

# Lower Thames Crossing

## 6.1 Environmental Statement

### Chapter 3 – Assessment of Reasonable Alternatives

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## 6.1 Environmental Statement

### Chapter 3 – Assessment of Reasonable Alternatives

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## 3 Assessment of reasonable alternatives

### 3.1 Introduction

- 3.1.1 This chapter identifies the reasonable alternatives that have been considered during the development of the A122 Lower Thames Crossing (the Project) and summarises the findings of the environmental assessments of those alternatives. This chapter describes the main alternatives identified and the reasons for their adoption or rejection by the Project. It also includes details of reappraisal work carried out to check the ongoing validity of those decisions as time has passed.
- 3.1.2 Full details of the decision-making process that led to the identification of the preferred route are included within the Planning Statement (Application Document 7.2). The subsequent design development and refinement is discussed in the Project Design Report (Application Document 7.4).

### 3.2 Policy and legislation

#### Infrastructure Planning (Environmental Impact Assessment) Regulations 2017

- 3.2.1 Regulation 11(2)(d) of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the EIA Regulations) imposes a duty on promoters to ensure that the ES includes *‘a description of the reasonable alternatives studied by the applicant, which are relevant to the proposed development and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the development on the environment’*.
- 3.2.2 Schedule 4 of the EIA Regulations defines reasonable alternatives as *‘development design, technology, location, size and scale’*.

#### National Policy Statements

- 3.2.3 Paragraphs 4.26 and 4.27 of the National Policy Statement for National Networks (NPSNN) published by the Department for Transport (DfT, 2014) set out the requirements in relation to the assessment of alternatives.
- 3.2.4 Section 4.4 of the Overarching National Policy Statement for Energy (EN-1) (Department of Energy and Climate Change, 2011a) include requirements relating to alternatives.
- 3.2.5 The National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011b) refers to EN-1 in relation to the assessment of the impacts of alternative routes on biodiversity and on geology and soils.
- 3.2.6 Paragraph 2.8.8 of the National Policy Statement for Electricity Networks Infrastructure (EN-5) (Department of Energy and Climate Change, 2011c) requires an assessment of alternatives where a route would lead to particularly significant landscape and/or visual impacts.

3.2.7 Details of these NPS requirements and how the Project has responded to them are provided in Table 3.1 of this chapter. Further details of how the Project complies with the National Policy Statements are provided in the Planning Statement (Application Document 7.2).

**Table 3.1 NPS requirements and the Project response**

Reference	Requirement	Project response
NPSNN Paragraph 4.26	<p><i>‘Applicants should comply with all legal requirements and any policy requirements set out in this NPS on the assessment of alternatives. In particular:</i></p> <ul style="list-style-type: none"> <li><i>• The EIA Directive requires projects with significant environmental effects to include an outline of the main alternatives studied by the applicant and an indication of the main reasons for the applicant’s choice, taking into account the environmental effects.</i></li> <li><i>• There may also be other specific legal requirements for the consideration of alternatives, for example, under the Habitats and Water Framework Directives.</i></li> <li><i>• There may also be policy requirements in this NPS, for example the flood risk sequential test and the assessment of alternatives for developments in National Parks, the Broads and Areas of Outstanding Natural Beauty (AONB).’</i></li> </ul>	<p>The Environmental Impact Assessment (EIA) has been completed in compliance with the EIA Regulations (as amended). This chapter of the Environmental Statement (ES) includes ‘a description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed Project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects’ as required by Schedule 4 of the EIA Regulations. Specific legal and policy requirements related to the environmental topics are considered within each topic chapter and in the Habitats Regulations Assessment (Application Document 6.5).</p> <p>A flood risk sequential test has been undertaken for the Project and is described in detail within Appendix 14.6: Flood Risk Assessment (Application Document 6.3).</p>
NPSNN Paragraph 4.27	<p><i>‘All projects should be subject to an options appraisal. The appraisal should consider viable modal alternatives and may also consider other options (in light of the paragraphs 3.23 to 3.27 of this NPS). Where projects have been subject to full options appraisal in achieving their status within Road or Rail Investment Strategies or</i></p>	<p>Options appraisals considering corridor location, route and crossing type have been completed through several Project stages leading to the announcement of the preferred route in April 2017. This included an assessment of alternative modal options.</p> <p>Alternatives are reported within the following documents:</p> <ul style="list-style-type: none"> <li>• Dartford River Crossing Study (DfT, 2009)</li> </ul>

Reference	Requirement	Project response
	<p><i>other appropriate policies or investment plans, option testing need not be considered by the examining authority or the decision maker. For national road and rail schemes, proportionate option consideration of alternatives will have been undertaken as part of the investment decision making process. It is not necessary for the Examining Authority and the decision maker to reconsider this process, but they should be satisfied that this assessment has been undertaken.'</i></p>	<ul style="list-style-type: none"> <li>• Pre-Consultation Scheme Assessment Report (Highways England, 2016)</li> <li>• Post-Consultation Scheme Assessment Report (Highways England, 2017)</li> <li>• Planning Statement (Application Document 7.2)</li> <li>• Project Design Report (Application Document 7.4)</li> </ul> <p>Environmental assessments that contributed to the options development, selection and design development are listed in Section 3.5 of this chapter.</p>
<p>EN-1 paragraph 4.41</p>	<p><i>'As in any planning case, the relevance or otherwise to the decision-making process of the existence (or alleged existence) of alternatives to the proposed development is in the first instance a matter of law, detailed guidance on which falls outside the scope of this NPS. From a policy perspective this NPS does not contain any general requirement to consider alternatives or to establish whether the proposed project represents the best option.'</i></p>	<p>The Environmental Impact Assessment (EIA) has been completed in compliance with the EIA Regulations.</p>
<p>EN-1 paragraph 4.42</p>	<p><i>'Applicants are obliged to include in their ES, as a matter of fact, information about the main alternatives they have studied. This should include an indication of the main reasons for the applicant's choice, taking into account the environmental, social and economic effects and including, where relevant, technical and commercial feasibility.'</i></p>	<p>This chapter of ES includes 'a description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed Project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects' as required by Schedule 4 of the EIA Regulations.</p> <p>Specific legal and policy requirements related to the environmental topics are considered within each topic chapter and in the Habitats Regulations Assessment (Application Document 6.5).</p>

Reference	Requirement	Project response
	<p><i>In some circumstances there are specific legislative requirements, notably under the Habitats Directive, for the IPC to consider alternatives. These should also be identified in the ES by the applicant; and in some circumstances, the relevant energy NPSs may impose a policy requirement to consider alternatives (as this NPS does in Sections 5.3, 5.7 and 5.9).'</i></p>	<p>A flood risk sequential test has been undertaken for the Project and is described in detail within Appendix 14.6: Flood Risk Assessment (Application Document 6.3).</p>
<p>EN-1 section 5</p>	<p><i>Sections 5.3, 5.7 and 5.9 of EN-1 require the consideration of reasonable alternatives with regard to avoiding significant adverse effects on biodiversity, flood risk and nationally designated landscapes respectively.</i></p>	<p>Specific legal and policy requirements related to the environmental topics are considered within each topic chapter and in the Habitats Regulations Assessment (Application Document 6.5). A flood risk sequential test has been undertaken for the Project and is described in detail within Appendix 14.6: Flood Risk Assessment (Application Document 6.3).</p>
<p>EN-4 paragraph 2.21.3</p>	<p><i>'The ES should include an assessment of the biodiversity and landscape and visual effects of the proposed route and of the main alternative routes considered (see Section 5.9 of EN-1).'</i></p>	<p>This chapter of the ES includes: <i>'a description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed Project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects'</i> as required by Schedule 4 of the EIA Regulations. Specific legal and policy requirements related to the environmental topics are considered within each topic chapter and in the Habitats Regulations Assessment (Application Document 6.5).</p>



Reference	Requirement	Project response
EN-5 paragraph 2.8.4	<i>'Where the nature or proposed route of an overhead line will likely result in particularly significant landscape and/or visual impacts, the Applicant should demonstrate that they have given due consideration to the costs and benefits of feasible alternatives to the line, including – where appropriate – underground or subsea cables. The ES should set out details of this consideration, including the Applicant's rationale for eschewing feasible alternatives to the overhead line, and the mitigation cost calculation methodology that this rationale may rely upon.'</i>	<p>This chapter of the ES includes 'a description of the reasonable alternatives (for example in terms of development design, technology, location, size and scale) studied by the developer, which are relevant to the proposed Project and its specific characteristics, and an indication of the main reasons for selecting the chosen option, including a comparison of the environmental effects' as required by Schedule 4 of the EIA Regulations.</p> <p>Further details relevant to this requirement are provided in the Planning Statement (Application Document 7.2).</p>

### 3.3 Guidance

- 3.3.1 The Design Manual for Roads and Bridges (DMRB) LA 104 Environmental Assessment and Monitoring (Highways England, 2020c) defines reasonable alternatives as *'different project design, technology, location, size and scale solutions considered by the developer'*.
- 3.3.2 DMRB LA 104 sets out National Highways' internal process for assessing alternative options, which aligns with the requirements of the EIA Regulations. Table 3.2 identifies the requirements in DMRB LA 104 and provides the section numbers where those assessments are set out in this chapter.

**Table 3.2 Coverage of LA 104 reporting requirements**

Alternative	Coverage in this chapter	Relevant section
1. Technology alternatives: temporary and permanent traffic control measures	In 2009, the DfT commissioned a study to investigate how to address capacity constraints at the Dartford Crossing. The options considered included using technology to change the method of collecting the charge so that the toll booths could be removed, thereby increasing the effective capacity at the Dartford Crossing.	3.6

Alternative	Coverage in this chapter	Relevant section
2. Design alternatives: physical elements, including structures and landscaping	<p>Alternative options for the crossing (i.e. a bridge or a tunnel) were considered.</p> <p>Alternative options for junction layouts and structures have been considered.</p> <p>Alternative options for the bridges and viaducts have also been considered.</p> <p>The landscaping design has been an iterative process throughout the development of the Project.</p>	3.10 to 3.28
3. Size and scale alternatives seeking opportunities to reduce the size and scale of the development where the Project objectives would not be compromised	<p>An extensive number of alternatives considering the size and scale of junctions and crossings have been explored. Alternative layouts have been considered, including at the following junctions, watercourse crossings and tunnel portals:</p> <ul style="list-style-type: none"> <li>• A2 junction</li> <li>• South Portal</li> <li>• North Portal</li> <li>• A13 junction</li> <li>• Mardyke crossing</li> <li>• M25 junction</li> <li>• A226 junction</li> <li>• Tilbury junction</li> </ul>	3.10 to 3.28
4. Demand alternatives to meet the need through demand management techniques	<p>A rail crossing was considered in the 2009 DfT study which investigated ways to address capacity constraints at the Dartford Crossing. The study considered both a heavy rail crossing of the River Thames and a combined heavy rail and road crossing, serving passengers and rail freight.</p> <p>Further consideration was given to demand alternatives, such as improved public transport in response to feedback received in the 2016 non-statutory consultation.</p>	3.6
	<p>A range of charging scenarios were considered as the level of charges would affect the demand to use the new crossing, the existing crossing at Dartford and the choice of crossing used by drivers.</p>	3.29
5. Activity alternatives, such as the provision of traffic calming instead of a new road	<p>Activity alternatives such as traffic-calming measures are considered unsuitable for this type of road. In addition, such measures would not achieve the Scheme Objectives, including the provision of a free-flowing crossing.</p>	3.6

Alternative	Coverage in this chapter	Relevant section
6. Location alternatives: selection of different corridors or access routes	The preferred route selection process and design development considered where alternative locations could be proposed. Options appraisals were undertaken in 2018, 2020 and 2022 to review the preferred route south of the River Thames. These studies reaffirmed the decisions made during the preferred route selection and took into account more recent design development.	3.7 to 3.9
7. Delivery alternatives: alternatives that reflect different means of delivering the desired end point in production terms (for example, a clear span bridge or one with piers and abutments in the river)	The 2014 option identification process considered a variety of bridge, immersed tube and bored tunnel solutions at crossing locations A and C.	3.8
8. Scheduling alternatives: programming the activities to avoid periods of enhanced environmental sensitivity, e.g. the consideration of alternative temporary land-take during construction	The general approach to construction and timings for works has been informed by the outcomes of the environmental assessment and mitigation requirements. At individual design stages, programme implications have been considered.	3.30
9. Input alternatives: use of different materials, lighting strategies or different designs	Different design alternatives are described throughout the chapter. An example is the design of the Mardyke crossing which considered crossing three watercourses via three bridges, a viaduct, or a hybrid of both options. Different crossings of the River Thames were considered including bored tunnel, immersed tube tunnel and a cable stayed bridge.	3.10 to 3.28
10. Mitigation alternatives: the variety of solutions available to mitigate the adverse consequences of a proposal	The design of mitigation has been developed following an iterative process based on stakeholder feedback, Project design changes and the outcomes of the environmental assessment.	3.31
11. The Do Minimum scenario	The Pre-Consultation Scheme Assessment Report (Highways England, 2016) considered the Without Scheme scenario, i.e. the future conditions at the existing Dartford Crossing without any further improvements.	3.6

## 3.4 Scope

3.4.1 Table 3.3 lists the alternatives that are discussed in this chapter from Section 3.6 onwards. It also includes the outcomes following consultation on each alternative.

**Table 3.3 Main alternatives**

Date	Alternatives	Outcome following consultation
2013	<p><b>Strategic alternatives</b></p> <p>The 2009 study (DfT, 2009) had concluded that there was a problem at the existing crossing which required resolution through the provision of additional road-based river crossing capacity in the Lower Thames area. It also concluded that the provision of rail freight as part of any new Lower Thames crossing would not address the rail-freight capacity issues that are forecast for the area. Passenger flow volumes on a cross-river rail route east of London would be likely to be limited, meaning the inclusion of passenger rail services would be unlikely to represent value for money.</p> <p>The 2009 study identified five location options (A-E) that could help alleviate the congestion problems at the existing crossing. Two of the five options (D and E) were not considered worthy of further investigation. Both were located further east than any of the other options considered and were shown to bring very limited congestion relief to the existing crossing. Both would also only be used by a low number of vehicles which, when coupled with the relatively high scheme costs, meant that they would be unlikely to provide value for money.</p> <p><b>2013 review and consultation</b></p> <p>In 2013, the DfT carried out a consultation on the options for a new Lower Thames Crossing. The options presented were all road options, although reference was made to the 2009 study, which had ruled out rail as a viable alternative.</p> <p><b>Location options</b></p> <p>The DfT consulted on four options for a new crossing of the Lower Thames:</p> <ul style="list-style-type: none"> <li>• Location A (at the existing Dartford Crossing)</li> <li>• Location B (connecting the A2 and the Swanscombe Peninsula with the A1089)</li> <li>• Location C (east of Gravesend and Tilbury)</li> <li>• Location C variant (widening of the A229 between the M2 and M20)</li> </ul>	<p>Location B removed from further consideration due to limited public support, the potential impact on local development plans and limited transport benefits.</p> <p>Locations A and C taken forward for further work with no preference yet identified.</p>
2016	<p><b>Route options</b></p> <p>Following an assessment of long-listed route options at locations A and C against the Scheme Objectives, consultations reviewed a shortlist of options considered to be viable:</p> <ul style="list-style-type: none"> <li>• Route 1 and Location A (with either bridge or bored tunnel river crossing)</li> </ul>	<p>Preferred Route Announcement (PRA) in 2017 for Route 3 and Location C, with a bored tunnel river crossing and the Western Southern Link (WSL) to the A2 east of Gravesend.</p> <p>Respondents to the 2016 non-statutory consultation</p>

Date	Alternatives	Outcome following consultation
	<ul style="list-style-type: none"> <li>• Routes 2, 3 and 4 at Location C (with either bridge, bored tunnel or immersed tube river crossing)</li> </ul> <p>These route options are shown in Plate 3.2 in Section 3.8 of this chapter.</p>	<p>raised concerns that there was a lack of consideration for public transport.</p> <p>Following the public consultation, as part of the process of selecting the preferred route, an assessment was undertaken to consider modal alternatives, including rail, ferry, road-based public transport and non-motorised modes. This assessment found that alternative modes would not provide a replacement for a new crossing.</p>
2018	<p><b>Location reappraisal</b></p> <p>The 2018 Statutory Consultation documentation included the findings of a reappraisal of the options previously considered, including some options discounted as non-viable prior to the 2013 consultation, in order to check that earlier decisions remained valid. This covered:</p> <ul style="list-style-type: none"> <li>• Location A</li> <li>• Location B</li> <li>• Location C</li> <li>• Eastern Southern Link</li> <li>• Location C variant</li> <li>• Location D</li> <li>• Location E</li> </ul> <p>Further information on this and subsequent reappraisals are provided in Section 3.9 of this chapter.</p> <p><b>Design options</b></p> <p>The Statutory Consultation covered the development of the design since the PRA, including consideration of alternative solutions for each of the following:</p> <ul style="list-style-type: none"> <li>• Road standard</li> <li>• Number of lanes</li> <li>• High and heavy load routes</li> <li>• Rest and service area</li> <li>• M2/A2 corridor</li> <li>• A2 junction</li> <li>• A226 junction</li> <li>• South Portal</li> <li>• Tunnel design</li> </ul>	<p>Further design and assessment of the preferred route, which would be the basis for further public consultation.</p>

Date	Alternatives	Outcome following consultation
	<ul style="list-style-type: none"> <li>• Tilbury junction and link road</li> <li>• Horizontal alignment and electricity pylons between Tilbury and the A13</li> <li>• A13 Junction</li> <li>• Mardyke crossing</li> <li>• Horizontal alignment at Ockendon landfill site</li> <li>• M25 junction</li> <li>• M25 corridor and M25 junction 29</li> </ul> <p>The consultation documents included a Preliminary Environmental Information Report (PEIR) for the proposed Lower Thames Crossing (Highways England, 2018b).</p>	
2020	<p><b>Updated design</b></p> <p>Supplementary Consultation in early 2020 covered changes and updates to the route, proposals for utility diversions, and proposals for walking, cycling and horse riding. An environmental impacts update was provided, which identified any changes to the environmental effects reported previously in the PEIR.</p> <p>A number of the changes and updates were to elements of the route for which alternatives had previously been consulted on, as listed below:</p> <ul style="list-style-type: none"> <li>• Narrowing of the M2/A2 corridor through the Kent Downs Area of Outstanding Natural Beauty (AONB) and Shorne Woods Country Park</li> <li>• The new road's junction with the M2/A2</li> <li>• Relocation of the South Portal approximately 350 metres south</li> <li>• Removal of the Tilbury junction, the rest and service area and maintenance depot</li> <li>• A13/A1089 junction changes</li> <li>• M25 to A13 southbound lane removal</li> <li>• Routing through the Mardyke valley</li> <li>• M25 junction 29 changes</li> </ul> <p>Further details of the design are available in the Project Design Report (Application Document 7.4). Consultees were asked if they supported the various refinements and to provide extra comments if they wished.</p>	Progress towards Design Refinement Consultation.
2020	<p><b>Design refinement</b></p> <p>The Design Refinement Consultation in the summer of 2020 covered a wide range of detailed design updates. Many of the updates related to the provision of environmental mitigation, compensation and enhancement measures, such as habitat creation, landscaping, green bridges and public rights of way. Other updates related to drainage, construction working</p>	Progress towards Community Impacts Consultation.

Date	Alternatives	Outcome following consultation
	<p>areas, land required for utility diversions and the provision of electricity substations.</p> <p>The environmental impacts update concluded that none of the proposals would result in a change to the nature of effects and mitigation measures reported in the PEIR in 2018.</p> <p>Alternatives to the design refinements were not proposed, although consultees were asked if they supported the various refinements and to provide extra comments if they wished.</p>	
2021	<p><b>Community impacts</b></p> <p>The Community Impacts Consultation was carried out to provide more detail about the Project and how it would affect local communities and the environment.</p> <p>The consultation documents included a construction update, an operations update, a set of ward summaries, and a ‘you said, we did’ document which summarised how the design had responded to earlier consultation responses.</p> <p>The two key types of design changes since the previous consultation were set out as:</p> <ul style="list-style-type: none"> <li>• Changes to the Order Limits (the land required)</li> <li>• Refined proposals for utility works</li> </ul> <p>At this stage, alternatives to the design changes were not proposed, although consultees were asked if they supported the various refinements and to provide extra comments if they wished.</p>	<p>Minor refinements made in response to stakeholder feedback and included in the Local Refinements Consultation.</p>
2022	<p><b>Local refinements</b></p> <p>The Local Refinement Consultation was carried out in May and June 2022. The design changes included in the consultation were as follows:</p> <ul style="list-style-type: none"> <li>• More public open space to the east of the tunnel entrance in Kent, connected to Chalk Park (the proposed new public park overlooking the Thames).</li> <li>• Changes to the design of Tilbury Fields (a new public park on the north bank of the River Thames) to make space for the planned Thames Freeport.</li> <li>• Inclusion of operational access roads north of the North Portal, so that maintenance and emergency vehicles could access the A122. This would improve the safety of the new road once it was in operation.</li> <li>• Modified connections between the A13 and the A1089, removing a free-flow slip road connecting the A13 to the A1089 and introducing a connection between Orsett Cock roundabout junction to the A1089, to reduce traffic impacts on some local roads. A new footbridge over the A127 and further improvements for walkers, cyclists and horse riders,</li> </ul>	<p>Progress towards Development Consent Order (DCO) application.</p>

Date	Alternatives	Outcome following consultation
	<p>including better bridleway connections around the A2 junction and the A226.</p> <ul style="list-style-type: none"> <li>• Further improvements to the landscaping proposals.</li> <li>• Further refinement of utility works to enable the Project to be built.</li> <li>• Refinements to the Order Limits, the land needed to build and operate the new road as a result of proposed changes.</li> <li>• Additional environmental compensation and mitigation.</li> </ul> <p>Most of the changes presented were design refinements and improvements. However, the additional environmental compensation measures, proposed to compensate for the effects of nitrogen deposition on designated habitats, were identified through a detailed process of site selection which included assessment of alternatives.</p>	

## 3.5 Environmental assessment

3.5.1 Environmental assessment has been undertaken as part of the iterative design process and various reports have been produced to assess the environmental effects of the options that were proposed and the design changes that were considered. Relevant documents reporting these assessments are identified throughout this chapter and are as listed below:

- a. Volume 6 – Environmental Appraisal of the Lower Thames Crossing Pre-Consultation Scheme Assessment Report (Highways England, 2016), published for the 2016 non-statutory public consultation
- b. Volume 6 – Environmental Appraisal of the Lower Thames Crossing Post-Consultation Scheme Assessment Report (Highways England, 2017), which presented the recommendations for the preferred route
- c. Lower Thames Crossing PEIR (Highways England, 2018b), published for the 2018 Statutory Consultation
- d. Lower Thames Crossing Environmental Impacts Update (Highways England, 2020a), published for the 2020 Supplementary Consultation
- e. Lower Thames Crossing Environmental Impacts Update (Highways England, 2020b), published for the 2020 Design Refinement Consultation
- f. Lower Thames Crossing Ward Impact Summaries (Highways England 2021), published for the 2021 Community Impacts Consultation
- g. Lower Thames Crossing Guide to Local Refinement Consultation (National Highways, 2022), published for the 2022 Local Refinement Consultation



## 3.6 Strategic alternatives

- 3.6.1 In 2009, the DfT commissioned a study (DfT, 2009) to investigate how to address capacity constraints at the Dartford Crossing. The study included consideration of the following:
- a. What could be done to improve traffic flow at the existing Dartford Crossing in the short- to medium-term.
  - b. What role other modes (for example, light/heavy rail, bus) might play in any plans for new capacity, leading to agreed options for evaluation.
  - c. Identification and review of six potential route corridors that could serve as future new routes for improvements in cross-river capacity.
- 3.6.2 The study identified options for providing additional capacity at the Dartford Crossing through use of new technology and amended layouts at the toll booths. These options were considered to provide only short-term enhancements rather than long-term solutions, as the capacity generated was likely to be relatively small and would not address the future capacity and congestion issues at the crossing.
- 3.6.3 The 2009 DfT study also assessed modal options, considering a rail crossing of the River Thames. It concluded that there was no reasonable business case for the inclusion of rail passenger services as part of any future Lower Thames crossing facility. It further concluded that the provision of rail freight facilities as part of a new crossing in the Lower Thames area would be unlikely to assist in addressing any shortage of freight paths on key rail routes. As a result of this study, provision of rail capacity crossing the Lower Thames was not considered further.
- 3.6.4 Respondents to the 2016 non-statutory consultation raised concerns that there was a lack of consideration for public transport. The following alternatives were considered in the Post-Consultation Scheme Assessment Report (Highways England, 2017):
- a. No road building and more provision of public transport, including a new rail link and enhanced bus services across the existing Dartford Crossing
  - b. A combined road/rail link for passengers and freight
  - c. More priority for bus services on the new crossing and provision of more bus services
  - d. New ferry services across the Thames
  - e. A revised national ports strategy
- 3.6.5 National Highways reconsidered the road and rail public transport solutions in 2017 in response to the public consultation and concluded that while some of the alternative modes could be complementary to a new road crossing of the Lower Thames, none had the capability of solving the identified strategic traffic problem and meeting the Scheme Objectives.

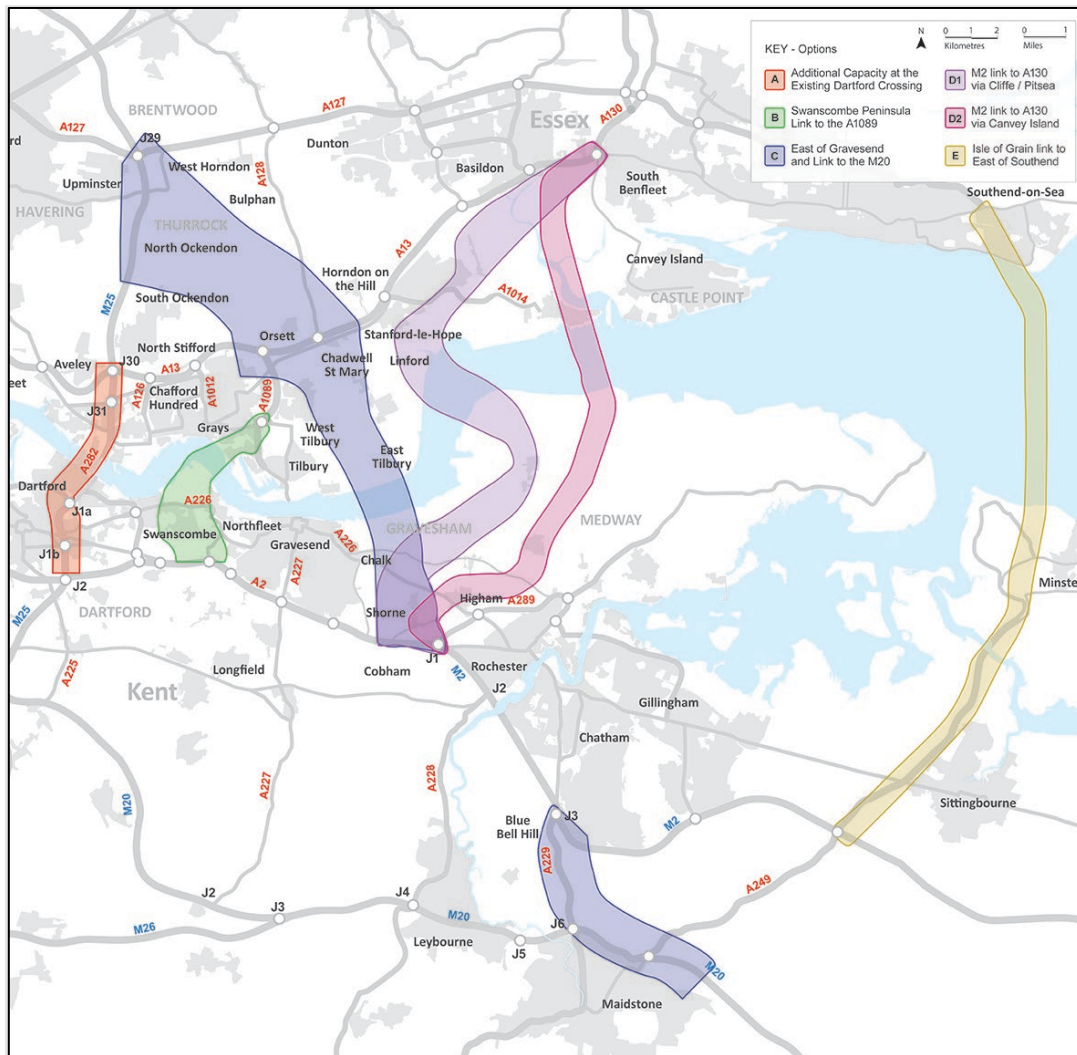
- 3.6.6 National Highways also considered the walker, cyclist and horse rider (WCH), road-based and ferry-based public transport options. These modes do not in themselves provide an alternative as they would not provide adequate capacity and would therefore be complementary to a new crossing and not a replacement for it. In the areas surrounding the Project, there would be adequate provision for WCH and road-based public transport.
- 3.6.7 Activity alternatives, such as implementing traffic-calming measures on the Dartford Crossing as an alternative to the provision of the Project, would not achieve the Scheme Objectives as these measures could not provide the capacity required. Activity alternatives would not provide a long-term solution to congestion problems at Dartford as they would not be able to significantly increase crossing capacity or effectively manage demand. These were considered in the 2009 DfT study, as well as in the Post-Consultation Scheme Assessment Report (Highways England, 2017) in response to consultation. Both concluded that activity alternatives did not provide the adequate capacity required. As a result, activity alternatives were not considered further in the options assessment for the Project.
- 3.6.8 Strategic options were revisited as part of the 2022 options reappraisal, which confirmed that the decisions made remain valid, as set out in Section 3.9 of this chapter.

## 3.7 Location options

### DfT studies

- 3.7.1 The 2009 study considered potential corridors for a new Lower Thames crossing. Six potential crossing locations were identified and assessed against DfT's goals as defined in Delivering a Sustainable Transport System (DfT, 2008). The six potential crossing locations are shown in Plate 3.1 and consisted of:
- a. A – Additional capacity at the existing Dartford Crossing
  - b. B – Swanscombe Peninsula link to the A1089
  - c. C – East of Gravesend and link to the M20
  - d. D1 – M2 link to A130 via Cliffe/Pitsea
  - e. D2 – M2 link to A130 via Canvey Island
  - f. E – Isle of Grain link to east of Southend
- 3.7.2 The crossing locations included a link between the M2 and M20 at Blue Bell Hill, which was considered as a variation of Location C with the potential to enhance benefits from the Project. This was therefore referred to as Location C variant but is shown as part of route corridor C in Plate 3.1.

**Plate 3.1 The six potential route corridors investigated in the 2009 DfT study**



3.7.3 The 2009 study concluded that three crossing locations (A, B and C) offered the greatest benefits in terms of relieving congestion at the existing Dartford Crossing and should be assessed further. Crossing locations D and E were discounted for the reasons described below, including environmental reasons.

3.7.4 The study identified that Location D (options D1 and D2) would not meet the traffic objective of relieving congestion at the existing Dartford Crossing and providing free-flowing north-south capacity. Both options would have poor to low value for money, limited safety benefits, require substantial areas of flood storage compensation, and have significant environmental impacts on the following designated sites:

- a. Mucking Flats and Marshes Site of Special Scientific Interest (SSSI) for option D1
- b. Holehaven Creek SSSI for option D2
- c. South Thames Estuary and Marshes SSSI for both options
- a. Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site for both options

- 3.7.5 The study identified that Location E would provide very limited relief to the Dartford Crossing and would have poor to low value for money. Environmental constraints were an important consideration, as potential direct and indirect effects were identified at the following designated sites:
- a. Medway Estuary and Marshes Ramsar site and SSSI
  - b. Swale Ramsar site and SSSI
  - c. Foulness (Mid-Essex Coast Phase 5) Ramsar site and SPA and the Foulness SSSI
  - d. Essex Estuary Special Area of Conservation (SAC)
- 3.7.6 Further work was carried out by DfT in 2013 to consider the three remaining crossing locations in more detail (A, B and C, including the C variant). The options were assessed using DfT processes relevant at that time. This included the framework provided by DfT's five case model and the technical guidance in the Transport Appraisal Guidance (TAG).
- 3.7.7 The findings of the DfT's review at that time are summarised here:
- a. Potential impacts of particular note for all location options are on the water and marine environment.
  - b. Options B and C require provision of new roads to link a new Thames structure to the strategic road network. The environmental risks would all be substantially greater for these options than for a new structure provided at Option A.
  - c. Environmental constraints of particular note for Option B include the area of rich archaeological heritage through which a future route would pass and Swanscombe heritage park landscape.
  - d. Environmental constraints of particular note for Option C include ancient woodland in Shorne and Ashenbank woods which are near the location proposed for a junction providing access to the M2/A2; the Thames Estuary and Marshes Ramsar site where proposed development would be subject to a test of over-riding public interest; and landscape and visual impacts on the Kent Downs AONB.
  - e. Options B and C would be expected to improve air quality in Thurrock and Dartford Air Quality Management Areas (AQMAs) but could impact on other AQMAs due to the expected increase in traffic passing adjacent to these areas if Options B or C were built. Option B could have an adverse impact on AQMAs declared for the A226 leading to the river crossing and at the Bean Interchange between the A2 and A296 by Dartford Borough Council. Option C could have an adverse impact on an AQMA declared for the A2 leading to the river crossing by Gravesham Borough Council, and for the whole of London Borough of Havering.

- f. The noise assessments indicated that while Option A could have slight impacts in terms of noise through traffic changes on the existing transport links, Options B and C would both establish new network links and thus be expected to increase exposure to properties and people that would otherwise be relatively unaffected by noise.
- g. Option A, if constructed as a bridge or immersed tunnel, would impact on the potential development of some commercial sites adjacent to the existing crossing, but these impacts might be avoided to some extent by constructing a bored tunnel instead.
- h. Option C would traverse land largely designated as Green Belt, which is a designation that generally constrains development, so it is less likely that a route at Option C would conflict with planned development.
- i. Option B, by contrast, traverses planned development sites north of the A2 corridor, particularly on the Swanscombe Peninsula.
- j. All of the options would deliver economic benefits due to congestion relief for users as a whole and improvements to the transport connections used by businesses, which would be expected to result in benefits to the national economy. Within the economic performance, Option A is likely to deliver greater congestion relief at the existing crossing, although additional capacity at this location is likely to worsen capacity issues at other points on the surrounding parts of the strategic road network. If new capacity is provided by Options B and C, it is likely that the existing crossing will remain close to capacity, and although delays would be reduced, incidents could still lead to long delays as they do at present.
- k. Option C in particular would offer shorter journey times to many users and deliver the largest wider economic benefits, which ultimately would contribute to national economic growth. Option C also is forecast to deliver the largest reduction in greenhouse gas emissions of the three options. Option C would be expected to impose other environmental costs on the greatest scale of the three options, although some of these costs could be mitigated to some extent by use of a bored tunnel instead of a bridge or immersed tunnel.

3.7.8 The proposed options were assessed against the Without Scheme scenario, i.e. the future conditions at the Dartford Crossing without any further improvements. This indicated that the existing crossing would operate with increased congestion and likelihood of incidents which would lead to greater unreliability.

3.7.9 These location options were presented at a public consultation held by DfT in 2013.

3.7.10 Three engineering solutions were considered: a bridge, an immersed tunnel and a bored tunnel. An immersed tunnel is a shallow depth tunnel submerged in a trench in the riverbed, while a bored tunnel requires the construction of a circular tunnel at depth without removing the ground above.

### Comparison of location options

3.7.11 Table 3.4 summarises the comparison presented in the 2013 consultation document.

**Table 3.4 Comparison of shortlisted location options**

Impacts	Location A	Location B	Location C and C variant
Economic	Forecast to stimulate relatively limited economic growth when compared with the other options.	This option would improve connectivity and is therefore forecast to be more effective than Option A in supporting the development of economic activity in the local area.	As a result of the improved connectivity, this option is forecast to achieve more economic benefit resulting from the agglomeration of business activity than Options A and B.  Location C variant would have similar impacts to Option C but owing to the enhanced connectivity it provides, it is expected to bring the largest economic benefits.
Social	Would potentially impact on a number of planned developments within Dartford and Thurrock.	Would cross planned development sites north of the A2 in the area of the Swanscombe Peninsula.	Almost all Green Belt land with no committed development in the area.
Environmental	Reduction in congestion would lead to a modest reduction in greenhouse gas emissions. Would have the least overall impact on the natural environment of all the options.	This option was forecast to increase greenhouse gas emissions.  A new route would cross an area of nationally important heritage and archaeological value and would therefore cause more environmental harm than Option A.	Option C would provide a more direct route for many journeys, which is forecast to result in a large decrease in greenhouse gas emissions.  Option C would be the longest route of all the options, passing largely through undeveloped land that is designated as Green Belt. A route at this location would also pass through environmentally sensitive areas, including the Kent Downs AONB, ancient woodland and the Thames Marshes Ramsar site, where development would need to be proven to be of 'overriding public interest' before it could go ahead. Overall, Option C would result in the greatest impacts on environmentally sensitive areas of all the options.

- 3.7.12 Consultees were asked if their location preference was dependent on the engineering solution, and if so, which type of crossing they would prefer. Only 10% of respondents reported that their location preference was dependent on the engineering solution, and of those, over 50% preferred a bored tunnel, 25% preferred a bridge and 16% preferred an immersed tunnel.
- 3.7.13 Following the 2013 public consultation, the Secretary of State announced in December 2013 that Location B had the weakest case of the three and that the location should be discarded. Location B would jeopardise major redevelopment of the Swanscombe Peninsula and this option received limited support in the 2013 public consultation. In addition, there were considered to be likely problems with connections to adjacent junctions and impacts on local roads, particularly the connection with the A2. The A2 in this area is likely to be heavily congested due to the existing and planned developments in the area. The Secretary of State concluded that there were sufficient grounds to discard Option B and that Government should focus on the choice between Options A and C.

## 3.8 Route options

- 3.8.1 The 2014 Scheme Objectives, as shown in Table 2.1 of Chapter 2: Project Description, were developed by National Highways and endorsed by DfT after the Government commissioned National Highways to identify and assess options for a new road crossing in the Lower Thames area.
- 3.8.2 Subsequently, National Highways undertook a further, more detailed appraisal of options at crossing locations A and C. The study identified a longlist of nine options at Location A, six options at Location C and four options for the C variant:
- a. The Location A options assessed a variety of bridge, immersed tube and bored tunnel solutions against a variety of factors, including environmental impacts. Details of the process for considering the options are provided within the Planning Statement (Application Document 7.2). As explained in the Need for the Project (Application Document 7.1), Location A options could not be developed into a solution that met the Scheme Objectives. It failed to relieve the congestion on the approaches to the Dartford Crossing as it did not provide a suitable alternative route for traffic travelling along the A2 and A13.
  - b. Alternatives considered at Location C included a bridge, a bored tunnel, and an immersed tube tunnel. The assessment determined that there would be a risk of significant effects to European Designated Sites including the Thames Estuary and Marshes SPA and Ramsar site with both bridge and immersed tube tunnel solutions. The bored tunnel was the least environmentally damaging alternative. The bored tunnel solution was considered unlikely to have direct impacts on the SPA and Ramsar site. It was therefore concluded that, of the crossing options at Location C, a bored tunnel would have the least environmental impact on designated sites.

- c. Assessment of the Location C variant options determined that they did not meet the Scheme Objective of providing additional relief to the existing Dartford Crossing beyond the relief that would be provided by the new route at Location C and would have substantial impacts on the Kent Downs AONB. As a result, the Location C variant options were not considered further.

3.8.3 The outcomes of the route options appraisal work, considering the performance against the Scheme Objectives and the environmental impacts, were presented at the 2016 non-statutory consultation. This included the shortlist of options from the appraisal, which were defined as one option at Location A (identified as route 1) and three options at Location C. The options at Location C were identified as routes 2, 3 and 4 to the north of the River Thames, and the Western Southern Link (WSL) and Eastern Southern Link (ESL) to the south of the River Thames.

3.8.4 All options at Location C used the same crossing point for the River Thames. The key constraints taken into account in determining a crossing at Location C include:

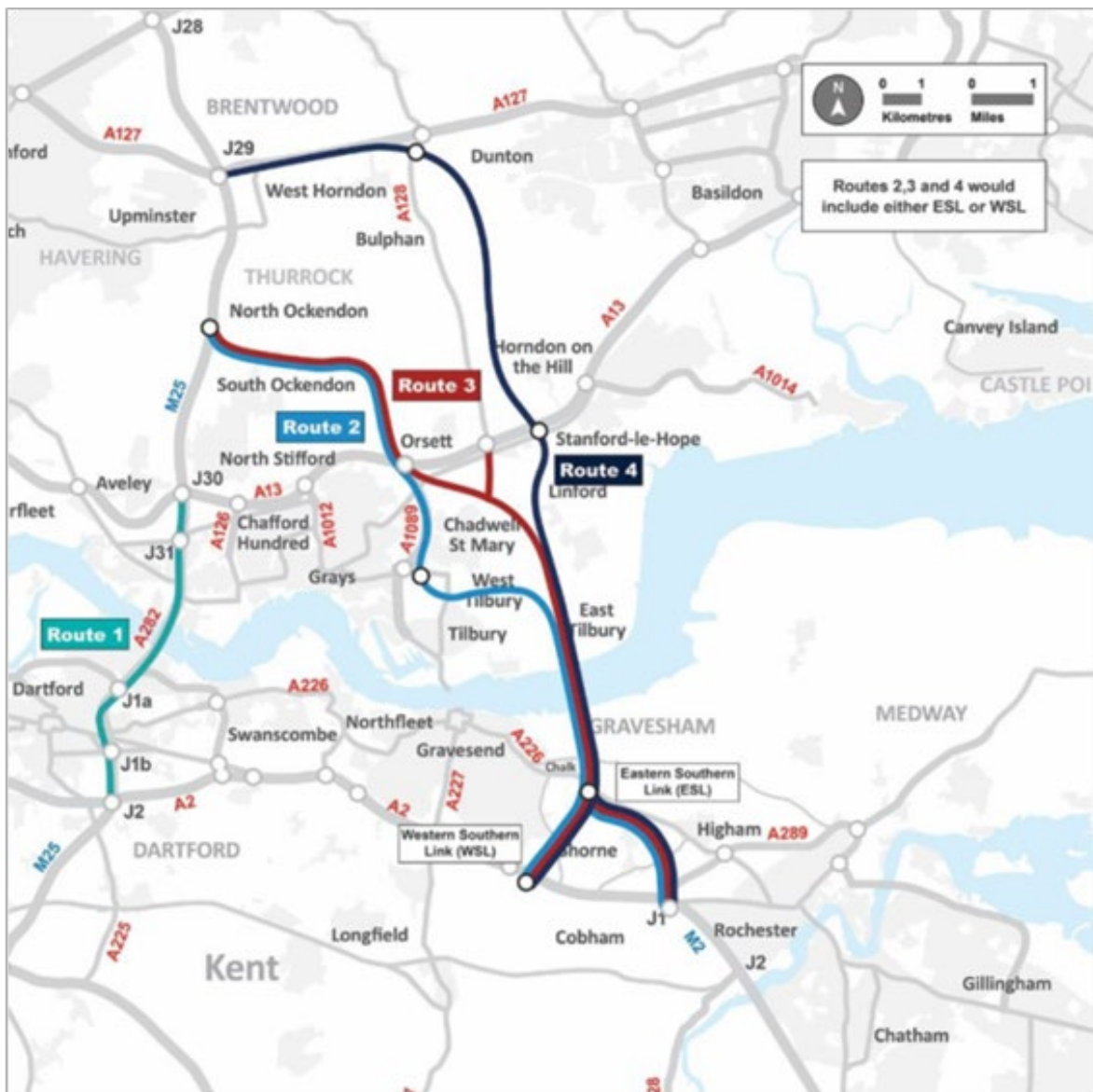
- a. The Ramsar site, the SPA, functionally linked land and a SSSI
- b. The village of Chalk
- c. Listed buildings, including the Grade II\* listed Church of St Mary
- d. Impact on the river hydrodynamics (current, water level and sediment dispersion)
- e. Impacts on river navigation and Port of London Authority considerations
- f. The Metropolitan Police specialist training facility on the south side of the River Thames
- g. Physical constraints including existing major services beneath river (high voltage (HV) transmission cable tunnel, high-pressure gas pipelines), overhead powerlines, clearances under/over the North Kent railway line and the Thames and Medway Canal

3.8.5 The selected alignment, approximately 200m from the village of Chalk, was chosen to balance air quality, noise and visual effects, avoid listed buildings, reduce intrusion into the Ramsar site, avoid the SPA and limit impact on the Metropolitan Police training facilities in 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 was adopted for each of the three crossing types of bridge, immersed tunnel and bored tunnel (see Table 3.7 for the types of crossings considered). The crossing would be perpendicular to the River Thames to minimise length and cost.

3.8.6 The consultation materials noted that Location C was being recommended by National Highways and put forward a proposed route from the shortlisted options.



**Plate 3.2 Shortlisted routes presented at the 2016 non-statutory consultation**



### Comparison of shortlisted route options

- 3.8.7 The following tables provide a summary of the environmental appraisal of the route options included in the 2016 consultation. Table 3.5 relates to route 1, Table 3.6 to routes 2, 3 and 4 north of the River Thames, Table 3.7 to the crossing options, and Table 3.8 to routes 2, 3 and 4 south of the Thames.
- 3.8.8 The information in this section dates from 2016. More recent reappraisals of the options have been carried out and are reported in Section 3.9.

**Table 3.5 Route 1**

<b>Topic</b>	<b>Route 1</b>
Landscape	Potential effect on Mardyke Valley setting
Historic Environment	No significant effects
Biodiversity	Possible indirect impacts on qualifying species associated with Ramsar/SPA, e.g. through loss of functionally linked land and collision risk with a bridge. Directly affects functionally linked land, four local wildlife sites and three areas of ancient woodland.
Water Environment	Affects the Mardyke as a result of multiple crossings. Direct effect on Thames recommended Marine Conservation Zone (rMCZ) with a bridge.
Air Quality	There would be a worsening of air quality at some properties compared with the Without Scheme situation, including new exceedances of European Union (EU) standards for NO <sub>2</sub> . During the 80-month construction period, there would be additional congestion resulting from traffic management requiring temporary speed limits and contraflow working at the existing Dartford Crossing and approach roads. It is likely that air quality would worsen during the construction period, and that there would be additional exceedances of EU standards for NO <sub>2</sub> .
Noise	There would be a small overall noise disbenefit with route 1, compared with the Without Scheme scenario. There would be greater effects for a bridge than a tunnel once operational.
Community Facilities	There could be direct effects on small areas of Mardyke Woods and Davy Down Riverside Park, footpaths, local cycle routes and Sustrans National Cycle Route Networks, and a small area of Open Access Land. The existing Queen Elizabeth II cycle pick up point would need to be relocated further north.

**Table 3.6 Location C route options north of the river**

<b>Topic</b>	<b>Route 2</b>	<b>Route 3</b>	<b>Route 4</b>
Landscape	Affects Green Belt land. Significant changes to landscape character.	Affects Green Belt land. Significant changes to landscape character.	Affects Green Belt land. There would also be loss of landscape features, such as woodland including from Thorndon Park Registered Park and Garden (Grade II*).
Historic Environment	Affects two parts of a conservation area, direct effects on two scheduled monuments and two Grade II Listed Buildings.	Directly affects a Scheduled Monument and two Grade II Listed Buildings.	Directly affects a Grade II listed building. Direct impact on Thorndon Park Registered Park and Garden (Grade II*) and the Thorndon Park Conservation Area.
Biodiversity	Directly affects functionally linked land, an area of ancient woodland and five local wildlife sites.	Directly affects functionally linked land and three local wildlife sites.	Directly affects functionally linked land, six areas of ancient woodland and eight local wildlife sites.

Topic	Route 2	Route 3	Route 4
Water Environment	Affects Tilbury flood storage area and Mardyke floodplain.	Affects Mardyke floodplain.	Avoids effects on Mardyke floodplain.
Air Quality (whole route)	All properties which are predicted to exceed or are at risk of exceeding air quality objectives adjacent to the A282 would experience an improvement in air quality compared with the Without Scheme situation. 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 in the With Scheme scenario.		
Noise (whole route)	There would be an overall noise benefit with routes 2, 3 and 4, compared with the Without Scheme scenario. Overall route 4 provides the largest benefit, followed by route 3 and route 2. 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, for example, the A282 and the A2.		
Community Facilities	Direct effect on two areas of Open Access Land, the Condovers Scout Activity Centre, footpaths, bridleways and local cycle routes.	Direct effect on an area of Open Access Land and the westernmost edge of Orsett Golf Course, footpaths, bridleways and local cycle routes.	Direct effect on two areas of Open Access Land, woodland which could be used for recreational purposes, Dunton Hills Family Golf Centre, footpaths, bridleways, a Byway open to all traffic and local cycle routes.

**Table 3.7 Location C crossing options**

Topic	Bridge	Bored tunnel	Immersed tunnel
Landscape	Adverse impact on the River Thames corridor and visual intrusion.	Minor effect	Minor effect
Historic Environment	Setting effects on listed buildings and scheduled monuments. Potential for disturbance of currently unknown marine archaeology assets.	No significant effects	No significant effects, although potential for disturbance of currently unknown marine archaeology assets.
Biodiversity	Direct effect on SSSI, Ramsar, two local wildlife sites and rMCZ. Possible impact on qualifying species associated with Ramsar/SPA, e.g. through loss of functionally linked land and collision risk.	Direct effect on a local wildlife site. Possible impact on qualifying species associated with Ramsar/SPA, e.g. through loss of functionally linked land.	Direct effect on SSSI, Ramsar, two local wildlife sites and rMCZ, some of which may be temporary. Possible impact on qualifying species associated with Ramsar/SPA, e.g. through loss of functionally linked land.

Topic	Bridge	Bored tunnel	Immersed tunnel
Water Environment	Direct effect on Thames rMCZ and complex hydrology.	No significant effect	Direct effect on Thames rMCZ and complex hydrology.
Air Quality	All properties that are predicted to exceed or are at risk of exceeding the Air Quality Strategy (AQS) objective adjacent to the A282 would experience an improvement in air quality compared with the Without Scheme situation. 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 in the With Scheme scenario.		
Noise	Greater effects for a bridge than a tunnel once operational.	Reduced effects for a tunnel than a bridge once operational.	Reduced effects for a tunnel than a bridge once operational.
Community Facilities	Direct effect on Shorne Marshes RSPB Nature Reserve, footpaths, Sustrans National Cycle Network routes and a local trail.	Unlikely to be any direct effects.	Direct effect on Shorne Marshes RSPB Nature Reserve, footpaths, Sustrans National Cycle Network routes and a local trail.

**Table 3.8 Location C route options south of the river**

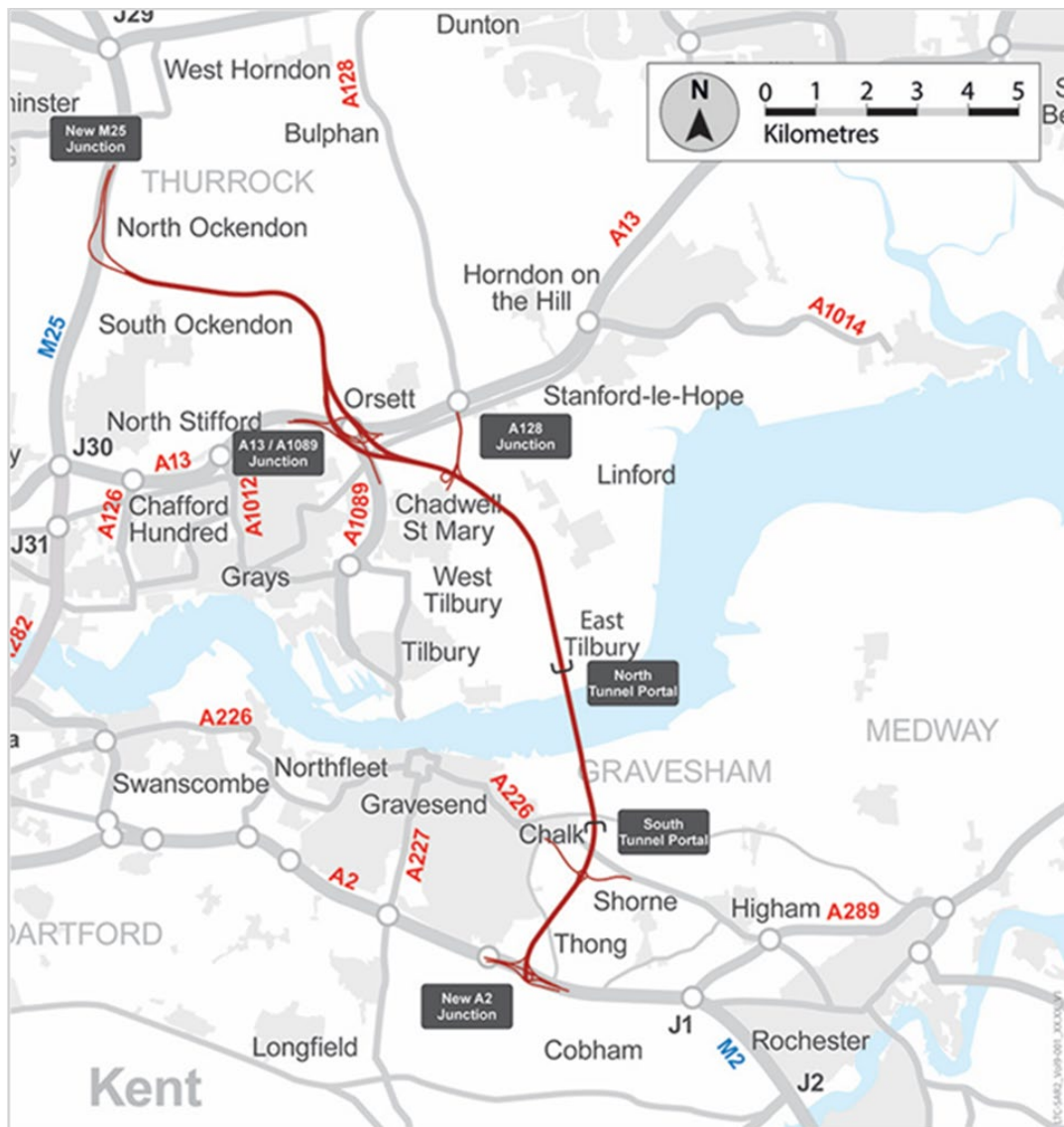
Topic	Western Southern Link	Eastern Southern Link
Landscape	Minor intrusion into Kent Downs AONB at the junction with the A2.	Greater intrusion into the Kent Downs AONB than WSL at the M2/A2/A122 junction.
Historic Environment	Direct effect on Registered Park and Garden. Potential setting effects on listed buildings and Thong Conservation Area.	Potential setting effects on listed buildings and Shorne Conservation Area.
Biodiversity	Direct habitat loss from Claylane Wood ancient woodland and Shorne and Ashenbank Woods SSSI.	Direct loss of habitat from and fragmentation of the woodland within the Great Crabbles Wood SSSI. Direct loss of two areas of ancient woodland and Court Wood Local Wildlife Site (LWS).
Water Environment	No significant effect	No significant effect
Air Quality	All properties that are predicted to exceed or are at risk of exceeding the AQS objective adjacent to the A282 would experience an improvement in air quality compared with the Without Scheme situation. 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 in the With Scheme scenario.	

Topic	Western Southern Link	Eastern Southern Link
Noise	<p>There would be an overall noise benefit with routes 2, 3 and 4, compared with the Without Scheme scenario. 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, for example, the A282 and the A2.</p> <p>Route 2 has less benefit with the WSL compared with the ESL. Routes 3 and 4 have more benefit with the WSL compared with the ESL.</p>	
Community Facilities	<p>Direct effect on Southern Valley Golf Club, Claylane Wood, footpaths, a bridleway, a Sustrans National Cycle Network route and a local cycle route.</p>	<p>Direct effect on Great Crabbles Wood, the Warren Wood and Cole Wood (the latter two forming part of Court Wood LWS). In addition, footpaths, a Sustrans National Cycle Network route, a local cycle route and a local trail are all potentially affected.</p>

### The preferred route

- 3.8.9 The PRA was made in April 2017 by the Secretary of State for Transport. This took into account the feedback received during the 2016 non-statutory consultation, and further appraisal work undertaken to supplement and update the pre-consultation appraisals. The route is illustrated in Plate 3.3.
- 3.8.10 The preferred route location of the crossing was announced as Location C and comprising route 3 to the north of the River Thames, with a bored tunnel crossing under the River Thames east of Gravesend and Tilbury, and the WSL to the south of the River Thames which would join the A2 east of Gravesend.
- 3.8.11 The appraisal had shown that Location C variant would not provide additional relief to the congested Dartford Crossing beyond that offered by a scheme in Location C, but that it would be considered as part of National Highways' wider route strategies.

**Plate 3.3 The preferred route announced in April 2017**



### 3.9 Location and route options reappraisals

#### Options reappraisal – 2018

- 3.9.1 In 2018, National Highways undertook a reappraisal of all the options previously presented, from the original six crossing locations presented by the DfT in 2009 up to the PRA in 2017, to ensure that as more information was becoming available as well as in response to design development, the decision making throughout the options appraisal process remained valid.
- 3.9.2 The conclusion of the options reappraisal was that the option identification and selection process remained valid; this was presented in the Design Construction and Operations report (Highways England, 2018a) at Statutory Consultation in 2018. It remained the conclusion that route options at crossing locations A, B, D and E would not meet the Scheme Objectives and were not considered viable. For the route options at Location C, route 3 and the WSL, connected by a bored tunnel, remained the best solution. Further details on the reappraisal process are provided in the Planning Statement (Application Document 7.2).

## Options reappraisal – 2020

### 3.9.3 The appraisal was revisited in 2020 for revalidation.

- a. Location A was not remodelled. The differences between the version of the Lower Thames Area Model (LTAM) used for the 2018 assessment and the version used in 2020 were not considered to be likely to result in a material change to the findings of the assessment. Consequently, the conclusion that Location A did not meet the Scheme Objectives was considered to remain valid.
- b. Regarding Location B, as there had been no significant reduction in the development plans in this area, the decision not to take forward Location B was considered to remain valid.
- c. The review of the potential Location C options north of the River Thames found the decision not to take these options forward remained valid. A review of the route south of the river identified that design changes along the A2 potentially had a material impact on the key factors that informed the decision to develop the WSL. Consequently, the selection of the WSL compared to the ESL was taken to a detailed appraisal, as reported in the next subsection of this chapter.
- d. Location C variant options were also reassessed: while the transport model showed that there are forecast increases in the traffic flows along the M2 and A229, as reported in Appendix C: Transport Forecasting Package of the Combined Modelling and Appraisal Report (Application Document 7.7), increasing the capacity along this route would not offer any additional relief to the congested Dartford Crossing beyond that offered by a scheme in Location C. Consequently, the decision not to take forward the Location C variant options was considered to remain valid.
- e. Regarding Locations D1 and D2, the assessment undertaken in 2018 was based on the 2016 traffic baseline, which remains the baseline for assessment of the Lower Thames Crossing. As such, there was no material change to the basis of the 2018 assessment and the decision not to take forward the options at Location D was considered to remain valid.
- f. The assessment of Location E in 2018 was based on the 2016 traffic baseline, which remains the baseline for assessment of the Lower Thames Crossing. As such, there was no material change to the basis of the 2018 assessment and the decision not to take forward Location E was considered to remain valid.

### Review of the preferred route south of the River Thames

- 3.9.4 An appraisal of the selection of the WSL as the preferred route south of the River Thames was undertaken in August 2020. This reassessed the earlier conclusion that the WSL was preferable to the ESL, considering the changes to proposed design for the A2 corridor and the M2/A2/A122 junction since PRA.
- 3.9.5 To support the detailed assessment of the ESL in 2020, the route considered before PRA was updated to allow a comparative reappraisal against the current WSL route. Following this reworking, the ESL performance was reappraised against the Scheme Objectives and the current WSL.
- 3.9.6 Since the PRA, the WSL design has developed to include widening of the A2 through the Kent Downs AONB, a larger M2/A2/A122 junction, and the section of the route between the A2 and the South Portal has increased to dual three-lane. There has also been further development in the understanding of the existing utility configurations and the diversion and protection works required as part of the Project. The detailed appraisal of the route south of the River Thames found that the adverse effects of the Project had increased since the PRA.
- 3.9.7 The reworked ESL is likely to impact more residential and commercial properties and significant utility assets. Both the WSL and the ESL would affect ancient woodland, and the reworked ESL would have worse biodiversity impacts overall, such as impacts on Great Crabbles Wood and loss of ancient woodland compensation planting. The updated ESL is likely to have more impact on the historic environment, with a larger impact on built heritage assets than the WSL. Impacts on landscape, such as impacts to the Kent Downs AONB, would be similar for both the reworked ESL and the WSL. For air quality and noise, the overall impact from the WSL is likely to be greater than the reworked ESL due to the larger number of receptors that could be affected.
- 3.9.8 The appraisal concluded that in comparing the current WSL design with a similarly updated ESL design, the ESL would be likely to have more adverse effects on the environment than the WSL.
- 3.9.9 Weighing up the relevant considerations, the balance of the community and environmental impacts of the ESL remain more significant than the overall balance of impacts of the WSL. Further detail can be found in the Planning Statement (Application Document 7.2).
- 3.9.10 The preferred route was assessed as meeting the Scheme Objectives, while having the lowest impact on several environmentally sensitive areas, including the Thames Estuary and Marshes SPA and Ramsar site, as well as on the communities close to the route.

### Options reappraisal – 2022

- 3.9.11 This section contains a review of the PRA in the current context.
- 3.9.12 The Dartford Crossing is operating at or beyond its effective capacity for much of the day. The physical constraints of the existing infrastructure have a severe effect on operations.



- 3.9.13 The Dartford Crossing retains its critical role in catering for strategic trips on the Strategic Road Network (SRN), providing a critical part of the road network for strategic trade links with Europe. The Dartford Crossing continues to present a barrier to economic growth, acting as a constraint on individuals and businesses. There remains strong evidence of the potential for the Project to generate significant wider economic impacts that could transform the economy of the Lower Thames area. The Project would drive economic benefit by unlocking constraints on economic growth and stimulating local and regional development, as well as supporting national growth.
- 3.9.14 Brexit has not had an impact on the preferred route decision. The Dartford Crossing remains a key strategic link between the UK and Europe, enabling goods and people to flow between the Channel ports and the UK's industrial heartlands and beyond. The Project's ability to reduce congestion in the road-using transport and logistics sector and to facilitate growth exports at the region's ports in the current post-Brexit environment would be critically important in boosting regional productivity.
- 3.9.15 The COVID-19 pandemic altered travel patterns temporarily, with traffic quickly returning to levels seen before the pandemic. With the changing working and shopping patterns, 42% of vehicles using the Dartford Crossing in June 2021 were goods vehicles, compared with 33% in 2019. December 2020 saw the busiest day ever recorded for Heavy Goods Vehicle (HGV) traffic on the Dartford Crossing. There is no evidence to suggest that changes to travel brought about by COVID-19 have significantly reduced the demand for a new crossing.
- 3.9.16 It is evident the factors that led to the preferred route selection (see Section 3.8 of this chapter) endure to the present day and that despite changes to the wider context, the justification for the 2017 PRA remains robust.

## 3.10 Road standard

- 3.10.1 At PRA, it was assumed that the Project's route would be an all-purpose trunk road (APTR), although it was acknowledged in the Post-Consultation Scheme Assessment Report that the Project could be designed to emerging 'expressway' standards introduced in the Road Investment Strategy (DfT, 2020).
- 3.10.2 Following the PRA, consideration was given to the following three road standards:
- g. APTR
  - h. Expressway
  - i. Conventional/smart motorway
- 3.10.3 Following assessment of the alternative road standards available, it was decided that the Project should be designed to the expressway standard.
- 3.10.4 The main reasons for this decision were:
- j. The classes of vehicles permitted to use the Project should be restricted for road safety and tunnel operational reasons. An APTR is, therefore, not appropriate without the application of restrictions on vehicle classes.

- k. This new type of standard would produce a high-standard free-flowing route for road users. Breakdowns would be managed through the provision of emergency areas and controlled motorway traffic control technology including lane signals and variable mandatory speed limits.
- l. This new standard would have lower environmental impacts than a motorway designed to conventional standards due to the lesser land-take.
- m. The Project would provide a free-flowing connection between the M2 and the M25.

3.10.5 In the Design Refinement Consultation in 2020, an update was provided on the proposed road standard that the Project would be defined as an all-purpose trunk road. The Project would operate as an all-lane running trunk road, where there is no hard shoulder (with the exception of sections of the A13 interchange where lane drop/lane gain arrangements are introduced).

### 3.11 Number of lanes

3.11.1 As the design has evolved and new information has become available, the number of lanes required for the Project in different locations has changed, as set out in Table 3.9.

**Table 3.9 Consideration of lane requirements**

Option	Discussion
Preferred Route Announcement: Dual two-lane throughout	At PRA, the Project route was a dual two-lane carriageway throughout. Following refinement of the traffic modelling, it was concluded that this option would not provide the required capacity.
Statutory Consultation: Dual three-lane throughout	<p>At Statutory Consultation, the design that was presented included the change to dual three-lane throughout, following the development of the LTAM. The reasons for proposing this solution were:</p> <ul style="list-style-type: none"> <li>• Between the M2/A2 and A13 junctions, analysis showed that with dual two-lanes the link was likely to become congested in peak periods soon after opening. By comparison, with dual three-lanes the crossing was forecast to better meet the transport-related Scheme Objectives.</li> <li>• Between the A13 and M25 junctions, analysis using the LTAM showed that dual three-lanes were also required northbound on this link to accommodate the heavy proportion of freight vehicles already on the A122 and merging on to the road from the A13 junction.</li> <li>• The provision of a third lane provided additional capacity for reliable and safe journeys on the Project’s main road.</li> </ul> <p>Even though the extra lane would increase the estimated cost of the Project, analysis showed that it would lead to improved journey times.</p> <ul style="list-style-type: none"> <li>• There are slight additional adverse environmental effects due to the greater land-take and additional traffic associated with dual three-lane throughout, and this was assessed in the PEIR as part of the presented design.</li> </ul>

Option	Discussion
<p>Supplementary Consultation: Dual two-lane only southbound from the M25 to the A13/A1089 junction</p>	<p>The design presented at the 2020 Supplementary Consultation removed one lane southbound between the M25 and the A13/A1089 junction.</p> <p>Updated traffic modelling showed that two lanes in this location would provide sufficient capacity for vehicles travelling southbound on the Project between the M25 and the A13/A1089 junction.</p> <p>The third lane northbound was still required to accommodate the HGV traffic merging on to the A122 northbound.</p> <p>This change enabled the redesign of the southbound link from the M25 to the Lower Thames Crossing to avoid demolition and reconstruction of the existing Ockendon Road bridge over the M25.</p> <p>Reducing the number of lanes would reduce the extent of habitat loss in this area. There would also be benefits for drainage and the water environment, linked to a smaller land-take/built footprint that would reduce effects on the local drainage regime. Also, at watercourse crossings, culverts would be shorter in length and open span crossings would be narrower, reducing the potential effects on water quality and hydromorphology.</p> <p>As there would be less land-take as a result of this change, this would reduce likely effects on agricultural land and businesses.</p>
<p>Additional lane provision on the A2</p>	<p>In the Statutory Consultation design, the A2 between M2 junction 1 and the Project was maintained as dual four-lanes, but the overall lane provision within the corridor was increased to six in each direction by the provision of two-lane parallel connector roads in each direction.</p> <p>The increased lane provision on the A2, A13 and M25 was proposed in order to:</p> <ul style="list-style-type: none"> <li>• Accommodate the design year traffic flows predicted by the updated traffic model.</li> <li>• Provide sufficient capacity following the results of more detailed assessment of the performance of the Project's junctions and connecting roads.</li> <li>• Allow joining and leaving traffic to change lanes safely between relatively closely spaced adjacent junctions as required by design standards.</li> <li>• Provide the layouts for joining and leaving traffic required by design standards. These include the provision of additional lanes or the loss of lanes at junctions.</li> </ul> <p>For more information on the options considered for the M2/A2 corridor, refer to Section 3.14.</p>
<p>Additional lane provision on the A13</p>	<p>In the Statutory Consultation design, the A13 was widened to four lanes eastbound between the Project and the A128 Orsett Cock junction.</p> <p>The increased lane provision on the A2, A13 and M25 was proposed in order to:</p> <ul style="list-style-type: none"> <li>• Accommodate the design year traffic flows predicted by the updated traffic model.</li> <li>• Provide sufficient capacity following the results of more detailed assessment of the performance of the Project's junctions and connecting roads.</li> </ul>

Option	Discussion
	<ul style="list-style-type: none"> <li>• Allow joining and leaving traffic to change lanes safely between relatively closely spaced adjacent junctions as required by design standards.</li> <li>• Provide the layouts for joining and leaving traffic required by design standards. These include the provision of additional lanes or the loss of lanes at junctions.</li> </ul> <p>For more information on the options considered for the A13 junction, refer to Section 3.22 below.</p>
<p>Additional lane provision on the M25</p>	<p>The Statutory Consultation design proposed:</p> <ul style="list-style-type: none"> <li>• Six lanes northbound in the M25 corridor between the Project's route and junction 29 by maintaining the M25 as four lanes and adding a two-lane connector road from the Project's route to junction 29</li> <li>• Five lanes southbound on the M25 from junction 29 to the Project's route</li> <li>• Dual four-lanes on the M25 through junction 29</li> </ul> <p>The increased lane provision on the A2, A13 and M25 is proposed in order to:</p> <ul style="list-style-type: none"> <li>• Accommodate the design year traffic flows predicted by the updated traffic model.</li> <li>• Provide sufficient capacity following more detailed assessment of the performance of the Project's junctions and connecting roads.</li> <li>• Allow joining and leaving traffic to change lanes safely between relatively closely spaced adjacent junctions as required by design standards.</li> <li>• Provide the layouts for joining and leaving traffic required by design standards. These include the provision of additional lanes or the loss of lanes at junctions.</li> </ul> <p>For more information on the options considered for the M25 corridor, refer to Section 3.26 below.</p>

### 3.12 High and heavy load routes

3.12.1 The Project would not make any specific provision for high or heavy load routes other than ensuring that the existing heavy load road along the A1089 and the A13 is maintained.

3.12.2 As set out in the Statutory Consultation, the creation of a dedicated high-load route or a route to cater for heavy loads greater than those covered by current design standards would not be economically justifiable.

### 3.13 Rest and service area

3.13.1 Consideration has been given to the inclusion of a rest and service area (RaSA) within the Project. The options considered are set out in Table 3.10.

**Table 3.10 Consideration of rest and service area (RaSA) options**

Option	Discussion
Provision of facility within the Project	<p>The strategic case for the provision of a RaSA was explained in the Statutory Consultation as follows:</p> <ul style="list-style-type: none"> <li>• RaSAs perform an important road safety function by providing opportunities for the travelling public to stop and take a break during their journey.</li> <li>• Government advice is that motorists should stop every 2 hours and take a break of at least 15 minutes. Drivers of many commercial and public service vehicles are subject to a regime of statutory breaks and other working time restrictions and these facilities assist in complying with such requirements. The RaSA would have facilities that allow customers to rest and relax before continuing their journey.</li> <li>• The ability to refuel or recharge vehicles is also an important element of a RaSA. By having refuelling and recharging facilities, it is hoped that the number of vehicles running out of fuel on the road network will be minimised, creating a safer road and reducing occurrences of lane closures due to broken down vehicles.</li> <li>• Refreshments are an important part of any rest break when undertaking a journey. The RaSA would include facilities for hot and cold refreshments, which would allow customers to obtain food and drinks. This would provide important nutrition, reducing fatigue for drivers when continuing their journey.</li> <li>• There is a government commitment to provide frequent electrical charging points due to the increasing use of electric and hybrid vehicles.</li> </ul>
Upgrading facilities on the A2	<p>This option was discounted prior to Statutory Consultation because it would not help to address the distance to the next services on the M25 (South Mimms). Also, there were no obvious sites available on the A2 near the Project that avoid the ancient woodland and SSSIs.</p>
New RaSA near Ockendon	<p>This option was discounted prior to Statutory Consultation because the Project would be on a viaduct at this location, making it difficult and expensive to provide an access roundabout, and because it would be located within the Green Belt.</p>
New RaSA near Tilbury	<p>At the time of the Statutory Consultation, a junction was proposed at Tilbury (see Section 3.20). A RaSA was proposed at this junction. An assessment was made of potential locations to the south-west, south-east and north-east of the junction.</p> <p>The north-eastern site was preferred because it was outside the flood zone, avoided the historic landfills and other poor ground conditions and ground water protection zones which would be affected by the other two sites. The site was also the furthest away from the scheduled monuments of Tilbury and Coalhouse Forts.</p>
No provision of a RaSA	<p>Following further investigations, consultation feedback, and consideration of environmental impacts, the RaSA was removed from the Project in advance of the Supplementary Consultation.</p> <p>The removal of the RaSA would lead to a slight improvement in the predicted landscape impacts in this area. There would be a reduction in land-take. Local concerns about community safety would be removed.</p>

## 3.14 M2/A2 corridor

3.14.1 The options set out in Table 3.11 were considered in this area.

**Table 3.11 Consideration of options for the M2/A2 corridor**

Option	Discussion
No change to the existing situation	The design at the time of the Preferred Route Announcement included no works in this area. However, vehicles travelling along the M2 and the A2 towards the Project route would cross with traffic using the A2 to travel to and from the Medway towns. This would result in high levels of weaving traffic, which would not comply with highway design standards or the Project's objective to improve safety.
Widening the A2 between M2 junction 1 and the Project's junction from dual four-lanes to dual five-lanes by adding an extra lane and keeping the hard shoulder	Widening to dual five-lanes would result in high levels of weaving traffic, which would not comply with highway design standards or the Project's objective to improve safety.
Widening the A2 between M2 junction 1 and the Project's junction from dual four-lanes to dual five-lanes by conversion of the existing hard shoulder to a running lane	Widening to dual five-lanes would result in high levels of weaving traffic, which would not comply with highway design standards or the Project's objective to improve safety.
Keeping the A2 as dual four-lanes and providing two-lane one-way connector roads in each direction parallel to the A2 between M2 junction 1 and the Project's junction. These connector roads connect to the A289 Wainscott Bypass and the old A2 into Strood and Rochester.	<p>This design was proposed in the Statutory Consultation in order to:</p> <ul style="list-style-type: none"> <li>• Accommodate the design year traffic flows predicted by the LTAM.</li> <li>• Avoid the high levels of weaving that would need to take place in the relatively short distance between M2 junction 1 and the Project's junction (about 2km) if this section was widened to dual five-lanes.</li> <li>• Provide connections between all the main roads (M2, A2, A289) and the Project's route while maintaining as many local traffic movements as possible.</li> <li>• Effectively provide a free-flow connection between the M2 and the Project's route.</li> <li>• Cater for local traffic between the A2 and M2 junction 1.</li> </ul> <p>The works in this area would be within the Kent Downs AONB and close to areas of ancient woodland, but would be kept within the existing highway, where practicable. Due to the impact of the Project in this area, the Project design includes a series of mitigation works, including the provision of green bridges.</p>

Option	Discussion
<p>Provide connector roads but reduce the widening of the M2/A2 corridor through the Kent Downs AONB and Shorne Woods Country Park</p>	<p>This narrower design was developed after the Statutory Consultation. It was presented in the Supplementary Consultation and was subsequently selected.</p> <p>The reduced footprint would be achieved by reducing the width of lane four on both M2 carriageways, as well as the central reservation, to minimise the footprint of the road through the AONB. The hard shoulder would be removed from the eastbound link road along the A2.</p> <p>The reduced footprint would require additional vegetation removal from the central reserve, which would be likely to increase visibility of the High Speed 1 (HS1)/A2 corridor, resulting in additional adverse effects on the Grade II* registered Cobham Hall park and garden. However, the smaller Project footprint would reduce the amount of ancient woodland from the Shorne and Ashenbank Woods SSSI that would require removal. The reduced footprint would also lessen the impacts on agricultural businesses and recreational users of Shorne Woods Country Park.</p>

### 3.15 A2 junction

3.15.1 The options set out in Table 3.12 were considered in this area.

**Table 3.12 Consideration of options for the A2 junction**

Option	Discussion
<p>Compact junction as included in the Preferred Route Announcement</p>	<p>To provide a junction in this location without impacting on HS1, which is adjacent to the highway boundary to the south, it was proposed that the existing A2 would be realigned north over an approximate length of 2.5km. This proposal required the east-facing slip roads at the Gravesend East junction to be closed due to the connections from the Project being too close to allow weaving to take place safely. In addition, the existing merge on the westbound A2 and diverge on the eastbound A2 from the Brewers Road junction would be closed. This was again due to there being insufficient weaving length.</p> <p>Because of closing these slip roads, the design included a new link road between Henhurst Road roundabout and Brewers Road roundabout on the south side of the A2.</p> <p>Due to the constraints in this area, the design required speeds as low as 50kph on the slip roads.</p>
<p>Higher speed junction</p>	<p>An assessment was undertaken to consider whether the proposed compact junction could be improved to provide a higher speed junction. It was concluded that this was possible without significantly increasing environmental impacts and therefore alternative higher speed junctions were considered following the PRA.</p> <p>A new higher speed junction was taken forward to the 2018 Statutory Consultation because it maintained an 85km/h (53mph) design speed, accommodated the forecast design year traffic flows, catered for both motorway and local traffic movements, and avoided the ancient woodland located adjacent to the northern boundary of the A2 corridor. However, the design resulted in an encroachment into the HS1 corridor.</p>

Option	Discussion
Altered higher speed junction	<p>The 2020 Supplementary Consultation presented further alterations to the M2/A2/A122 junction to provide a more compact layout while maintaining the higher design speed, reducing land-take and enabling the tunnel to be extended south. (Further discussion on the changes to the South Portal is provided in Section 3.17.)</p> <p>Local connections with the A2 were also modified as part of the revised proposals, including the addition of a new connection between the Gravesend East junction and the M2 eastbound. These were to reduce congestion and to provide better connections with the existing Marling Cross bridge and Henhurst Road.</p> <p>The layout selected was chosen for its reduced impact on heritage, landscape and biodiversity. However, as a result of the South Portal move and the new connection from Valley Drive, the junction would now encroach into the Claylane ancient woodland (as it also did at PRA).</p>

- 3.15.2 To the north of the A2 junction, the Project route would cross under Thong Lane. In the Statutory Consultation, the proposals included a green bridge at Thong Lane to provide some connectivity of woodland planting and a footpath for pedestrians. In the Supplementary Consultation, this design was amended to include a wider green bridge at Thong Lane to enable walkers, cyclists and horse riders to cross the newly constructed Lower Thames Crossing, and to access Shorne Woods Country Park and the AONB. The widened bridge would enable more substantial tree planting to benefit wildlife.

## 3.16 A226 junction

- 3.16.1 The options set out in Table 3.13 were considered in this area.

**Table 3.13 Consideration of options for the A226 junction**

Option	Discussion
Junction with the A226	<p>A local junction with the A226 was included in the Project following early engagement with key stakeholders as the connectivity created would potentially unlock economic development opportunities, providing benefit to the surrounding community and local businesses.</p> <p>The junction was included in the public consultation in early 2016. It was subsequently included in the preferred route but with a commitment to giving further consideration as to whether or not it should remain part of the Project.</p>
Junction with no eastern connections	<p>This option was developed to address concerns about the impact of additional traffic volumes through Higham village and was considered as one of the options before the Statutory Consultation.</p>
No junction with the A226	<p>Following further appraisal of the Project's route with and without an A226 junction, it was concluded that the A226 junction should not be included in the Statutory Consultation design of the Project. The main reasons for this conclusion are:</p> <ul style="list-style-type: none"> <li>• The removal of the A226 junction was supported by the majority of key stakeholders associated with the Project.</li> <li>• Most of the benefits of the junction would have been for local rather than strategic traffic.</li> </ul>



Option	Discussion
	<ul style="list-style-type: none"> <li>• The junction would have had a negligible effect on traffic levels at the existing Dartford Crossing.</li> <li>• The junction would have resulted in significant increases in traffic flows on unsuitable local routes, particularly the A226 to the east and west of the Project's route.</li> <li>• There are no environmental reasons to support the retention of an A226 junction in the Project.</li> <li>• An A226 junction is not needed for maintenance or operational reasons.</li> </ul> <p>Providing an A226 junction is not compatible with moving the South Portal southwards. (Further discussion on the changes to the South Portal is provided in Section 3.17.)</p>

### 3.17 South Portal

3.17.1 The options set out in Table 3.14 were considered for the location of the South Portal.

**Table 3.14 Consideration of options for the South Portal**

Option	Discussion
<p>South of Lower Higham Road (PRA location)</p>	<p>The South Portal at PRA was located to the south of Lower Higham Road, outside of the Thames Estuary and Marshes Ramsar and SPA and South Thames Estuary and Marshes SSSI. The total tunnel length (the length of the enclosed road) was 3.33km.</p> <p>To the south of the South Portal, the preferred route was in a 25m deep, water impervious structure, to prevent ingress from the groundwater table in highly permeable chalk. This crossed under the A226 and between the village of Chalk and the Grade II* listed St Mary the Virgin church.</p> <p>Heading south from the A226, the road was above the groundwater table and the water retaining trough structure transitioned to an open cutting with free-standing slopes in the chalk.</p> <p>This location had risks associated with the construction of a deep excavation under the groundwater table, close to the Ramsar site.</p> <p>In addition, the South Portal in this location would have created a physical barrier between the village of Chalk and St Mary the Virgin church.</p> <p>In order to address the issues identified, and to address feedback from the 2016 non-statutory consultation, alternative locations to the south were considered (see below). These would enable the bored tunnel to be extended, thus avoiding the need for deep excavation within the water table.</p>
<p>100m south of the A226 (location presented at Statutory Consultation)</p>	<p>This option would have provided an additional tunnel length of 600m, when compared to the PRA location, giving a total tunnel length of 3.9km.</p> <p>The design also adjusted the route horizontally for about 2.2km to make it straighter to allow the drainage cross falls in both tunnel bores to be directed away from the centre. This positioned the new South Portal location approximately 50m west from its previous position.</p>

Option	Discussion
	<p>This option was taken forward to 2018 Statutory Consultation. It was selected at that stage as it was assessed to provide sufficient mitigation to the impacts on the local groundwater with limited additional tunnelling and the least impact to the overall Scheme Objectives. Other reasons also included reduced risk of impacts on the adjacent Thames Estuary and Marshes Ramsar site, and it addressed concerns regarding severance between the village of Chalk and St Mary the Virgin church.</p>
<p>300m south of the A226</p>	<p>This was one of the alternatives assessed before the 2018 Statutory Consultation. It would have provided an additional tunnel length of 800m, when compared to the PRA location, giving a total tunnel length of 4.1km. This was not taken forward at the Statutory Consultation stage, as the location immediately south of the A226 was assessed to provide sufficient mitigation with limited additional tunnelling. It was considered that the additional cost of further tunnelling would be higher than any benefits. In addition, with this option, there would not have been enough distance between the tunnel portal and the start of the diverge for the A2 junction to accommodate the required signs and signals, without departures from standards.</p>
<p>Within the boundary of the Southern Valley Golf Course</p>	<p>This was one of the alternatives assessed before the 2018 Statutory Consultation. It would have provided an additional length of 1.2km, when compared to the PRA location, giving a total tunnel length of 4.5km. This was not taken forward at the Statutory Consultation stage, as the location immediately south of the A226 was assessed to provide sufficient mitigation with limited additional tunnelling. It was considered that the additional cost of further tunnelling would be higher than any benefits. In addition, with this option, there would not have been enough distance between the tunnel portal and the start of the diverge for the A2 junction to accommodate the required signs and signals, without departures from standards.</p>
<p>350m further south of the A226 (design presented at Supplementary Consultation)</p>	<p>Following further design development (including ground investigation) and a detailed assessment of the construction sequence for the South Portal, the tunnel was extended a further 350m south to avoid the need to pump water from the underlying Chalk aquifer during construction and potentially during operation.</p> <p>This revised design further reduced the potential for impacts to the Thames Estuary and Marshes Ramsar and SPA and South Thames Estuary and Marshes SSSI. This was achieved by reducing the risks of saline intrusion, groundwater pollution and changes to the groundwater component of the water balance that supports the designated interests of the wetland site.</p> <p>The amended tunnel location would also result in an improvement to the visual impacts compared to the 2018 Statutory Consultation design as the new tunnel location would have less impact on the landform.</p> <p>As set out in the Supplementary Consultation, the design now includes additional landscaping as replacement open space to the east of Gravesend and surrounding the southern tunnel entrance, to create Chalk Park. This has also resulted in the opportunity for beneficial reuse of excavated material from the southern entrance approach ramp. More information is provided in Chapter 2: Project Description.</p>

3.17.2 The 2022 Local Refinement Consultation included an additional 8ha of land for public recreation, linked to the east of Chalk Park by a public footpath. This was added to the proposals following engagement with the landowner, feedback from the Community Impacts Consultation and further design development. It would be created by permanently acquiring the remaining 8ha area of Southern Valley Golf Club, previously identified for temporary use during construction. The existing ground level would be maintained, and the planting would include species that provide a rich, chalk grassland habitat and woodland groups that are reflective of the local area.

### 3.18 Tunnel design

3.18.1 Alternative designs for key aspects of the tunnel design were considered after the PRA, leading to the design presented at the Statutory Consultation, as set out in Table 3.15.

**Table 3.15 Tunnel design options**

Aspect	Preferred Route Announcement	Statutory Consultation changes, with reasons
Cover under the river	A minimum cover under the River Thames of 1.5 times the outer diameter of the tunnel	Reduced the minimum cover to the tunnel under the River Thames to 1.0 times the outer diameter of the tunnel.  An assessment of the unit weight of relevant soils and the risk of tunnel uplift allowed the cover to be reduced without exceeding the limits for a safe design. This reduces the cost of construction.
Cover onshore	A minimum cover for the onshore section of the tunnel equal to the outer diameter of the tunnel	Reduced the minimum cover to the tunnel for the onshore section to 0.8 times the outer diameter of the tunnel.  An assessment of the unit weight of relevant soils and the risk of tunnel uplift allowed the cover to be reduced without exceeding the limits for a safe design. This reduces the cost of construction.
Road gradient	A maximum road gradient both north and south of the river of 4%	The maximum road gradient on the north side of the river has been reduced to 3%, to match the Expressway standard. This change would also bring benefits through reduced vehicle emissions.  On the north side of the river, the assessment has shown that it is possible to accommodate this change without a change to the portal location.  On the south side of the river, the maximum road gradient remains at 4%. This is because the ground level in this area is also sloping at about 4%. Therefore, the road gradient cannot be reduced to 3% without significantly further extending the tunnel length and increasing the depth and width of the approach cutting, which would have a potentially greater impact on properties around Thong Lane.

Aspect	Preferred Route Announcement	Statutory Consultation changes, with reasons
Length of cut-and-cover at South Portal	100m of cut-and-cover tunnel and retained ramp structure at the South Portal	Changed the length of cut-and-cover tunnel and retained ramp structure to 60m at the South Portal, to reflect the changed location of the South Portal and greater knowledge and understanding of the ground conditions.
Length of cut-and-cover at North Portal	320m of cut and cover tunnel and retained ramp structure at the North Portal	Changed the length of cut-and-cover tunnel and retained ramp structure to 950m at the North Portal, to reflect greater knowledge and understanding of the ground conditions.
Structure beneath the roadway in the tunnel	Ballast concrete placed as support under the roadway with some of the mechanical and electrical equipment placed within the concrete ballast	Changed from ballast concrete to an under-deck gallery beneath the roadway. This would provide safe access to the mechanical and electrical equipment for maintenance during normal operation.

3.18.2 River transport has been proposed as an alternative to road transport for the import of some materials. It would be feasible for the Project to import materials via existing ports on the north side of the River Thames (e.g. Port of Tilbury London Limited (PoTLL) and Tilbury2), with onward transport via the road network. The effects of river transport have been assessed in the relevant topic chapters of the ES to allow the Contractors the opportunity to consider the alternative during the construction phase.

## 3.19 North Portal

3.19.1 The North Portal has been located to limit the length of the tunnel required, and to enable the vertical alignment to reach ground level to the south of the Tilbury Loop railway line before rising on an embankment and bridge to cross the railway and pass near Coopers Shaw Road to the north-east of Tilbury.

3.19.2 Consideration was given by the design team to locating the portal 1km further north, but this was discounted because the critical risks relating to engineering and ground conditions outweighed the potential advantages, which included reduced adverse impacts on landscape and visual amenity, cultural heritage and air quality.

3.19.3 The 2020 Design Refinement Consultation presented changes to the design of the maintenance access tracks at the North Portal. The maintenance access tracks would be moved closer to the Lower Thames Crossing to allow for a shorter culvert length (approximately 60 metres instead of 80 metres). A shorter culvert would minimise the impact on local ecology and allow wildlife, such as water voles, fish and eels, to navigate through the culvert more easily.

3.19.4 The design of the operational access roads in this location was updated further and included in the 2022 Local Refinement Consultation. The proposals now include a new bridge over the new road, a realigned access road on the western side, and the removal of the proposed access road on the eastern side. The changes provide more flexibility for emergency access and would not significantly change the assessed environmental effects.

- 3.19.5 A new public park, known as Tilbury Fields, is proposed on the north bank of the Thames, adjacent to the North Portal. The 2022 Local Refinement Consultation presented changes to the design of Tilbury Fields, to make space for the planned Thames Freeport. The design includes landscaping, accessible footpaths and habitat creation, with connections to the existing footpath network and to existing habitats.

## 3.20 Tilbury junction and link road

- 3.20.1 The options considered for a possible junction and link road at Tilbury are set out in Table 3.16.

**Table 3.16 Tilbury junction options**

Option	Discussion
PRA design with no junction or link road	A junction and link road were not proposed as part of the PRA. However, the Post-Consultation Scheme Assessment Report (Highways England, 2017), produced in response to the 2016 consultation, committed to considering a local junction at Tilbury.
Junction north or south of the Tilbury Loop Railway, with link road to the proposed Tilbury2 port development and Tilbury to the west	<p>Although a link road to Tilbury2 and Tilbury would have some benefits in providing additional connectivity, it would also have significant environmental impacts, including impacts on ecological sites and cultural heritage sites, particularly Tilbury Fort.</p> <p>Traffic modelling highlighted several drawbacks with the link road design including unnecessary delays to Heavy Goods Vehicle journeys and significant impacts on the local road network.</p> <p>The link road would be located in the flood zone and would require the provision of a significant additional flood storage compensation volume.</p> <p>The link road would not be compatible with the Tilbury2 DCO application, which envisages road traffic from the port using the existing A1089.</p> <p>A link road would not contribute to the Scheme Objective of relieving the congested Dartford Crossing and approach roads and improving their performance by providing free-flowing north-south capacity.</p> <p>A link road to Tilbury2 and Tilbury was therefore ruled out.</p>
Junction north of the Tilbury Loop railway line, without a link road	A junction to the north of the railway would not have provided access to the proposed RaSA included in the design for Statutory Consultation. (The RaSA was subsequently deleted from the Project – see Section 3.13).
Junction south of the Tilbury Loop railway line, without a link road	<p>For the Statutory Consultation design, the design included a junction south of the Tilbury Loop railway line. This would give access to the potential provision of a RaSA (see Section 3.13). It did not include a link road to the west towards Tilbury, for the reasons noted above.</p> <p>Any potential for a future link road in this area could be developed as a separate project.</p>

Option	Discussion
No junction	<p>The 2020 Supplementary Consultation design also removed the Tilbury junction, RaSA and maintenance depot.</p> <p>Following consideration of the benefits, the potential environmental impact and the views of consultees, it was concluded it was not necessary to include the RaSA and maintenance depot in the proposals (as described in Section 3.13 of this chapter). As these were removed from the design, there was no requirement to have a junction at Tilbury.</p>

3.20.2 To the north of this area, the Project route would cross over Station Road and the Tilbury Loop railway line on a viaduct. In the Supplementary Consultation design, the proposed viaduct was reduced in length from 1,100 metres to 660 metres, and the height from 12.5 metres to 6.8 metres. These changes would reduce both the cost and the visual impact and would avoid the need to make changes to Station Road.

3.20.3 North of the viaduct, the Project route would cross under Muckingford Road. In the Supplementary Consultation design, the alignment of Muckingford Road was moved slightly south of its existing alignment, in order to reduce the overall height of the bridge over the new road, while providing the required structural headroom. The bridge design was upgraded to a green bridge with provision for walkers, cyclists and horse riders. The planting on the green bridge would strengthen the mitigation for biodiversity impacts in this area, and the provision for walkers, cyclists and horse riders would provide benefits for local communities.

### 3.21 Horizontal alignment and electricity pylons between Tilbury and the A13

3.21.1 The options considered for the alignment of the Project route in proximity to the electricity transmission and distribution lines in the area between Tilbury and the A13 are set out in Table 3.17.

**Table 3.17 Project route options in proximity to overhead line routes**

Option	Discussion
Preferred route alignment	<p>The Preferred Route would have passed under three overhead electricity transmission lines and two overhead electricity distribution lines in this area. Two of the transmission lines, running around the east and north of Chadwell, would have needed to be diverted for 1.5km, affecting 10 pylons, and bringing the overhead lines within 70m of residential properties in Chadwell St Mary. National Grid expressed concern about these diversions being permitted. Alternative route alignments were, therefore, considered.</p> <p>The Preferred Route road alignment passed about 820m from the nearest residential properties in West Tilbury, 470m from the nearest residential properties in East Tilbury, 500m from the nearest residential properties in Linford and 140m from the nearest residential properties in Chadwell St Mary. It would have bisected six fields and would not have required the demolition of any properties.</p>

Option	Discussion
Alternative 1	<p>This alternative alignment for the road would not have any impact on the two overhead transmission line routes and their pylons. This would be achieved by reducing the minimum horizontal radius (opening out the curve) to move the line of the route further north and east from Chadwell.</p> <p>In comparison to the preferred route, Alternative 1 would be slightly closer to West Tilbury, the same distance from East Tilbury, 200m closer to Linford and 80m further away from Chadwell St Mary. It would bisect two additional fields and would affect access to two properties.</p>
Alternative 2	<p>This alternative alignment for the road had the same horizontal radius as the preferred route but was realigned in the south of this area to affect a shorter section of the overhead lines. It would clash with the pylons where the lines change direction to the west of Linford.</p> <p>This alternative would, therefore, require the removal of two pylons, modification of four pylons and a diversion length of 600m.</p> <p>Compared to the preferred route, this route would be slightly closer to West Tilbury, slightly further away from East Tilbury, slightly closer to Linford (by 60m) and 140m further away from Chadwell St Mary. It would bisect the same number of fields as the preferred route. It would require the demolition of two isolated residential properties.</p>
Alignment for Statutory Consultation	<p>The route proposed in the Statutory Consultation design was a compromise between Alternatives 1 and 2.</p> <p>It would have a decreased minimum horizontal radius, when compared to the preferred route alignment, but not as decreased as Alternative 1.</p> <p>As with Alternative 2, it would require the removal of two pylons, the modification of four pylons and diversion of 600m of cables.</p> <p>This route would be the same distance from West Tilbury and East Tilbury as the preferred route. It would be closer to Linford than the preferred route and Alternative 2, but not as close as Alternative 1. It would be about the same distance from Chadwell St Mary as Alternative 1. It would avoid the requirement to demolish the two isolated residential properties.</p> <p>The reasons for selecting this alignment for Statutory Consultation were because it would:</p> <ul style="list-style-type: none"> <li>• Significantly reduce the impact on the overhead transmission line routes while not moving the diverted lines closer to residential areas. This addresses the main concern expressed by National Grid.</li> <li>• Make the future maintenance of the overhead transmission lines easier.</li> <li>• Maintain a distance of at least 200m between the route and residential properties.</li> <li>• Not require the demolition of any properties.</li> <li>• Limit the severance of agricultural land.</li> <li>• Result in a cost saving through not relocating as many pylons.</li> </ul>

Option	Discussion
Alignment for Supplementary Consultation	<p>In 2020, the Project route in this area was moved approximately 60 metres closer to Linford and part of Hornsby Lane was to be stopped up, with areas provided for turning either side of the new road, rather than providing an overbridge. These design changes were developed to reduce the extent of the modifications required to overhead power lines and pylons on the ZB network and the YYJ network. A direct clash was avoided with pylons ZB014 and YYJ124, meaning a larger section of the existing network could be retained.</p> <p>Alternative means of access would be available to Orsett Heath from the north, hence there would be no additional adverse effect caused by the closure of Hornsby Lane. The removal of the bridge from the design would reduce the adverse effects on the local landscape and on the setting of the Grade II listed Heath Place.</p> <p>Overall, it was considered that the design change would result in an improvement to the effects on people and communities reported in the 2018 Statutory Consultation, whilst impacts on landscape during construction would be slightly worse. For other environmental topics, the nature of the change would be the same as reported in the 2018 Statutory Consultation.</p>

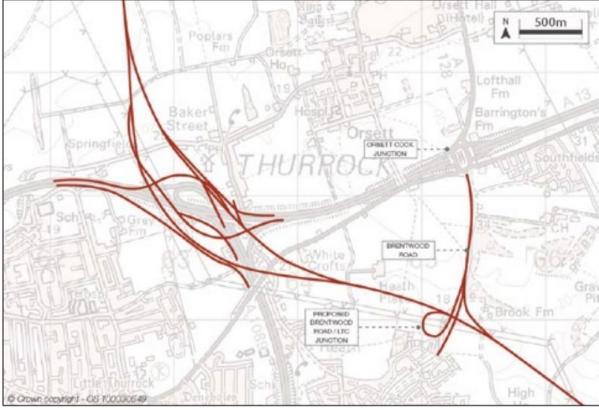
### 3.22 A13/A1089 junction

3.22.1 The following options, summarised in Table 3.18, were considered for the junction with the A13.

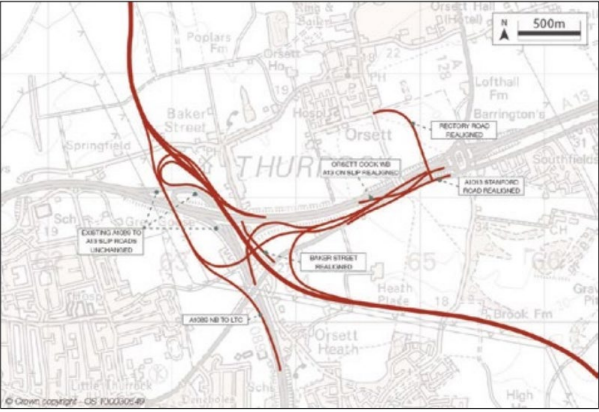

**Table 3.18 A13/A1089 junction options**

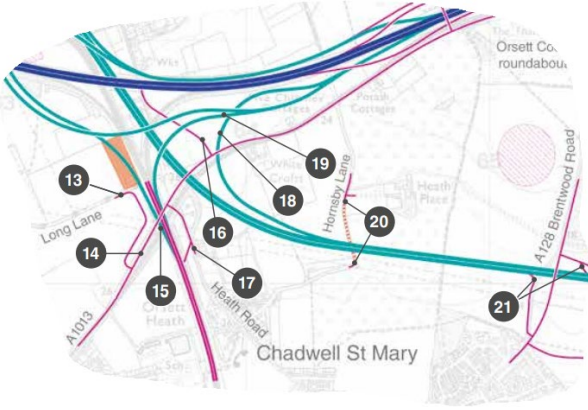
Option	Description	Discussion
PRA	<p>The junction would be located at the site of the existing A13/A1089 junction.</p> <p>All existing traffic movements between the A13 and A1089 would be retained, with some layout changes.</p> <p>Provision would be added for traffic movements between the Project's route in the north and the A13 in the east, in both directions, and between the A13 in the west and the Project's route in the south, in both directions. To achieve this, the Project's northbound and southbound carriageways would be separated to the east and west of the junction.</p> <p>Links between the Project's route in the south and the A13 in the east, in both directions, would be provided through the existing Orsett Cock junction (where the A128 Brentwood Road crosses the A13, to the east), via the A128. This would require the provision of an additional junction where the Project's route would cross the A128, north-east of Chadwell St Mary. It would also require the widening (to a dual two-lane carriageway) of the A128 between that junction and Orsett Cock.</p>	<p>The preferred route junction layout would require the demolition of the following properties:</p> <ul style="list-style-type: none"> <li>• The whole of a travellers' site to the west of the A1089 (22 properties)</li> <li>• Seven properties along the A1089</li> <li>• Seven properties on Baker Street</li> <li>• Two properties on Stifford Clays Road</li> </ul> <p>In the 2016 public consultation, several issues were raised about the junction layout including:</p> <ul style="list-style-type: none"> <li>• The layout's impact on properties</li> <li>• The impact on the existing Orsett Cock junction</li> </ul>




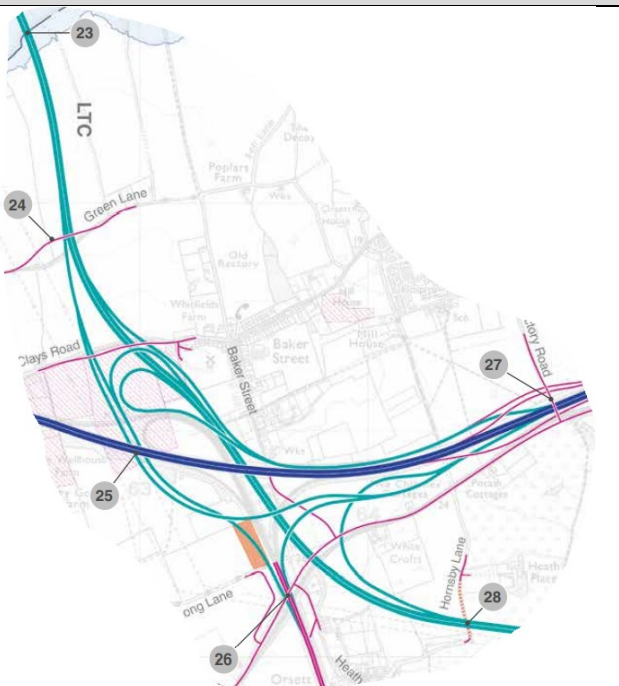

Option	Description	Discussion
	<p>Traffic movements would not be enabled between the Project's route in the north and the A13 in the west, in either direction, due to predicted low traffic demand.</p> <p>The following plan of the Preferred Route in this area was presented in the Statutory Consultation</p> 	<ul style="list-style-type: none"> <li>• The size and complexity of the junction layout and its consequent impact on local residents</li> <li>• Impact on agricultural land and segregating farms</li> </ul>
<p>Refined design options after PRA</p>	<p>The Statutory Consultation documentation described the development of options between the PRA and the Statutory Consultation. Shortly after PRA, a refined version of the junction layout was prepared, to address some of the most immediate concerns with the preferred route.</p> <p>To address more of the issues and concerns with the preferred route, ten alternative options were then developed.</p> <p>Following a high-level engineering and traffic appraisal of all ten options, eight of the options were discounted as they were considered not to be viable.</p> <p>Two options remained, and were subject to a more detailed appraisal, considering safety, buildability and environmental effects.</p>	<p>The appraisal of the two viable options found that, although there were some improvements compared to the preferred route, neither option addressed all of the issues and there were still concerns over the complexity of the junction and impacts on the Orsett Cock junction.</p>
<p>Further Option 1</p>	<p>This was one of two further options developed before the Statutory Consultation. This would be based on the preferred route design, with an enhanced junction at Orsett Cock.</p>	<p>At this stage, the appraisal showed that Further Option 2, with no changes required to the Orsett Cock junction, would have advantages over this one.</p>
<p>Further Option 2</p>	<p>This was the second of the further options developed before the Statutory Consultation.</p> <ul style="list-style-type: none"> <li>• It would provide a simplified A13 junction.</li> <li>• It would avoid the requirement for changes to the A13 Orsett Cock junction.</li> </ul>	<p>The following issues were identified with this option</p>

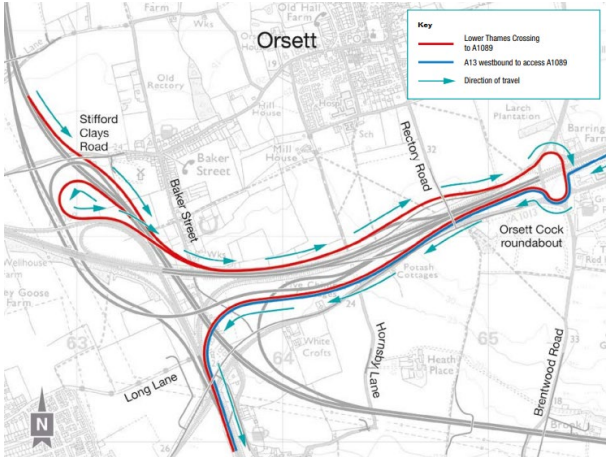
Option	Description	Discussion
	<ul style="list-style-type: none"> <li>It would work together with a Tilbury junction (see Section 3.20). The Tilbury junction would provide direct access between the Project's route and the Port of Tilbury and associated logistics area.</li> </ul>	<ul style="list-style-type: none"> <li>The environmental impact of the Tilbury link road and the incompatibility of the Tilbury link road with the most recent version of the Tilbury2 DCO application. The link road was removed from the Project before Statutory Consultation, although the Tilbury junction remained (see Section 3.20).</li> <li>The complexity of the A13/A1089 junction which included long viaduct structures on links carrying relatively little traffic.</li> <li>The need to widen the A13 between the A1012 Stifford junction and the Project's route.</li> <li>The need to demolish and replace the A1089 bridge under the A13 leading to significant buildability concerns.</li> <li>Without the Tilbury link road, the connections between the A1089 and A13 need to be retained. The addition of an at-grade roundabout with the A1013 would not be appropriate due to the delays that it would introduce.</li> </ul>
<p>Statutory Consultation design</p>	<p>To address the issues identified with Further Option 2, a simplified A13 junction was designed. This would:</p> <ul style="list-style-type: none"> <li>Maintain the connections between the A1089 and A13</li> <li>Provide the key strategic connections between A13 east and the Project's route</li> <li>Provide connections between A1089 northbound and the Project's route northbound and southbound for traffic from the Port of Tilbury</li> </ul> <p>The following plan was presented in the Statutory Consultation.</p>	<p>The main reasons for taking this design forward to Statutory Consultation were that it would:</p> <ul style="list-style-type: none"> <li>Maintain all the existing connections between the A13 and A1089, providing free-flow access for traffic from the Port of Tilbury.</li> <li>Maintain the port's connections to the Project's route, reduce traffic flows on the A13 and protect local roads in Tilbury.</li> </ul>

Option	Description	Discussion
		<ul style="list-style-type: none"> <li>• Provide the key strategic connections between the Project's route and the A13 to the east, while not providing connections between the Project's route and the A13 to the west, which would carry relatively little traffic.</li> <li>• Retain the existing A1089 bridge under the A13 and provide a new separate underbridge for the Project's route. This addresses some of the most significant build concerns with the previous layout.</li> <li>• Simplify the junction layout overall to improve connections to Tilbury port enabling the removal of the proposed Tilbury link road, which would have had a negative impact on the local road network.</li> <li>• Limit changes on the A13.</li> </ul>
<p>Supplementary Consultation design</p>	<p>A further revision to the simplified A13 junction was included within the design for the 2020 Supplementary Consultation. This included modifications to a number of connections at the junction between the Project, the A13, the A1089 and the A1013.</p> <p>The following plans and descriptions of the changes were presented in the Supplementary Consultation</p> 	<p>The changes were made to increase separation of roads from properties and from the area to the south-west side of the junction.</p> <p>The changes were also designed to improve the safety of motorists passing through the junction.</p> <p>There would be reduced impacts on nearby properties in terms of land-take, access and construction impacts.</p>

Option	Description	Discussion
	<ol style="list-style-type: none"> <li>1 Green Lane has been moved slightly north due to the changes to the A13 westbound and A1089 northbound slip roads, which join the LTC northbound.</li> <li>2 Stifford Clays Road has been moved slightly south due to the changes to the A13 westbound and A1089 northbound slip roads, which join the LTC northbound.</li> <li>3 The slip roads from the LTC northbound and southbound, to the A13 eastbound and Orsett Cock junction, have been redesigned removing the need for drivers to change lanes on the A13.</li> <li>4 A13 junction slip roads have been designed to tie into the Orsett Cock junction improvement works, which are currently under construction.</li> <li>5 The Rectory Road diversion shown during statutory consultation has been removed so the alignment follows the existing Rectory Road.</li> <li>6 A new link road north of the A13 has been included to provide access from the LTC northbound and southbound to the Orsett Cock junction.</li> <li>7 The A13 eastbound has been reduced to two lanes from four lanes, near the Orsett Cock roundabout. This removes the need for drivers to change lanes on the A13.</li> <li>8 Improved slip road layout for drivers heading north on the A1089 or west on the A13 wishing to head north on the LTC.</li> <li>9 We have identified two potential locations for the relocation of the travellers site. One is adjacent to its current location with access off Long Lane, the other is further to the west along Long Lane opposite the junction with Kerry Road. These locations are shown in the Map Book 1: General Arrangements.</li> <li>10 A13 westbound to LTC northbound link road has been moved further north and further away from the A1013 and local properties.</li> <li>11 A shared path for walkers and cyclists is proposed along the A1013 Stanford Road.</li> <li>12 The A1013 has been moved closer to its existing position.</li> </ol> 	

Option	Description	Discussion
	<p>13 Gammonfields Way has been realigned to connect into Long Lane, which could provide access to the relocated travellers site.</p> <p>14 The A1013 from the north of Whitecroft Care Home to the west side of the A1089 has been moved. It will run over the A1089, LTC and link roads to ease traffic management during construction.</p> <p>15 The A1089 northbound to LTC northbound slip road has been moved further north to reduce the impact on a local school.</p> <p>16 Baker Street will be moved so it runs under the LTC link roads and connects to the existing A1013 slightly further east of its current position. This is because the new LTC runs through this section of Baker Street. Its realignment will also help construction of the bridges.</p> <p>17 Heath Road has been moved to tie in with the redesigned A1013. Emergency access off Heath Road to the A1089 southbound has been provided so emergency services can maintain response times from the fire station at Orsett Cock junction to Tilbury Port.</p> <p>18 The A13 westbound to the LTC southbound link road has been moved further west increasing the distance between this road and the Whitecroft Care Home on the A1013.</p> <p>19 The A13 westbound slip road to the A1089 southbound has been revised to improve traffic movements between A-roads and the LTC.</p> <p>20 Part of Hornsby Lane would be permanently closed, with areas provided for turning either side of the LTC. This closure would avoid having to move some overhead lines.</p> <p>21 Emergency access will be provided from Brentwood Road on to the LTC northbound and southbound to improve response times for emergency services from Orsett and Grays. Access to properties will be maintained.</p> <p>22 The LTC east of Chadwell St. Mary has been moved approximately 60 metres north-east to avoid moving some overhead cables and pylons.</p>  <p>The map shows a section of the Lower Thames Crossing (LTC) highlighted in teal. A callout circle with the number '22' points to a specific location on the LTC route, east of Chadwell St. Mary. The map also shows other roads like 'Hoford Road' and 'Whitecroft Care Home'.</p>	

Option	Description	Discussion
	 <p>23 The viaduct across the Orsett Fen Sewer has been increased in length from 50 metres to 200 metres to manage the risk of flooding.</p> <p>24 Green Lane bridge upgraded to a green bridge.</p> <p>25 A new underbridge has been included to take the slip roads underneath the A13.</p> <p>26 The A1013 on the west side of the A1089 has been revised to reduce the impact on the proposed school sports field development and move the route further away from local properties. This allows the new bridge over the A1089 to be built off the local road network, without the existing road having to be closed.</p> <p>27 A new Rectory Road bridge will be built over the A13. The height has been increased to achieve clearance over the slip roads connecting into the Orsett Cock roundabout.</p> <p>28 Removal of Hornsby Lane bridge.</p> <p>29 Hoford Road has been realigned to protect existing laneway and structure upgraded to a green bridge.</p> <p>30 The LTC has been raised by approximately one metre under Hoford Road, so Hoford Road crosses the LTC with sufficient structural headroom and avoids a watercourse diversion.</p> 	

Option	Description	Discussion
<p>Local Refinement Consultation design</p>	<p>Following feedback on traffic modelling presented at the Community Impacts Consultation, modifications were made to the proposed link road south of the A13, between the Orsett Cock junction and the A1089. The connection from the A13 westbound to the A1089 southbound would be via the Orsett Cock junction. Traffic would be able to access the A1089 southbound from the A13 and Orsett Cock junction without the need to use local roads. Westbound traffic on the A13 to the east of the Orsett Cock junction would need to leave the A13 at the junction to access the new link road to the A1089 southbound.</p> <p>The following plan was presented in the Local Refinement Consultation.</p> 	<p>The introduction of the new link road would enable traffic from the A122 to access the A1089 via the Orsett Cock junction, as well as enabling local traffic at the Orsett Cock junction to reach destinations on the A1089 without using local roads, as it can currently. As such this revised link road would result in less traffic on local roads (especially Brentwood Road and the A1013) than the link road arrangement previously proposed.</p> <p>However, this new link road would result in more traffic than was forecast in the arrangement previously proposed using Rectory Road/Conways Road between the Orsett Cock junction and the A1089, Marshfoot Road and on the A1089 southbound.</p>
	<p>Updated landscaping design at various locations around the A13/A1089 junction to provide noise mitigation bunds, enhance biodiversity and create other environmental benefits. This would involve the reuse of clean excavated material for construction activities.</p>	<p>These proposals would result in a reduction in the amount of excavated material required to be disposed offsite. As a result, this would reduce the need to use local waste management infrastructure and reduce the truck movements on the road network during the construction period (compared with the proposals at the Community Impacts Consultation).</p>

### 3.23 Mardyke crossing

3.23.1 The following options, summarised in Table 3,19, were considered for crossing the Mardyke River, Orsett Fen Sewer and Golden Bridge Sewer.

**Table 3.19 Mardyke crossing options**

Option	Description	Discussion
PRA	<p>In the PRA, the section of the Project between the A13 and M25 crossed the Mardyke Valley on a low embankment approximately 4m high. It also crossed the Mardyke River and the nearby main river tributaries (Orsett Fen Sewer and Golden Bridge Sewer) on short, individual, single-span structures which were slightly wider than the rivers.</p>	<p>Engagement with the Environment Agency after PRA led to the agreement of the following criteria for crossing these three rivers:</p> <ul style="list-style-type: none"> <li>• Minimum headroom over river of 4.0m</li> <li>• Minimum clearance either side of river of 8.0m</li> </ul> <p>More detailed consideration of geotechnical information indicated that construction of embankments in this area would require ground improvements. Embankments in the flood zone would need to be compensated by an equivalent volume of excavation contiguous with the flood zone to maintain the current flood storage capacity. Three options were therefore considered leading up to the Statutory Consultation design, as described below.</p>
Option 1	<p>Similar to the design at the PRA with embankment and three separate short span structures crossing the rivers. The embankment would be higher to provide the required clearance over the rivers and the spans of the structures would be increased.</p>	<p>The larger embankment would take more capacity from the flood zone, increasing the volume of flood compensation required.</p>
Option 2	<p>A long viaduct (approximately 1,500m in length) spanning all three rivers with typical pier spacings of 40m to 50m.</p>	<p>This minimises the volume of flood compensation required.</p>
Option 3 (Statutory Consultation design)	<p>A hybrid option with:</p> <ul style="list-style-type: none"> <li>• A shorter viaduct (approximately 450m in length) over the Mardyke River and Golden Bridge Sewer</li> <li>• A single span bridge (approximately 50m in length) over the Orsett Fen Sewer</li> <li>• Embankment (approximately 980m in length) across the rest of the area</li> </ul>	<p>Following comparison of the three options, Option 3 became the Statutory Consultation design. The main reasons for this were:</p> <ul style="list-style-type: none"> <li>• Including a viaduct gives a more open aspect reducing the visual impact in this open area.</li> <li>• A combination of viaduct and embankment is a more cost-effective solution than a viaduct over the whole of the valley.</li> </ul>



Option	Description	Discussion
		<ul style="list-style-type: none"> <li>• A shorter viaduct would be less of a long-term maintenance issue than the longer viaduct while still presenting an opportunity for architectural treatment to reduce visual impact.</li> <li>• Reducing the length of embankment would reduce the volume of flood compensation and associated land required.</li> </ul>
Design for Supplementary Consultation	<p>The route was moved approximately 200 metres south-west to reduce the work required to move an existing gas main and to reduce the impact on a nearby landfill site.</p> <p>The design of the structures over the Mardyke River, Golden Bridge Sewer and Orsett Fen Sewer was amended to reduce the visual impact and the volume of flood compensation needed. The total length of the viaducts in the area was increased by approximately 50m, to reduce the length of embankment.</p>	<p>This amended design had the following advantages:</p> <ul style="list-style-type: none"> <li>• Reduced habitat loss in this area compared to previous design iterations.</li> <li>• Reduced loss of floodplain storage.</li> <li>• More diverse habitat proposal in this area, rather than returning land to agriculture.</li> <li>• Reduced need for, or spatial extent of, mitigation measures. For example, the land-take required for provision of compensatory floodplain storage to mitigate flood risk effects would be reduced.</li> </ul>

### 3.24 Horizontal alignment at Ockendon landfill site

3.24.1 The following options, summarised in Table 3.20, were considered for the Project's route in this area.

**Table 3.20 Options for the horizontal alignment near Ockendon landfill site**

Option	Description	Discussion
PRA	<p>At PRA the route passed through a closed landfill site north of South Ockendon.</p> <p>The route was mainly on embankment with a minimum horizontal radius of 1,020m. which allowed the route to pass through a small corridor between proposed solar farms.</p> <p>This route would have also provided an appropriate connection with the M25 junction.</p>	<p>After the PRA, three alternative options were developed to avoid the landfill site, as set out below.</p>
Alternative 1	<p>This route would run north of the landfill site close to its northern boundary, passing through a proposed solar farm to the east of the landfill site.</p> <p>The route would cross the Horndon to Barking gas pipeline in two places.</p>	<p>This route would create a triangle of land between the landfill and the route. This could be used to compensate for the solar farm area that would be lost.</p>

Option	Description	Discussion
	<p>It would have had an improved horizontal alignment to the east of the landfill site as it has a radius of 1,700m compared with 1,020m in the PRA.</p>	<p>This was selected to replace the preferred route and was included in the Statutory Consultation design for the following reasons:</p> <ul style="list-style-type: none"> <li>• It would avoid the high geotechnical and geo-environmental remedial costs of taking the route through the landfill site.</li> <li>• It would have lower construction risk as it avoids: the handling of landfill materials; potential settlement issues from construction of an embankment over landfill material; modifications to the existing landfill leachate and gas management systems; and possible creation of preferential contaminant pathways.</li> <li>• It would avoid operation and maintenance risks and liabilities which would apply with a route through the landfill.</li> </ul>
<p>Alternative 2</p>	<p>This route would also run north of the landfill site but further from the northern boundary of the site, avoiding the proposed solar farm. This route crosses three high-pressure gas pipelines (the Horndon to Barking pipeline, Horndon to Abridge pipeline and Mardyke to Stock pipeline).</p> <p>It would have the same radius as the preferred route to the east of the landfill site: 1,020m. This is followed by a curve of radius 1,400m as it heads west.</p>	<p>This would be the most northerly route, avoiding both the landfill sites and solar farm developments. This would create a longer route than the preferred route and would therefore require more land and have slightly longer journey times.</p> <p>This alignment was not selected.</p>
<p>Alternative 3</p>	<p>This route would run south of the landfill site through a historic landfill area which is also the site of a proposed solar farm.</p> <p>This route would cross the Horndon to Barking gas pipeline.</p> <p>It would have had the same radius as the current route to the east of the landfill site with two 1,020m radii to the south of the landfill site.</p> <p>A narrow corridor to the west of South Ockendon Hall would be used to connect this southern route to the M25 junction.</p>	<p>Using this corridor would place the route closer to a listed building and several ancient monuments. This route is also closer to residential areas in South Ockendon than the preferred route and the other two alternatives.</p> <p>This alignment was not selected.</p>

- 3.24.2 It was not possible to identify an option that would both avoid the landfill areas and avoid the gas mains.
- 3.24.3 To the west of the landfill area, the route of the new road would cross under North Road. In the Supplementary Consultation, the vertical alignments of both the route of the new road and North Road were lowered by two metres. This change was made in order to reduce the visual impact and to improve drainage.

### 3.25 M25 junction

- 3.25.1 The following options, summarised in Table 3.21, were considered for the M25 junction.

**Table 3.21 Options for the M25 junction**

Option	Description	Discussion
PRA	<p>The Preferred Route for the M25 junction connected the Project's route to the M25 approximately 3.4km south of junction 29 and 5km north of junction 30 around Ockendon Road.</p> <p>The junction was a free-flow interchange which provided the following movements:</p> <ul style="list-style-type: none"> <li>• The Project's route northbound to M25 northbound</li> <li>• M25 southbound to the Project's route southbound</li> </ul> <p>This proposal involved the construction of high embankments, two railway crossings and a viaduct structure over the M25.</p> <p>In terms of horizontal alignment, this junction layout included several relaxations from standard due to site constraints and proximity to junction 29 which imposed a weaving length constraint.</p> <p>Because this layout did not involve any works to the M25 north of the junctions, there were departures from standards for the proposed layouts for joining and leaving the M25.</p>	<p>This option would require the demolition of two properties at Ockendon Road.</p> <p>In the 2016 public consultation several issues were raised about the junction layout including:</p> <ul style="list-style-type: none"> <li>• The impact on the M25 during construction and in operation</li> <li>• The impact on Ockendon Road and adjacent properties</li> <li>• Visual impact due to the high embankments and viaduct structures</li> <li>• Route going over a live railway twice and over the M25 on a long, skewed structure</li> </ul>
Statutory Consultation design	<p>The changes compared to the preferred route are:</p> <ul style="list-style-type: none"> <li>• The northbound link would not cross the railway.</li> <li>• The northbound link would go under instead of over the M25 and Ockendon Road.</li> <li>• The southbound link would be lower and goes under instead of over Ockendon Road. This change means that the Ockendon Road overbridge needs to be demolished and replaced.</li> </ul>	<p>This option would have a significantly lower impact on the landscape and visual amenity compared to the preferred route, which was on significant embankment and viaduct structure where it crossed over the existing railway, M25 and Ockendon Road.</p>

Option	Description	Discussion
	<ul style="list-style-type: none"> <li>There would be changes to the layouts for joining and leaving the M25.</li> </ul>	<p>This option would avoid two railway crossings, which could have programme and future operational implications. However, it does require the construction of a skewed crossing under the M25 close to the railway line.</p>
<p>Supplementary Consultation design</p>	<p>The following improvements were added to the Thames Chase Community Forest Centre, north of the M25 junction:</p> <ul style="list-style-type: none"> <li>A new equestrian-standard bridge across the M25 to link the east and west of the forest centre site.</li> <li>A new shared path to link East Thames Chase to Clay Tye Road, providing a connection to the existing footpath FP232.</li> <li>An upgrade of the existing maintenance track, from Ockendon Road north into Thames Chase, to a bridleway. This would be mitigation for the impacts of the Project on the existing path south of Thames Chase.</li> </ul>	<p>These changes at Thames Chase would not be expected to change any of the environmental effects reported in the PEIR, other than providing improvements for the local community for access and recreation.</p>
<p>Local Refinement Consultation design</p>	<ul style="list-style-type: none"> <li>Updated landscaping design at the M25/Lower Thames Crossing junction in North Ockendon to provide noise mitigation bunds, enhance biodiversity and create other environmental benefits. This would involve the reuse of clean excavated material for construction activities.</li> <li>Raising the road level in cuttings where this can be achieved without increasing other impacts (for example visual and noise). This means that less material would need to be excavated and disposed of. Raising the road level in this way is proposed at a section of the route along Ockendon Link at North Road crossing ('The Wilderness') and at the M25/Lower Thames Crossing junction (North Ockendon).</li> </ul>	<p>These proposals would result in a reduction of excavated material required to be disposed offsite. As a result, this would reduce the need to use local waste management infrastructure and reduce the truck movements on the road network during the construction period (compared with the proposals at the Community Impacts Consultation).</p>

### 3.26 M25 corridor and M25 junction 29

3.26.1 The following options, summarised in Table 3.22, were considered for the M25 corridor and M25 junction 29.

**Table 3.22 Options for the M25 corridor and M25 junction 29**

Option	Description	Discussion
PRA	The design at this stage did not include any works on the M25 north of the connection of the Project's route.	It later became necessary to consider works in this area because of the increased traffic flows predicted by the LTAM and because of the increase of the Project's main road from dual two- to dual three-lanes (see Section 3.11).
Statutory Consultation design	<p>The Statutory Consultation design includes:</p> <ul style="list-style-type: none"> <li>• The addition of a parallel two-lane connector road (with hard shoulder) northbound to the junction 29 roundabout with connections from the Project's route to the M25 and from the M25 to the connector road. This also includes reducing the M25 to three lanes between the diverge to the connector road and the merge from the Project's route.</li> <li>• M25 southbound widened from four to five lanes with hard shoulder between junction 29 and the Project route junction.</li> <li>• M25 through junction 29 widened to dual four-lanes with hard shoulder, including widening of the viaduct over the junction.</li> <li>• Changing the layouts for joining and leaving traffic north of junction 29.</li> <li>• Making improvements to the junction 29 roundabout.</li> </ul>	<p>The main reasons for these proposals are:</p> <ul style="list-style-type: none"> <li>• To relieve congestion and provide free-flowing capacity.</li> <li>• To accommodate the design year traffic flows predicted by the updated traffic model.</li> <li>• To avoid weaving on the northbound carriageway in the short length between the Project's route junction and junction 29 (about 1.3km).</li> <li>• To maintain the performance of junction 29 and to reduce queueing on slip roads blocking back onto the Project's main road.</li> <li>• Hard shoulders are provided for safety reasons and to maintain operational flexibility.</li> </ul> <p>The northbound connector road would require land to be taken from the Thames Chase Community Forest. Alternative land would need to be provided as compensation</p> <p>The design avoids areas of ancient woodland around junction 29.</p>
Supplementary Consultation	Some minor alterations proposed to the layout of M25 junction 29, to omit the overhead-line diversion works.	This would cause no significant changes to the environmental effects previously identified, although there would be additional vegetation removal, which would slightly worsen the effects on the local landscape.

Option	Description	Discussion
Local Refinement Consultation	<p>The design of a proposed new bridge over the A127 west of M25 junction 29, to link Moor Lane in the south to Folkes Lane in the north, has been amended to be suitable for horse riders as well as pedestrians and cyclists</p> <p>The design of a new bridge over the A127 east of M25 junction 29 has been amended to be suitable for horse riders as well as pedestrians and cyclists. It includes a link to bridleway BR183.</p>	<p>The design changes would address historic severance caused by the A127 and would improve connectivity and safety for horse riders.</p>

### 3.27 Compensation sites for the effects of nitrogen deposition

- 3.27.1 Many petrol and diesel vehicles use catalytic converters to reduce the emissions of some pollutants, such as nitrogen oxides (NOx), but these catalytic converters emit ammonia as a by-product. Ammonia, along with NOx, can contribute to nitrogen deposition. Government data shows that nitrogen levels from road transport and other sources have fallen by 79% since 1990, and it is predicted that this downward trend will continue and accelerate as a result of the Government’s ongoing decarbonisation policies.
- 3.27.2 Changes to vehicle emissions when the Project is open may slow down the rate at which nitrogen levels reduce in some designated sites (habitats of ecological importance) within 200 metres of the affected road network. This may result in the quality of those habitats recovering more slowly than they would otherwise. The combined area of the 60 relevant designated sites is approximately 250 hectares.
- 3.27.3 The Project proposes to offset the impacts of nitrogen deposition by creating new compensation habitats. The proposal is to create approximately 250 hectares of new wildlife-rich habitats. Where practicable, these would be linked to existing habitats, improving biodiversity along new ‘green corridors’. Appendix 5.6 of the ES (Application Document 6.3) includes the detailed methodology used for selecting the most suitable sites for compensation habitat creation.
- 3.27.4 Two alternative approaches were considered for the identification of suitable sites for the compensation habitat creation. These were either to create multiple, small, new habitat sites or to use a landscape-scale approach.
- 3.27.5 The landscape-scale approach is one that seeks to accrue multiple benefits from habitat creation. For example, providing social benefits such as public access with additional environmental benefits such as climate change resilience and increased biodiversity. By creating new habitats on a large scale (rather than in a series of scattered sites), these benefits can be enhanced.
- 3.27.6 After consideration, and following guidance and advice provided by the Department for Environment, Food and Rural Affairs and Natural England, the landscape-scale compensation approach was progressed. This offers long-term enhancements and improvements in quality to the wider ecological network of habitats, building resilience to climate change, and providing strong green corridors for the movement of species across the landscape.

- 3.27.7 Multiple new smaller habitat sites would be less resilient to external pressures such as extreme weather and would not offer landscape-scale corridors where protected species could move.
- 3.27.8 The habitat creation proposals would include habitat types that are similar or complementary to ones that are likely to be significantly affected, which are mostly woodlands. It would therefore include a variety of habitats linked to woodland ones, such as grassland and scrub.
- 3.27.9 The methodology used to identify potential areas for compensation was as follows:
- a. Ranking the ecological suitability of areas based on the proximity to designated receptors, in particular SSSIs and ancient woodlands
  - b. Identifying potentially suitable areas of land by analysing how any new habitats could connect with existing ones
  - c. Excluding areas that are not suitable for tree planting such as areas allocated for development, roads, water features, and those already planted or within 200 metres of the affected road network
  - d. Excluding areas where it was considered that existing land uses should not be changed, for example good quality agricultural land, registered common land or land used for recreational purposes
  - e. Excluding sites that contain known environmental constraints including existing wildlife-rich habitats (such as designated sites), heritage designations (e.g. areas within 200 metres of scheduled monuments or Grade I or II\* listed buildings), and flood risk areas
  - f. Further filtering of suitable areas by specialist teams, including heritage, landscape, utilities, land referencing and planning
  - g. Developing a shortlist of possible sites with the best ecological opportunities and no, or manageable, constraints
- 3.27.10 This led to the identification of potential sites for habitat creation in the following four areas:
- a. M2 corridor and Blue Bell Hill
  - b. Gravesham and Shorne Woods
  - c. Southfields, Thurrock
  - d. Hole Farm, Brentwood
- 3.27.11 Within those areas, the selection methodology was used to identify parcels of land that could be used for habitat creation. In those locations, significant new areas of wildlife-rich habitats would be created, along with smaller areas to connect existing habitats that have been fragmented in the past.

## 3.28 Utilities diversions and connections

- 3.28.1 The Project would require works to a number of existing utilities including overhead electricity transmission and distribution lines, gas pipelines, water pipes, sewers, electricity cables, fibre-optic and telecommunication networks, and their associated infrastructure. These works would include diversions to enable the Project to be constructed safely, protect existing supplies, facilitate future maintenance, and provide utilities connections to construction sites and the tunnel portal buildings.
- 3.28.2 The development of the design for utilities diversions has recognised the potential for impacts from the proposals on features such as woodlands, open space and communities. The design development has sought to keep these impacts to a minimum through close working with the utility companies to agree how these works should be carried out and to identify the most appropriate diversion routes. Key considerations influencing the design have been:
- Limiting diversions
  - Utility undertakers' alignment requirements
  - Reducing working areas
  - Minimising the environmental impact
  - Minimising the amount and duration of traffic management
  - Using the same corridors to combine multiple utilities
- 3.28.3 To reduce disruption for road users and the local community, various construction methods have been considered, for example the use of trenchless technology such as directional drilling and tunnelling to install utilities beneath railways, watercourses and roads.
- 3.28.4 The proposals have sought to avoid or reduce impacts on environmentally sensitive areas. However, some utility works would be required in woodland (some of which is ancient woodland), local parks and open spaces, the Kent Downs AONB and the Shorne and Ashenbank Woods SSSI. The routes of proposed diversion works which affect these features are considered necessary to achieve a balance between the engineering constraints, impacts on residential areas and ensuring customer supply is maintained. Appropriate mitigation measures, such as planting, have been identified to compensate for losses. Embedded mitigation is included within the Design Principles (Application Document 7.5). A summary of the good practice and essential mitigation presented in the ES is listed in the Register of Environmental Actions and Commitments (REAC) which forms part of the Code of Construction Practice (Appendix 2.2) (Application Document 6.3). Environmental mitigation (embedded mitigation) is also identified on the General Arrangement (Application Document 2.5) and Figure 2.4 illustrates the Environmental Masterplan for the Project (Application Document 6.2).



## Examples of utility diversions and their alternatives

- 3.28.5 Some examples of utility diversions required by the Project are explained below, as well as how they have developed to the current design. There are several utility works required for the Project, so a sample of some of the major utility works have been picked out in this section.
- 3.28.6 The proposed utility diversions are shown in the Works Plans (Application Document 2.6). Overhead powerline diversions, including proposed heights, are included in the Engineering Drawings and Sections (Application Document 2.9).
- 3.28.7 Three of the Project's gas pipeline works (Work numbers G2, G3 and G4) are considered likely to have a significant effect on the environment for the purposes of section 20(3) of the Planning Act 2008 and are considered to be Nationally Significant Infrastructure Projects (NSIPs). Further information is available in Appendix 1.3: Assessment of proposed gas pipeline works for the purposes of section 20 of the Planning Act 2008 (Application Document 6.3).
- 3.28.8 One of the Project's overhead line diversions (Works number OH7) has been screened against criteria for replacement lines set out in Section 16(3) of the Planning Act 2008 and is considered as an NSIP. Further information on this screening is in Application Document 3.2 Annex 2 to the Explanatory Memorandum - Assessment of proposed above ground electricity line works for the purposes of Section 16 of the Planning Act 2008

### **M2/A2/A122 junction: NG Feeder 5 (Work Numbers G2 and G4) and Feeder 18 (Work Number G3)**

- 3.28.9 Between the M2/A2/A122 Junction and the A226, eight initial options were considered in relation to the National Grid Feeder 5 and Feeder 18 high-pressure gas pipe diversions. The promoted design enables National Grid to divert from connection points off both pipelines north of the A2, therefore retaining the existing crossings of the A2. This removes the need for two trenchless installations of circa 400m in length under the A2 and HS1, removing potential risk to HS1 which has a lower threshold of acceptable movement of the railway and the associated infrastructure, due to the speed that HS1 operates at. It also omits the potential impact to its customers that would occur if remediation works were required.
- 3.28.10 Alternatives involving trenchless installations under HS1 and the A2 would have required shafts and adjoining tunnels to have been constructed that would have potentially extended the Order Limits into Jeskyns Community Woodland and impeded the use of that woodland to a far greater extent. The length of time required to complete a diversion of the pipelines in this manner would have been greater than currently proposed for the Project and is likely to have extended the Project completion programme.
- 3.28.11 If alternative alignments of the pipelines were promoted to the eastern side of the junction, they would have conflicted with large sections of the proposed A2 Construction Compound, which would then have needed an alternative location. It is likely that a relocation of the A2 Construction Compound would have moved it to the location of the A2 West Utility Hub, and so moved the associated impacts closer to the residents of Riverview Park.

- 3.28.12 If the trenchless installations had been developed to align under Claylane Woods from south of the HS1 (approximately 800m length installations) these would have increased the risks geotechnically and would present risks to the existing infrastructure such as the pipelines, overhead powerlines and other utility networks, as well as risks to costs and programme. The required ground investigation works on which to design the crossing would have had an environmental impact on Claylane Wood.
- 3.28.13 An option to have both high-pressure gas pipeline diversions (Feeder 5 and 18) in the same trench was discounted as it would present a safety risk.
- 3.28.14 National Highways has been working with stakeholders, including the utility companies, to refine the proposals and minimise the land required for the gas diversion works. The preferred option alignments have been promoted following site investigations and assessments by National Grid and aim to contain the works so far as reasonably practicable to those areas of previous tree felling to avoid mature trees, to minimise the ecological and arboricultural effects on Claylane Wood. The proposal includes the use of some open space at Claylane Wood, as well as clearing a portion of ancient woodland with opportunities for replanting. At the Design Refinement Consultation, the ancient woodland compensation near Claylane Wood was reduced; however, as a result the proposed ancient woodland compensation planting was increased to the north on the edge of Gravesend.

#### **Thong Lane: Work Number OH1**

- 3.28.15 Four National Grid overhead transmission line diversion options were considered that would cross the Project between the A2 and Riverview Park and Thong Lane.
- 3.28.16 The diversion option closest to a perpendicular crossing of the Project route at Thong Lane was preferred as it permitted future operation and maintenance of the network considering the alignment of the A122 and the proposed Thong Lane green bridge. It also considered the planting proposals of the Project along the boundary of Riverview Park and the alignment and engineering requirements of the diverted gas pipelines (Work Nos G3 & G4) both during construction and operation of both networks and sought to remove any unnecessary interface without introducing a series of additional impacts, such as the demolition of properties along Thong Lane.
- 3.28.17 Installing the overhead transmission lines underground was considered but discounted by the Project in agreement with National Grid. To underground the line would have required two Cable Sealing End Compounds to be constructed to enable the transition from overground line to underground. Due to the lack of space around Pylon 4YN050, which is located between HS1 and the A2 and provides a connection to the HS1 Substation, the length of line to be diverted would have had to have been considered from a location further south-west along the alignment, potentially with new impacts to the environment (Pylon 4YN051) or residents (Pylon 4YN052) to achieve this. The underground cables would have required the construction of at least two sections of underground tunnels adjoining deep shafts to navigate the crossing beneath HS1 and the A2 and then to cross beneath the A122 and Thong Lane in constrained areas of existing or proposed high-pressure gas pipelines.

- 3.28.18 Undergrounding would have presented construction, operation and maintenance considerations for National Grid who had communicated to the Project that they could not accept any adverse impact on the safety, security, efficiency or reliability of the electricity and gas transmission networks or increase in the cost of the operating of these as a result of the Proposed Development.”
- 3.28.19 Due to proposed changes to the Thong Lane green bridge over the Project, at the 2020 Design Refinement Consultation, the proposed overhead line diversion (Work Number OH1) was moved further south (235 metres south of that proposed at the 2020 Supplementary Consultation, which is approximately 90 metres south of the existing overhead electricity line). As a result, the proposed overhead line diversion has moved away from Riverview Park and closer to Thong. To facilitate the diversion of the electricity transmission network at Thong Lane two temporary pylons are required, one west of Thong Lane and one east, 30m north of the existing overhead network. To facilitate the pylon replacement works at Claylane Wood and to maintain continued electricity supply, two temporary pylons are required. The temporary overhead line diversion is located to the east, outside the area of ancient woodland. The proposed overhead line diversion therefore reduces the impact on Riverview Park and ancient woodland.

**A13/A1089 junction: National Grid ZB (Work Number OH7) and YYJ (Work Number OH6)**

- 3.28.20 Between the west of the A13/A1089 junction and Hoford Road, three National Grid overhead transmission line diversion options and two underground cable options (National Grid ZB (Works No OH7) and YYJ (Works No OH6) routes) were previously considered to accommodate the Project route.
- 3.28.21 The three overhead line diversion options required the installation of new pylons and realignment of the overhead lines further south, closer to Chadwell St Mary.
- 3.28.22 The two underground cable routes were discounted by the Project in agreement with National Grid as they required the construction of a Cable Sealing End Compound at the transition point of overground to underground at each end for each network, four in total, resulting in a larger construction and easement area. The undergrounding would have required complex installation methods (trenchless methods of installation) in sensitive locations such as near to Scheduled Monuments, Blackshots Nature Area Local Wildlife Site and potentially contaminated land potentially resulting in greater environmental, ecological and archaeological impacts than the proposed design. The proposal would have added significant complexity to the network (due to ratings and system design) as well as increasing costs. This proposal would have committed the Project to modifying a larger section of the existing overhead line networks than is proposed.
- 3.28.23 Undergrounding would have presented construction, operation and maintenance considerations for National Grid who had communicated to the Project that they could not accept any adverse impact on the safety, security, efficiency or reliability of the electricity and gas transmission networks or increase in the cost of the operation of these as a result of the Project.

- 3.28.24 Following engagement with National Grid, Thurrock Council and design review, the A122 route alignment in the Chadwell St Mary's link area was moved northwards to reduce the extent of the proposed overhead line diversion between Hornsby Lane and Hoford Road. This required the stopping up of Hornsby Lane and removal of a previously proposed bridge from the Project. The design then allowed the National Grid ZB and YYJ routes to maintain their existing alignments south of the Project between Hornsby Lane and Hoford Road, reducing the length of the required overhead line diversion. This diversion route was included within the 2020 Supplementary Consultation.

**A13/A1089 junction (Cadent Gas Baker Street to Canvey Pipeline)  
(Work Number G6 and Works No G6a)**

- 3.28.25 Four options were considered in relation to the Cadent Gas Baker Street to Canvey Pipeline high-pressure gas pipe diversion between Stanford Road and the west of the A13 junction. Two route options were considered to the south of the A13 and two route options to the north.
- 3.28.26 Option 1, north of the A13, proposed a diversion routed through a section of the historic landfill and mineral extraction area. The pipeline would also run through the Orsett Showground and recreational fields to the north of the A13 which would require agreement subject to future land use. If this option was to be progressed, boreholes and detailed land surveys of the historic landfill would be required to confirm viability and whether trenchless methods could be used to negotiate the landfill site. This proposal would require the construction of a permanent operational valve along Stanford Road for future maintenance and network operation (Work No G6a). The pipeline would require two separate crossings of the existing A13 as well as six existing minor other road crossings and three future road crossings. The route also traverses two existing water pipelines, existing overhead power lines and numerous buried services.
- 3.28.27 Option 2, north of the A13 would largely avoid routing the pipeline within the Project working areas and would provide Cadent with good access for future maintenance, whilst avoiding the historic landfill area, mineral extraction areas and the existing quarry to the south of the A13. This option moved the gas pipe away from the Project, reducing risks to the gas pipe involved with constructing the new road, and the route also minimises the number of complex trenchless crossings. In this option the road would run through the existing Orsett Showground, dividing the site; therefore, it is assumed that the show grounds would no longer be operational. If maintained, the pipeline diversion would need to be agreed with the landowner as this would sterilise a section of land around the diversion if outdoor events with large groups of people are to be continued. The route through the recreational fields near the Orsett Cock junction would also need to be developed during conceptual design to minimise the impact on future use. This proposal would require the construction of a permanent operational valve along Stanford Road for future maintenance and network operation (Work Number G6a). The pipeline would require eight existing road crossings and seven minor roads and three future road crossings which can be open cut. The route also traverses three existing water pipelines, two existing overhead power lines and buried services to the south of the A13.

- 3.28.28 Option 3, south of the A13, would avoid the historic landfill and quarry, but would require two significant trenchless crossings of the A13. The pipeline would require six existing road crossings and six minor roads and two future road crossings which can be open cut. The route would also traverse two existing water pipelines, two existing overhead power lines and a buried service to the south of the A13. In this option the road would run through the existing Orsett Showgrounds dividing the site; therefore, it is assumed that the show grounds would no longer be operational. If maintained, the pipeline diversion would need to be agreed with the landowner as this would sterilise a section of land around the diversion if outdoor events with large groups of people are to be continued. The route through the recreational fields near the Orsett Cock roundabout would also need to be developed during conceptual design to minimise the impact on future use. This proposal would require the construction of a permanent operational valve along Stanford Road for future maintenance and network operation (Work Number G6a).
- 3.28.29 Option 4, south of the A13, included proposals for a pipeline diversion and protection slabs at the edge of the quarry and beneath the A1089 road to the south of the A13. A crossing of the A13 would not be required and the tie-in point would be to the west of the Orsett Cock block valve, which would allow internal inspection of the pipeline to be maintained. Cadent would however have no access to a significant section of the pipeline beneath the protection slabs, which is not desirable. An assessment of the quarrying activities may also be required due to the proximity of the pipeline to the quarry. The route would require the removal of existing buildings in the location of the tie-in point near the quarry. The pipeline would require three existing road crossings, one minor road and one future road crossing which can be open cut. The route also traverses two existing water pipelines, two existing overhead power lines and buried electricity services to the south of the A13.
- 3.28.30 If the Project had progressed with Option 3 or Option 4, there would have been a complex design and construction interface with the NGET ZB and YYJ diversions around the A1089. If the Project had continued with Option 4, it is likely that the proposal would have been undeliverable following the further refinements to the highway at the Orsett Cock.
- 3.28.31 Option 2 was the preferred option and was presented in the 2020 Supplementary Consultation. Option 2 would route the gas pipeline to the north and was chosen as it would avoid the historic landfill and mineral extraction areas. It would also move the gas pipeline away from the Project, reducing risks to the gas pipeline during operation and those risks involved with constructing the new road and the route as it minimises the number of complex trenchless crossings. The proposed diversion route would however be close to the Scheduled Monument (Iron Age Enclosures) to the north of the A13, however the alignment has been modified at the 2022 Local Refinement Consultation to move the workforce and the pipeline from having a direct interface with the Scheduled Monument and a veteran tree, and the Order Limits have been locally extended to allow construction vehicles to pass through an existing gap in a row of trees bordering a field.

### Low Street: National Grid ZJ route (Work Number OH4)

- 3.28.32 Between Low Street and Linford, four National Grid overhead transmission line diversion options (National Grid ZJ route (Work Number OH4)) were previously considered to accommodate the Project route. The alternative diversion options considered would require the installation of new pylons and realigned overhead lines further west, closer to Low Street and/or would provide technical challenges regarding the crossing of the Tilbury Loop railway line and adjacent commercial properties. In the preferred option, presented at the 2020 Supplementary Consultation, the overhead transmission line diversion would be routed south of Station Road up to the west of the village of Linford and is located to minimise the impact on Low Street Conservation Area and adjacent commercial properties.

## 3.29 Charging scenario alternatives

- 3.29.1 Road user charging is an effective and potentially flexible tool for managing demand and the associated congestion and consequent environmental impacts. At the 2018 Statutory Consultation, two scenarios for charging were considered:
- a. An ‘assessed charging case’ that assumed equal charging between the Project and the Dartford Crossing
  - b. A flexible charging scheme, which would include but would not be limited to:
    - i. Changing the amount of the charges
    - ii. Charged and non-charged hours
    - iii. Peak charging
    - iv. Vehicle classification
    - v. Emissions-based charging
- 3.29.2 A flexible charging scheme was proposed at the 2018 Statutory Consultation as this would provide ongoing flexibility, including the ability to optimise network performance and effectively manage traffic demand and distribution.
- 3.29.3 Following the 2018 Statutory Consultation, further modelling and assessments have shown that making the charge for the Lower Thames Crossing the same as for the Dartford Crossing would be the most beneficial option as it:
- a. Simplifies the decision making for the driver as the choice of crossing will be informed by the most convenient route
  - b. Minimises operational complexity, enabling the combined operation of the Dartford Crossing and Lower Thames Crossing charging schemes and also removes complexity for the user

### 3.30 Programme alternatives

- 3.30.1 Construction has been programmed to take six years (further information in Chapter 2: Project Description).
- 3.30.2 The overall construction programme developed at this stage is not sufficiently detailed to show every construction activity. However, the general approach to construction and timings for works has been informed by the outcomes of the environmental assessment and mitigation requirements.

### 3.31 Developing mitigation

- 3.31.1 Alternatives for mitigation have been considered. The mitigation strategy for the Project was established following the PRA and has been subsequently developed based on stakeholder feedback, Project design changes and the outcomes of the environmental assessment.
- 3.31.2 A number of mitigation proposals have been considered following an iterative process and based on the overarching mitigation strategy. However, an options development process has not been undertaken specifically for mitigation; the mitigation that has been developed has been identified through engagement with appropriate environmental consultees and on the basis of environmental assessment. The Design Principles (Application Document 7.5) captures the embedded mitigation that has been incorporated into the design and the REAC (Appendix 2.2, Application Document 6.3) contains the best practice and essential mitigation measures identified through the EIA process.

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