has been exacerbated by recent improvements to the surrounding strategic road network. This has removed some of the constraints on traffic reaching the crossing. These improvements are summarised in **Table 1**.

**Table 1: Recent Improvements to the network around Dartford**

<b>Improvement</b>	<b>Detail</b>	<b>Date Opened</b>
<b>M25 Junction 27 - Junction 30</b>	Widening from generally 3 lanes to 4 lanes, carried out as part of the M25 Design, Build, Finance and Operate contract (DBFO).	2012
<b>M25 Junction 1b - Junction 3</b>	Widening from generally 3 lanes to 4 lanes carried out in conjunction with the A2/ A282 Improvement.	2008
<b>A2/ A282 Improvement</b>	Free-flow link/ slip roads between A2 and M25 and widening of A2 from 3 to 4 lanes between M25 Junction 2 and A2 Bean junction.	2007
<b>M25 Junction 30 Interim scheme</b>	Minor improvements at Junction 30 to accommodate initial additional traffic from the London Gateway Port.	2013

Other planned improvements to the network around Dartford are M25 Junction 30/ A13 Congestion Relief Scheme, including widening to the A13 and improvements at Junction 30, which commenced construction in Spring 2015, and junction improvements on the A2 at Bean and Ebbsfleet Junctions.

### **3.5 Dart Charge**

In November 2014 Dart Charge, a free-flow electronic number plate recognition charging system, was introduced. This aims to improve the flow of traffic. Dart Charge is making significant improvements, and is projected to reduce journey times by 2-5 minutes between Junction 3 and Junction 31 southbound and northbound. This system became fully operational in June 2015. This system permits a charge but does not involve the manual collection of tolls at toll booths. However Dart Charge will not solve the problems of congestion and reliability in the long term, as traffic continues to grow; by 2025, northbound journey time delays are forecast to be similar to those experienced before Dart Charge was implemented. The restrictions on the northbound tunnels remain and involve the implementation of a traffic management cell to deal with restricted vehicles.

### **3.6 Existing environmental conditions**

#### ***Air quality***

There are a number of Air Quality Management Areas (AQMAs) within the local authorities that form part of the study area.

#### ***Noise***

There are a number of Noise Important Areas (NIAs) within the study area.

#### ***Biodiversity***

The River Thames runs through the centre of the study area with a diverse and highly designated environment both north and south of the river. Designated sites include the internationally important Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site, a large number of nationally important ecological sites including Sites of Special Scientific Interest (SSSI) and areas of ancient woodland and the River Thames recommended Marine Conservation Zone.

#### ***Heritage***

Nationally important heritage features include scheduled monuments such as Tilbury Fort and Coalhouse Fort Battery and artillery defences on the north side of the River Thames and a large number of listed buildings and conservation areas.

#### ***Landscape***

To the south of the river there is the nationally important Kent Downs Area of Outstanding Natural Beauty, as well as Registered Parks and Gardens both north and south of the river.

## ***Communities***

There are large population centres particularly Dartford, Gravesend, Grays, and Tilbury as well as a number of smaller settlements across the more rural parts of the study area.

## **4 Future Development**

There are a number of significant developments that will lead to further traffic growth and influence the solution for Lower Thames Crossing.

### ***Paramount London***

London Paramount Entertainment Resort (Paramount London) is a proposed theme park and entertainment resort on the Swanscombe peninsula in Kent.<sup>3</sup> The development will be twice the size of the Olympic Park in East London and is expected to attract on average 40,000 visitors on a typical day. This development is classed as a Nationally Significant Infrastructure Project (NSIP).

### ***Ebbsfleet Garden City***

In the 2014 Budget, the Government announced plans to create a new garden city at Ebbsfleet, Kent, capable of providing up to 15,000 new homes, and establish an Urban Development Corporation to drive forward delivery.<sup>4</sup> The Government established a development corporation at Ebbsfleet in April 2015.

### ***Port of Dover***

The Western Docks is a major regeneration project within the area. The Port could create over 600 new jobs for Dover.<sup>5</sup> The Port of Dover is home to the busiest international 24/7 roll-on roll-off ferry port in Europe.

### ***London Gateway Port (DP World)***

London Gateway is a development on the north bank of the River Thames in Thurrock, Essex. It comprises a new deep-water port, as well as one of Europe's largest logistics park. Once fully operational, the port could handle around 3.5 million containers a year.<sup>6</sup>

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<sup>3</sup> London Paramount: <http://www.londonparamount.info/>

<sup>4</sup> Budget 2014: <https://www.gov.uk/government/speeches/chancellor-george-osbornes-budget-2014-speech>

<sup>5</sup> Port of Dover: <http://www.doverport.co.uk/about/port-development/>

<sup>6</sup> London Gateway: <http://www.londongateway.com/>

### ***Port of Tilbury***

The Port is a significant multi-modal distribution centre covering 850 acres. Adjacent to the Port of Tilbury is the London Distribution Park (LDP)<sup>7</sup>, a 70-acre development.

### ***RWE npower***

There is proposed redevelopment of the Tilbury and Littlebrook power station sites.<sup>8</sup>

### ***Bluewater and Lakeside Shopping Centres***

Bluewater opened in 1999 and is the fourth-largest shopping centre in the UK.<sup>9</sup> Lakeside opened in 1990 and is the eleventh largest shopping centre in the UK.<sup>10</sup> Both Bluewater and Lakeside have plans for expansion.

### ***Housing Development***

Local Authorities have increased demand for new homes through their objectively assessed needs, and this has led to significant plans for housing development over the next 15 years across all local authorities in the area. High levels of development are likely to continue beyond the next 15 years.

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<sup>7</sup> Port of Tilbury: <https://forthports.co.uk/tilbury-london/>

<sup>8</sup> RWE npower: <http://www.rwe.com/web/cms/en/97662/rwe-npower/about-us/our-businesses/power-generation/>

<sup>9</sup> Bluewater: <http://www.bluewater.co.uk/en/About-Us/The-Bluewater-Story>

<sup>10</sup> Intu Lakeside: <http://www.intugroup.co.uk/where-we-do-it/our-uk-centres/>

### Transport for London River Crossings

Transport for London is considering a number of options for new river crossings for east London (see **Figure 5**) at Silvertown, Woolwich, Gallions Reach and Belvedere. Consultation on these crossings are planned for 2015/2016.



**Figure 5: Transport for London (TfL) River Crossings**

## 5 Stakeholder Engagement

Engagement with stakeholders has been undertaken during the options identification and development work, and the information obtained has played an important part in the option development work. There has been engagement with local authorities, environmental bodies, regulatory authorities, utility companies, businesses and other interested parties.

The LTC Stakeholder Advisory Panel (SAP) brings together key local authority stakeholders to share progress on option development work, and understand local knowledge, needs, priorities and opinions with respect to Lower Thames Crossing. SAP meetings have been held at key stages of the project and the longlist of Route Options and subsequent emerging shortlist were both shared with the SAP.

## 6 Scheme Objectives

The scheme objectives for the new crossing are shown in **Table 2**.

**Table 2: 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

## 7 Appraisal Approach

The approach to the appraisal of options is summarised in **Figure 6**.



*The red arrow indicates the current stage i.e. completion of the appraisal of the longlist.*

**Figure 6: Appraisal Approach**

The key stages in the appraisal are set out 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 longlist options were appraised, as reported in this Technical Appraisal Report. The output from this appraisal is the shortlist of options.
- c) **Appraisal of shortlist.** A detailed appraisal of the shortlist options, and those options to be taken to consultation will be reported in the 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 Preferred Option will be determined taking account of this appraisal and the responses to the public consultation.

## 8 Development of the Longlist of Options

The options development and selection work has followed a staged proportionate approach. Initially all possible options within Locations A, C and C Variant were considered, and an initial viability check undertaken considering technical viability and high level appraisal against the scheme objectives. This resulted in 11 options not being selected for the longlist as shown in **Table 3** below. **Figure 7** shows the longlist Options.

**Table 3: Pre-Longlist Options Not Selected**

Option	Description and Key Reasons for Non Selection
<b>A3</b>	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
<b>A5</b>	Double deck tunnel. Technical non-viability; insufficient space to create effective connections to existing roads
<b>A6</b>	Bored tunnels east and west. Significant impact on existing development north and south of the river east of existing crossing
<b>A7</b>	Bored tunnel east. Significant impact on existing development north and south of the river east of existing crossing
<b>A10</b>	Immersed tube tunnel east. Significant impact on existing development north and south of the river east of existing crossing
<b>A11</b>	A2/ A13 connection (west). Doesn't solve strategic traffic problem, too far from Dartford and too close to proposed TfL Belvedere crossing
<b>A13</b>	Swanscombe Peninsular (east). Impact on new development (Paramount London and Ebbsfleet Garden City)
<b>C5</b>	East route. Significant environmental impacts on protected ecological sites (Ramsar, SPA) and Cliffe Pools (RSPB)
<b>C6</b>	Ebbsfleet Junction connection. Technical non-viability due to insufficient space to effectively connect to A2 and impact on new development (Ebbsfleet Garden City)
<b>CV3</b>	Bored tunnel and viaducts at M2 J3. Impact on Blue Bell Hill village and construction impact at M2 Junction 3
<b>CV4</b>	Two bored tunnels at M2 J3. Significant environmental impact and high cost of tunnels

Refer to Figures 5.2, 5.3 and 5.8 in Volume 2 of Technical Appraisal Report (HA540039-HHJ-ZZZ-REP-OPT-009) for the pre-longlist options.

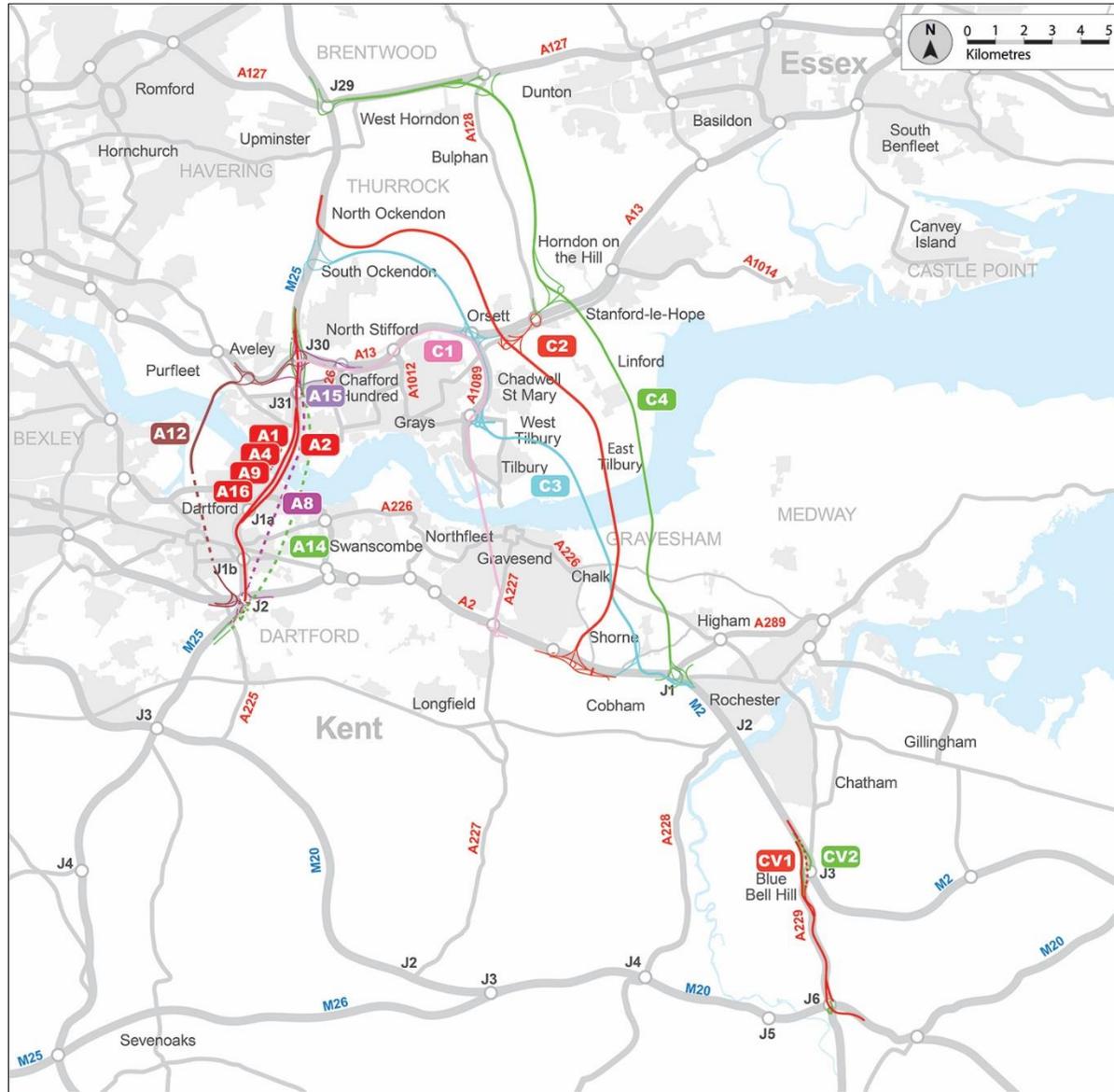


Figure 7: Longlist Options

## 9 Longlist Appraisal

The appraisal of the longlist was carried out in two stages.

The first stage of appraisal of the longlist options 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)

Three Options and part of an Option were not selected following the first stage of appraisal as shown in **Table 4**.

**Table 4: Longlist Options Not Selected, First Stage Appraisal**

Option	Description and Key Reasons for Non Selection
<b>A12</b>	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).
<b>A14</b>	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.
<b>A8</b>	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
<b>C3</b> (Southern section – 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)

The second stage of appraisal involved appraisal of the options against criteria considered to be differentiators; these criteria are shown in **Table 5**. The appraisal of option C3 was for the revised route with the southern section the same as C2. Options C9 and C19 are combination options based on Options C2 and C4 that were developed and appraised as part of the second stage of longlist appraisal.

**Table 5: Second Stage Appraisal Criteria**

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

As a result of this second stage of appraisal, further options were not selected – see **Table 6** below.

**Table 6: Longlist - Options Not Selected, Second Stage Sifting**

Option	Description and Key Reasons for Non Selection
<b>A9</b>	Immersed tube west. High technical risks, significantly more difficult to construct than other options. Impact on river/ jetty operations unlikely to be acceptable to owners/ operators or Port of London Authority (PLA)
<b>A2</b>	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 SSSI
<b>A15</b>	Alternative Junction 30 improvement. Significant impact on commercial property around Junction 31. Major high voltage overhead cable diversions required
<b>C1</b>	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. Potential impacts on Tilbury Docks from tunneling under existing structures.
<b>C4</b>	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. Impact on scheduled monuments. There are better, lower cost options available
<b>C Variant with A or C Option</b>	Relatively small impact on transferring M20 traffic from existing Dartford Crossing onto new route at C. Significant impact on AONB. High cost. Does not bring wider benefits that materially add value to the Lower Thames Crossing scheme.
<b>A16 – Any C Option combined with 2 lane NB tunnel at Dartford</b>	Poor value for money. High cost solution with limited additional economic benefits

The shortlist to be taken forward for more detailed appraisal is shown in **Figure 8**.

Key features of the shortlist routes are summarised in **Table 7**.

**Table 7: Shortlist Routes Key Features**

<b>Option</b>	<b>Key Features of Shortlist Routes</b>
<p><b>A1/ A4</b> - on-line, bridge/ bored tunnel crossing options</p>	<p>Relieves congestion at Dartford crossing but only improves resilience locally at the crossing. The solution at A is constrained by existing alignment, development and infrastructure, restricting the design speed to 85kph. There would be substantial disruption during construction due to the improvements being on-line. Principal impacts on urban/natural environments – air quality, noise.</p>
<p><b>C2</b> – bridge/ bored tunnel/ immersed tunnel options</p>	<p>Relieves congestion at Dartford crossing. By providing a new crossing resilience is improved across the network. The option provides for greater wider economic benefits and better connectivity between north and south of the river than A options Principal impacts on urban/ natural environments – rural communities, ecology (Ramsar/ SPA/ SSSI)</p>
<p><b>C3</b> – bridge/ bored tunnel/ immersed tunnel options</p>	<p>Relieves congestion at Dartford By providing a new crossing resilience is improved across the network; however uses an improved A1089 as part of solution. The option provides for greater wider economic benefits and better connectivity between north and south of the river than A options Principal impacts on urban/ natural environments – rural communities, ecology (Ramsar/ SPA/ SSSI)</p>
<p><b>C9</b> – bridge/ bored tunnel/ immersed tunnel options</p>	<p>Relieves congestion at Dartford By providing a new crossing resilience is improved across the network; however uses an improved A127 as part of solution. The option provides for greater wider economic benefits and better connectivity between north and south of the river than A options Principal impacts on urban/natural environments – rural communities, ecology (Ramsar/ SPA/ SSSI)</p>
<p><b>C19</b> – Alternative Southern Link (can be used with C2, C3 or C9)</p>	<p>Compared to routes with connection to new A2 junction to west, there are greater community and environmental impacts, but greater travel time benefits.</p>

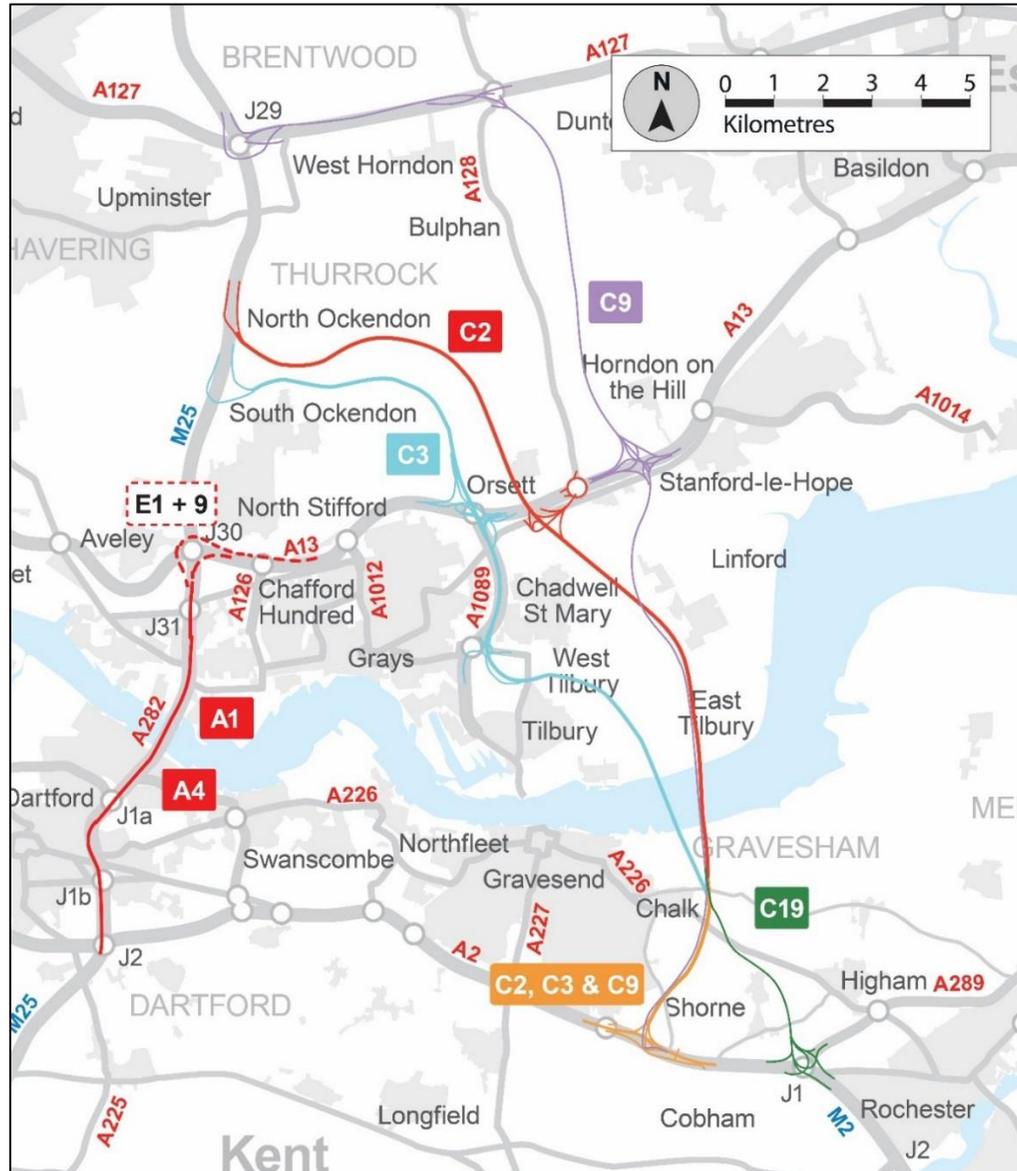
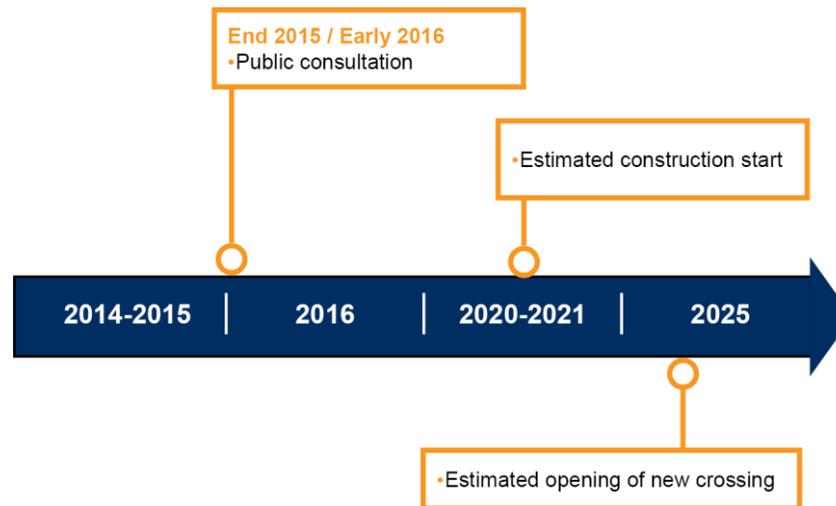


Figure 8: Proposed Shortlist

## 10 Future Programme

Key milestones for the project are shown in **Figure 9**.



**Figure 9: Future Key Milestones**