

Lower Thames Crossing

Scheme number **HE540039**

Environmental Impact Assessment – Scoping Report

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Revision	Production Date	Prepared By	Checked By	Approved For Release By
1.0	26.01.2017	Simon Rimell	Nicky Hartley	Jeff Meerdink
2.0	30.10.2017	Simon Rimell	Caroline-Soubry-Smith	Jeff Meerdink

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1 Introduction

1.1 The Applicants Request

1.1.1 This Scoping Report has been prepared in accordance with Section 10 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017. It is submitted on behalf of Highways England to request a Scoping Opinion in respect of the Lower Thames Crossing.

1.2 Background To The Lower Thames Crossing Project

1.2.1 The Lower Thames Crossing (LTC) is a proposed new crossing of the River Thames east of London that will connect Kent and Essex (the Project). For more than 50 years, the Dartford Crossing has provided the only road crossing of the Thames Estuary east of London.

1.2.2 The existing Dartford Crossing consists of two bored tunnels for northbound traffic and a bridge for southbound traffic. It is one of the most strategically important pieces of road network in the UK (see Plate 1-1 below for the Strategic Road Network), carrying traffic of international and national importance, as well as catering for regional and local movements.



Plate 1-1: The Strategic Road Network In Context And The Location Of The Dartford Crossing

1.2.3 Plate 1-2 shows the location of the Dartford Crossing in its local context.

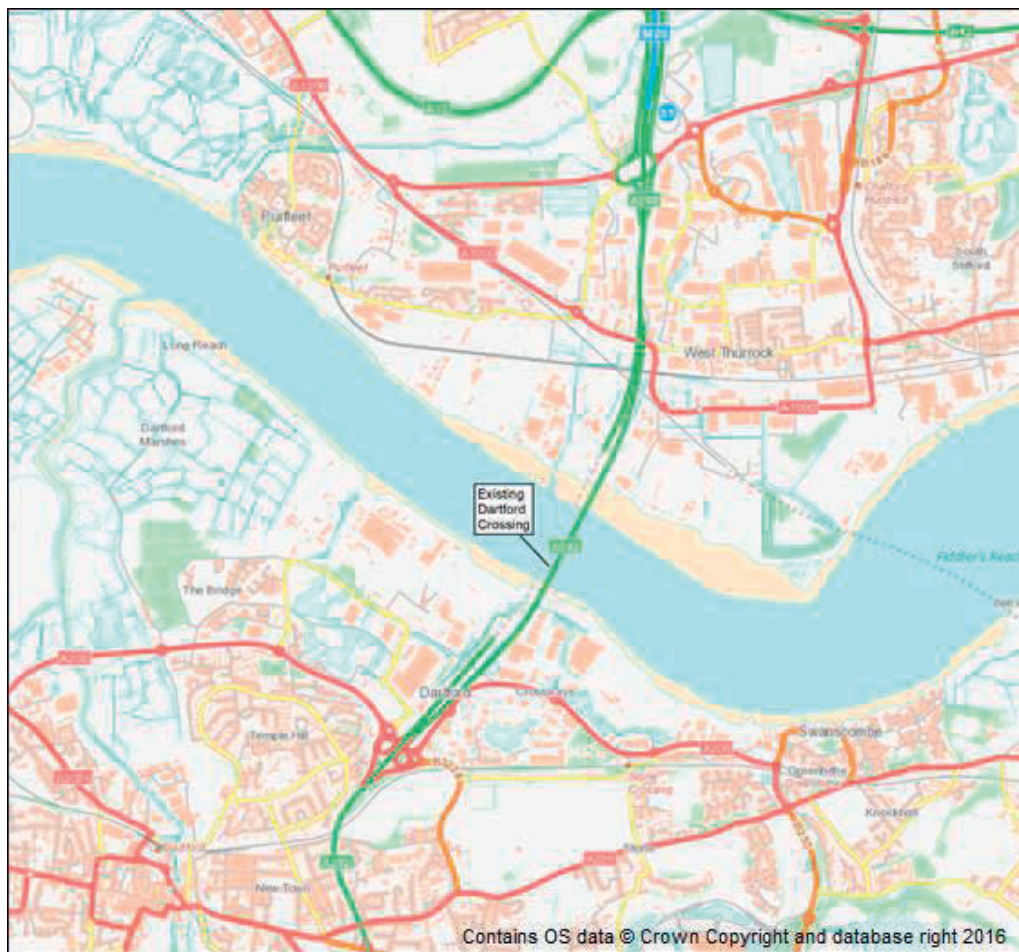


Plate 1-2: The Dartford Crossing In Its Local Context

- 1.2.4 The existing crossing has many problems because of the volume of traffic and the physical constraints of the existing infrastructure. These constraints have a severe effect on operations and limit the capacity of the crossing.
- 1.2.5 The existing crossing is heavily congested. Average daily two-way traffic flows are typically about 155,000 vehicles, and flows frequently exceed the design capacity of the crossing at peak periods. Forecast traffic growth is expected to result in an increase in traffic volume of 23% by 2025.
- 1.2.6 Congestion and incidents at the crossing cause slow and unreliable journeys for a high number of vehicles for long periods of every day. Queuing traffic causes long delays on the crossing approaches and on local roads. This has severe economic, safety and environmental impacts on users and local communities.
- 1.2.7 The purpose of the new crossing is to provide a safer, faster, more reliable road offering easier travel between Kent and Essex and beyond. It will offer new connections and shorter journey times to local destinations, as well as regional and national destinations. It will create a second crossing of the Thames east of London, providing a modern,

resilient, alternative crossing and in doing so, relieving pressure and congestion on the existing Dartford Crossing and approach roads.

- 1.2.8 The new crossing will open opportunities for investment and regeneration, supporting local businesses, national companies and international trade through the Channel and Thames Estuary ports. It will create jobs, apprenticeships and training opportunities for people both during construction and long-term.

1.3 Project Objectives

- 1.3.1 The Project Objectives are shown in Table 1-1. They are presented in three principal categories: economic, environment and community, and transport objectives. These Project Objectives were agreed between Highways England and the Department for Transport (DfT).

Table 1-1: Project Objectives

Project Objectives	
Economic	<ul style="list-style-type: none"> To support sustainable local development, regional economic growth in the medium to long-term To be affordable to Government and users To achieve value for money
Environment & Community	<ul style="list-style-type: none"> To minimise adverse impacts on health and the environment
Transport	<ul style="list-style-type: none"> To relieve the congested Dartford Crossing and approach roads and improve their performance by providing free flowing north-south capacity To improve resilience of the Thames crossings and major road network To improve safety

1.4 Project History

- 1.4.1 The opening of the Queen Elizabeth II Bridge in 1991 was followed by a period of growth in both traffic volumes and economic development. Traffic volumes grew quickly and the Department for Transport (DfT) recognised the need to investigate options for additional crossing capacity as part of its long-term planning for the strategic road network.
- 1.4.2 In 2009, the DfT examined five locations where an additional crossing could be built. The most easterly of these (Locations D and E) were found to be too far from the existing crossing to ease the problems at Dartford and were eliminated from further consideration.
- 1.4.3 The need for a new crossing was recognised in the National Infrastructure Plan: November 2011, where it was included as one of the Government’s top 40 priority projects.

- 1.4.4 In 2013, further analysis was undertaken of the three remaining options at Locations A, B and C. This included C Variant, an improvement of the A229 between the M2 and M20 south of the River Thames. The DfT then held a public consultation on the need for a new crossing and invited views on locations A, B, C and C Variant. Later that year, the Government announced its decision not to proceed with Location B.
- 1.4.5 In 2014, the Government published its response to the 2013 consultation, confirming the need for an additional crossing between Kent and Essex. The response acknowledged that there was no preference at that stage on location, and that further work would be carried out to develop and appraise remaining location options.
- 1.4.6 DfT then instructed Highways England (the Applicant) to identify and appraise route options at Locations A and C, with or without C Variant. Highways England held a non-statutory consultation between January and March 2016. Further details about the options development process can be found in Chapter 3: Alternatives Considered.
- 1.4.7 Following extensive analysis of the consultation responses and further assessment of the route options, Highways England submitted its route recommendation to DfT. The Preferred Route was announced by the Secretary of state for Transport in April 2017. This was Route 3 with a bored tunnel crossing of the River Thames and the Western Southern Link.
- 1.4.8 Since the Preferred Route was announced, further assessments and surveys have been ongoing in order to gain a better understanding of the area where the new crossing is proposed. Development of the design has resulted in changes to the alignment of the preferred route. This revised alignment is hereinafter referred to as the 'Project' and is shown in Plate 1-3 below:

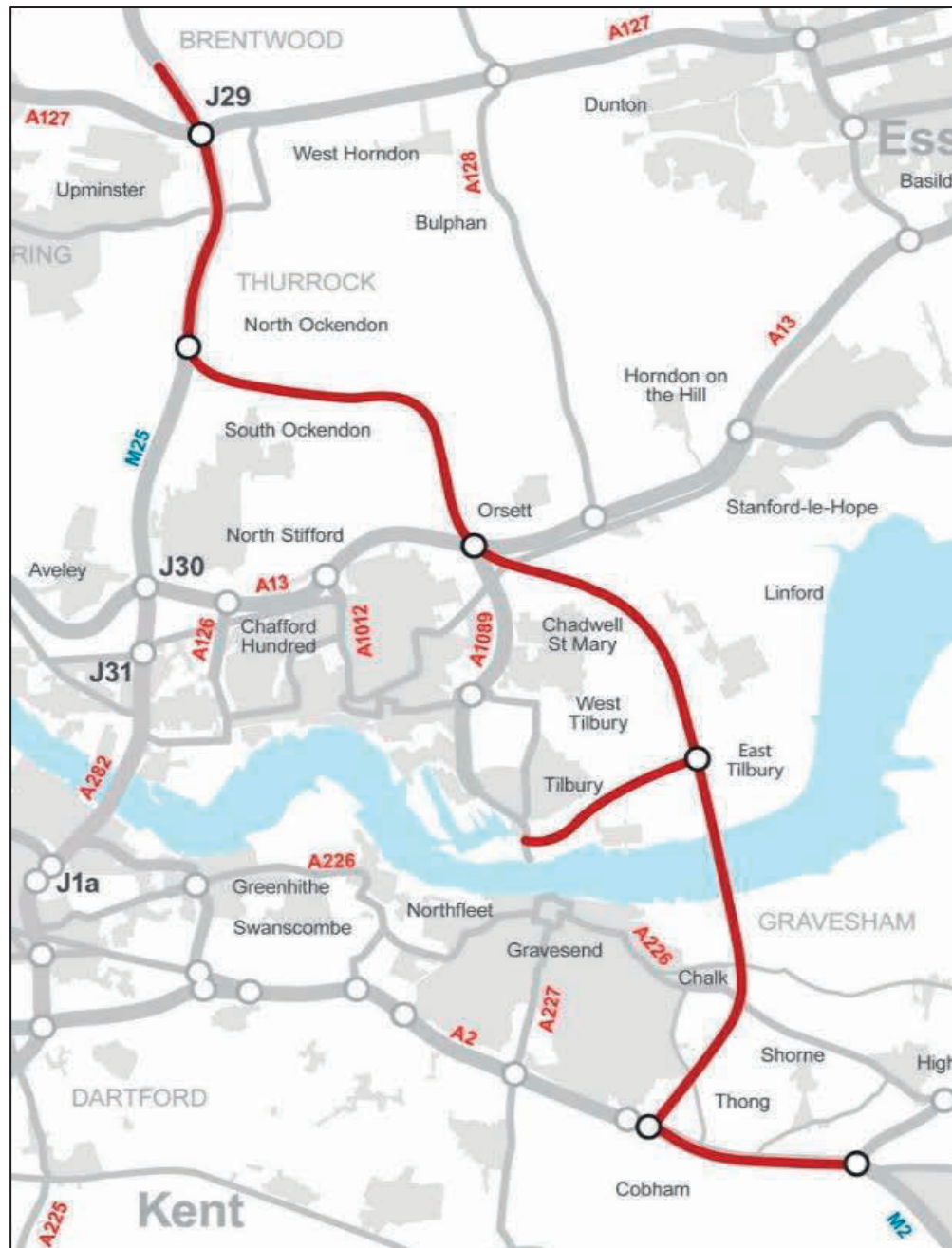


Plate 1-3: Indicative Route Alignment

- 1.4.9 The Project would provide a new 70 mph route between the M25 in Essex and the A2 in Kent.
- 1.4.10 A more detailed description of the key elements of the Project is provided in Chapter 2: The Project.

1.5 Project Location And The Existing Highway Network

- 1.5.1 The Project is located in a very populated area of the country in the vicinity of urban areas including, but not limited to, Gravesend, Grays and Tilbury. There are a large number of footpaths, bridleways, National Cycle Network routes, local cycle routes and trails within the area to

provide Non-Motorised Users (NMUs) with access and connectivity to surrounding areas.

- 1.5.2 Areas of the physical environment around the Project is designated for its important ecological, cultural heritage and landscape features.
- 1.5.3 South of the River Thames, and in close proximity to the A2, there are a number of areas of nationally important ancient woodland, Sites of Special Scientific Interest (SSSI) and sites of local biodiversity importance. On the south bank of the River Thames to the east of Gravesend and the north of Chalk lies the Thames Estuary and Marshes Ramsar Site and SSSI with the land further east also being designated as Special Protection Area. The River Thames itself is designated a recommended Marine Conservation Zone. To the north of the River Thames lies Goshems Farm Local Wildlife Site (LWS). There are a number of other LWSs between the river and the M25, as well as other areas of ancient woodland.
- 1.5.4 The land between the villages of Thong and Shorne and to the south of the A2 forms part of the Kent Downs Area of Outstanding Natural Beauty (AONB). Also, south of the A2, lies the Cobham Hall Registered Park and Garden. The villages of Shorne and Cobham are also designated as Conservation Areas. North of the River Thames the settlements of East and West Tilbury are designated as Conservation Areas. Both south and north of the Thames there are a number of Listed Buildings of all grades, particularly Grade II and II*. Other heritage features of note are Scheduled Monuments that include New Tavern Fort and Cliffe Fort on the southern bank of the River Thames and Coalhouse Fort Battery and Artillery Defences and Tilbury Fort on the northern bank of the River Thames as well as a crop mark complex at Orsett adjacent to the A13.
- 1.5.5 There are extensive areas of floodplain across the area associated with the River Thames and Mardyke which lies to the north of the River Thames in Thurrock and flows into the River Thames at Purfleet. Parts of the area benefit from the River Thames tidal flood defences. Numerous smaller watercourses and drainage ditches traverse the area particularly to the north of the River Thames.
- 1.5.6 There are a number of Air Quality Management Areas (AQMAs) designated by Gravesham, Thurrock and Havering Councils, which demonstrate the existing air quality issues in these areas. There is also an AQMA designated at the existing Dartford Crossing. A number of Noise Important Areas (NIAs) are also designated south of Gravesend along parts of the A2, along the A13 and the M25. Further details about the local environment are provided in Chapters 6 to 15 of this Scoping Report.

1.6 The Project Team

- 1.6.1 Table 1-2 provides a summary of the key organisations involved in the delivery of this Project and their role.

Table 1-2: Organisations And Their Role Within The Project Team

Organisation	Role
Highways England	Applicant.
Arcadis, CH2M, COWI	<ul style="list-style-type: none"> • EIA and environmental design; • Stakeholder management and engagement • Technical Design; • Traffic modelling and economic appraisal; • Management and delivery of the Development Consent Order (DCO) application; and • Legacy and Benefits.
BDB	Legal Advisors.

1.7 Purpose And Structure Of The EIA Scoping Report

- 1.7.1 The Project is a Nationally Significant Infrastructure Project (NSIP) under the Planning Act 2008 as amended. Therefore, an application for development consent will be submitted to the Planning Inspectorate (PINS). This application will be accompanied by an Environmental Statement (ES), prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (Statutory Instrument 2017/572) (the EIA Regulations).
- 1.7.2 The purpose of this EIA Scoping Report is to establish the scope of the ES and to support the request for a scoping opinion under Regulation 10 (1) of the Infrastructure Planning (EIA Regulations) 2017.
- 1.7.3 The EIA Regulations set out the requirements for an applicant who proposes to request a scoping opinion from PINS. Section 10 Paragraph 3 of the EIA Regulations requires a request for a scoping opinion to include:
- A plan sufficient to identify the land;
 - A description of the proposed development including its location and technical capacity;
 - An explanation of the likely significant effects of the development on the environment; and,
 - Such other information or representations as the person making the request may wish to provide or make.
- 1.7.4 PINS Advice Note 7: EIA, Screening and Scoping (March 2015) provides advice on the information that should be provided in the EIA Scoping Report. This is based upon the EIA Regulations (2009) and is awaiting revision. However for the purposes of Table 1-3, PINS Advice note 7: EIA, Screening and Scoping, has been used to list the suggested

information requirements and identifies where they are presented in this EIA Scoping Report.

Table 1-3: Suggested EIA Scoping Report Contents In PINS Advice Note 7

Suggested EIA Scoping Report Contents (Based on Advice Note 7)	Relevant chapters in the EIA Scoping Report
<p>A plan showing:</p> <ul style="list-style-type: none"> • The proposed draft DCO site boundary (identified by a red line), including any associated development; • Any permanent land take required for the proposed development; • Any temporary land take required for construction, including construction compounds; • Any existing infrastructure which would be retained or upgraded for use as part of the proposed development and any existing infrastructure which would be removed; and • Features including planning constraints and designated areas on and around the site, such as national parks or historic landscapes. 	Appendix F
<p>A description of the proposed development including both the NSIP and any of the associated development.</p>	Chapter 2
<p>In dealing with the description of the development and its possible effects on the environment, applicants should: Set out the information using the headings in Schedule 3 to the EIA Regulations (NOTE: this refers to the EIA Regulations 2009), being:</p> <ul style="list-style-type: none"> • Characteristics of the development; • Location of the development; • Characteristics of the potential impacts; and • Ensure that all aspects of the environment likely to be significantly affected by the development are addressed. 	Chapter 2 and 6 to 16
<p>An outline of the reasonable alternatives considered and the reasons for selecting a preferred option.</p>	Chapter 3
<p>Results of desktop and baseline studies where available.</p>	Chapter 6 to 16

Suggested EIA Scoping Report Contents (Based on Advice Note 7)	Relevant chapters in the EIA Scoping Report
Referenced plans presented at an appropriate scale to convey clearly the information and all known aspects associated with the proposal.	Appendix F
Guidance and best practice to be relied upon, and whether this has been agreed with the relevant bodies (for example the statutory nature conservation bodies or local authorities) together with copies of correspondence to support these agreements.	Chapter 6 to 16
Methods used or proposed to be used to predict impacts and the significance criteria framework used.	Chapter 6 to 16
Any mitigation proposed and predicted residual impacts.	Chapter 6 to 16
Where impacts from consequential or cumulative development have been identified, how applicants intend to assess these impacts in the ES.	Chapter 16
An indication of any European designated nature conservation sites that are likely to be significantly affected by the proposed development and the nature of the likely significant impacts on these sites.	Chapter 9
Key topics covered as part of applicants' scoping exercise.	Chapter 6 to 16
An outline of the structure of the proposed ES.	Chapter 17
The elements of the proposed development likely to have a significant environmental effect should be identified. Where uncertainty remains, the applicant should provide as much detail as possible, or assume the worst case (e.g. maximum dimensions of a building or feature).	Chapter 6 to 16
The applicant may also wish to provide a completed transboundary screening matrix dealing with the effect of the proposed development on other European Economic Area (EEA) States with the scoping report.	Chapter 18

2 The Project

2.1 Introduction

- 2.1.1 This section provides an outline of the key elements of the Project including the alignment, tunnel construction and ancillary works such as service and utility diversions, traffic forecasting and user charging. Details are also provided about how environmental considerations will inform the evolution of the design.
- 2.1.2 The area required for development (both the permanent and temporary land take) is shown on Figure 2.1 in Appendix F. This also presents the proposed Project route alignment.
- 2.1.3 The design of the Scheme remains under development. The scheme will be subject to statutory consultation, planned for 2018, before the design is further developed and an application for development consent is made. As the design develops in light of more detailed baseline information being gathered and as a result of stakeholders' engagement, the embedded mitigation measures will also be refined as part of the iterative process.
- 2.1.4 The Lower Thames Crossing is expected to be open by 2027, subject to the necessary funding and planning approvals. As set out in the 2016 consultation, the date of opening was expected to be in 2025 if wholly publicly funded. If private funding is also used to meet the costs of the project, it is anticipated the crossing would be open by 2027. Highways England and Government are investigating funding and finance options. For the purposes of the traffic forecasting and other assessments within this report, an estimated opening date of 2026 has been used.

2.2 Project Alignment

- 2.2.1 The route would connect the A2 in Kent, east of Gravesend, crossing under the River Thames by means of two bored tunnels, before joining the M25 south of Junction 29. Between the A2 and A13 Junctions the route is currently proposed as a dual three lane carriageway; north of the A13 the route would be a dual two-lane carriageway. The improvements would include widening of the M2/A2 and the M25 at each end of the route. The total length of the route, including M2/A2 and M25 widening, would be approximately 31km, with approximately 3.5km in tunnel.
- 2.2.2 Currently, the Project is being designed as a high-standard free-flowing route, with grade separated junctions, and safety levels matching the highest standards of the network, and would provide a motorway-quality journey for drivers.
- 2.2.3 The main carriageway horizontal and vertical alignments would be designed to the Design Manual for Roads and Bridges (DMRB) TD 09/93 Table 3 for highway link design. The design speed would be 120km/h (70mph speed limit).

- 2.2.4 From the A2, the new route would pass under Thong Lane between Gravesend and Thong and would cross the Southern Valley Golf Course towards the A226. The approach to the tunnel portal from the south would be in deep chalk cutting. The proposed southern portal is located to the east of Chalk Village with the precise location still under assessment.
- 2.2.5 The tunnel crossing is located to the east of Chalk Village on the south of the River Thames and to the west of East Tilbury on the north side. The tunnel would pass under the Thames Medway Canal, North Kent railway line, the Thames Estuary and Marshes Ramsar site / South Thames Estuary and Marshes SSSI and the Metropolitan Police Service Specialist Training Centre at Gravesend on the south of the River Thames.
- 2.2.6 On the north side of the river, the route would run to the west of East Tilbury and between Chadwell St Mary and Linford. The route would cross the A13 to the west of Orsett at the location of the existing A13/A1089 junction. To the north of the A13 the route would pass to the west of Orsett and then turn to the west passing north of South Ockendon before connecting with the M25 between Junctions 29 and 30 via a new junction with north facing slip roads.
- 2.2.7 Junctions are being considered at the following locations:
- A new junction with north-facing slip roads on the M25 between Junctions 29 and 30.
 - A modified junction with the A13/A1089 in Essex.
 - A new junction east of Tilbury.
 - A new link road is provided from the new junction east of Tilbury to the west which would connect to Tilbury.
 - A new junction with the A2 to the east of Gravesend.
- 2.2.8 An indicative plan of the Project alignment is shown on Plate 1-1 in Chapter 1.

2.3 Safety And Security

- 2.3.1 The route will be designed with modern safety measures and construction standards with technology to manage traffic and provide better information to drivers.

2.4 Earthworks Design

- 2.4.1 Three main geological formations would be encountered along the route of the Project:
- Area 1 - South of the Thames – Predominately chalk;
 - Area 2 - North of the Thames, south of A13 – Thanet Sand (clayey silty sand) and River Terrace Deposits (sand and gravel); and

- Area 3 - North of the A13 – London Clay (silty clay), Lambeth Group (clay, silts and silty sands) Head and Alluvium (peats, silts, clay, sands and gravels).

2.4.2 The south portal structures and cut and cover tunnels will be constructed predominantly in chalk, largely below the groundwater table. The north portal and approach ramps will be constructed in the flood plain where ground conditions comprise Made Ground, including potentially contaminated soil overlying Alluvium (silts, clays and peat), River Terrace Deposits and Chalk with the below ground structures constructed below the groundwater table.

2.4.3 The preliminary slope recommendations within these areas are based on the primary geology likely to be present. All recommendations are subject to change as soil parameters would be obtained through a ground investigation.

2.5 Highways Structures

2.5.1 Bridges and civil infrastructure e.g. underpasses would be designed, developed and options appraised against each other to ensure that the solution:

- Is safe during the whole life cycle, from construction to the end of serviceable life;
- Enhances the built environment solution in keeping with leaving a positive legacy for the projects, thus providing a pleasant experience for the road network user;
- Offers value for money;
- Minimises any impacts on the environment both during construction and operation; and
- Minimises disruption during construction.

2.5.2 All the structure details given in this section are indicative of potential solutions and are subject to change as the scheme is developed and appraised further. The range of new structures required is summarised in Table 2-1.

2.5.3 The Project is seeking to incorporate existing bridges where possible; there are several of these existing bridges on the M25, A13, and A2 that will be incorporated into the scheme as the scheme layout is finalised.

Table 2-1: Summary Of Indicative Highways Structures Along The Project

Type of Structure	Number of Structures
Rail bridge	1
Road overbridge	17
Road underbridge	7
Viaduct	3

Type of Structure	Number of Structures
Underpass	8
Footbridge	3
Main river bridge	2

Note: indicative numbers only, subject to change as the design develops

2.6 Highways Drainage

2.6.1 The Project is located within two distinct drainage sections which are:

- South of the river, geological conditions are chalk. A network of ditches draining to a surface watercourse which exists close to the River Thames. The chalk is particularly permeable. The road is generally in deep cutting and has a longitudinal gradient of up to 4%; and
- North of the river, ground conditions are more variable and less permeable. The road is generally at-grade/on embankment and has flat longitudinal gradients. This area is characterised by the presence of natural watercourses that regularly cross the proposed alignment with the primary watercourse being Mardyke, which is designated as 'Statutory Main River' by the Environment Agency.

2.6.2 The two distinct sections require a different approach to drainage.

2.6.3 South of the river, the drainage system could be a conventional drainage network draining to soakaways. Existing soakaways along the A2 would either be removed or enhanced as part of the Project. Revised soakaways would be provided with open basins to provide water quality treatment and act to contain any potential accidental spillages.

2.6.4 The section north of the river lends itself to two potential options:

- Applying swales with linear infiltration to ground along the entire length of the road; and
- A design based on a positive drainage network of channels and pipes, discharging to surface watercourses via wetland treatment basins.

2.6.5 Ultimately, the solution adopted would depend on constraints at any particular location including the extent of flood plains, the location of landfills and final ground conditions, most particularly ground water levels and permeability of the sub-soils.

2.6.6 It would be necessary to include facilities for accidental spillage containment, either in the form of oversized pipes, or a section of swale with an impervious lining.

2.6.7 Some areas of the road would be in deep cutting, where swales would not be suitable and infiltration unlikely to function. For this area, a positive drainage network is envisaged, with filter drains in cuttings, draining via a balancing pond prior to discharge to a watercourse

2.6.8 In the absence of any particular constraints, swales would be the preferred solution to the disposal of surface water run-off. Where swales

are not feasible, either in some areas or across the entire new road, a positive drainage network would be used. Balancing ponds including wetlands could be provided prior to discharge to various local watercourses to mitigate the impacts in water quality and flow rates. Ponds would also be provided with shut-off valves at the outfalls in the event of an accidental spillage.

2.7 Highways Lighting

- 2.7.1 Lighting would be required at junctions and interchanges on the route, parts of the local access roads and certain sections of the Project. The lighting design is at an early stage of development, therefore, the actual extent of new lighting is yet to be confirmed.
- 2.7.2 The lighting design would minimise light pollution which can cause sky glow, glare and light trespass. The design of the lighting would take into account potential landscape and ecological effects.
- 2.7.3 Lighting would be required at the tunnel as outlined in section 2.11.

2.8 Technology

- 2.8.1 The Project would include technology assets including:
- Variable message signs mounted on cantilever gantries;
 - CCTV cameras; and
 - Above ground traffic detectors.
- 2.8.2 Emergency Rescue Areas (ERAs) and variable message signs would be provided along the route based on Highways England guidance. These signs would be used by the Highways England Regional Control Centre to display travel information, hazard warnings and both advisory and mandatory signage to drivers. The signs would be a standard Highways England design and mounted on standard cantilever gantries located in the verge. Where practical, the signs would be co-located with gantry-mounted direction signage to minimise the number of gantries on the road.
- 2.8.3 On each approach to the tunnel, LED matrix lane control signals would be mounted on cantilever gantries above each lane. These would allow Highways England to condition traffic before entering the tunnel, applying any lane closures or speed restrictions in advance, to allow traffic to flow freely through the tunnel. Where practical, the signals would be located on gantries provided for other purposes. The number and spacing of these gantries is to be discussed with stakeholders as part of the Project development.
- 2.8.4 CCTV masts would typically also be sited at ERAs, with additional masts installed if necessary to avoid blind-spots and provide surveillance coverage of the whole road. Images from the CCTV cameras are used by Highways England for a wide variety of purposes including managing and investigating incidents, monitoring of activities on site including the health and safety of workers and the public, asset protection, monitoring

specific operations and network usage and the prevention and detection of crime. Standard CCTV mast height is between 10m and 15m above ground level.

- 2.8.5 Traffic detectors would be mounted on poles in the verge at approximately 500m spacing, co-located with ERAs wherever possible. The detectors are needed to control automatic traffic management systems (variable speed limits for example) and to collect historical data on traffic flows. The poles are typically slender and around 4 to 6m high.
- 2.8.6 Equipment cabinets would be collocated with ERAs wherever possible otherwise clustered at locations that offer safe maintenance access, from adjacent land for example.
- 2.8.7 The need for any additional variable message signs on the roads approaching the Project (the M25, A2 and A13) would be discussed with stakeholders as part of the Project development. It is feasible that little additional variable message signage could be required as the approaching roads are already equipped with highway communications equipment. However, it may be necessary to move or add some signage to enable drivers to be advised of alternative routes when either the Project or Dartford River Crossings are congested or closed. It is expected that variable message signs for strategic diversions would be mounted on cantilever structures, providing a display matrix.
- 2.8.8 In conjunction with the requirements for technology, highways signs will be included in the design. This could include both gantry and roadside mounted signs. Where large advance directional signs are required, their height will be kept to a minimum using reduced letter heights where standards permit.

2.9 Non-Motorised User (NMU) Provision

- 2.9.1 Where the proposed route would affect the existing Public Rights of Way network and existing cycle routes, provision would be made to ensure that the route remains open, by providing under or overbridges or a suitable diversion.
- 2.9.2 For safety reasons, NMUs which include pedestrians, cyclists and equestrians and slow-moving vehicles would be prohibited from using the new route.

2.10 Flood Risk Management

- 2.10.1 In accordance with the requirements of the National Planning Policy Framework (NPPF) the National Policy Statement for National Networks (NPSNN), a Flood Risk Assessment (FRA) will be prepared to demonstrate how flood risk to the development will be managed now, and when taking future climate change into account. The FRA will also consider the flood risks generated as a result of the Project's construction.
- 2.10.2 Although the majority of the development lies in Flood Zone 1, parts of the development will lie in Flood Zone 3. Those parts of the development

that lie in Flood Zone 3 will benefit from existing flood defences. The areas that lie in Flood Zone 3 are as follows:

- Adjacent to the River Thames (north).
- Near to the Mardyke (main river).
- These are indicated on Drawing 14.1 in Appendix F.

2.10.3 The Project will be divided into a number of sub-catchments, the extents of which will generally be defined by high points but with due consideration to flood zone category, significant topographical features, geology and hydrogeology.

2.10.4 In addition to assessing flood risk, the FRA will also be used to inform certain elements of the detailed design, including:

- Flood defence of the tunnel portals;
- Bridge deck levels and spans;
- Road levels;
- Development of a principal drainage strategy including dealing with exceedance flows;
- Pollution control and water quality;
- Run-off assessment; and
- Location of surface water balancing facilities.

2.11 Tunnel Design

2.11.1 The Project would comprise twin bored tunnels of at least 3km in length with cut and cover tunnels on the approaches. The size of the twin tunnels would be able to accommodate a dual three lane carriageway, and the external diameter of each tunnel bore would be approximately 15.8m with a maximum road gradient of 4% within the tunnel.

2.11.2 The tunnel solution would be designed in accordance with the DMRB, BD78-Design of Road Tunnels and would achieve the minimum safety requirements for tunnels on the trans-European road network. A system of height detection would be used to prevent over-sized vehicles accessing the tunnel. A detour road may be required to allow over-sized vehicles to leave the highway before entering the tunnel.

2.11.3 The tunnels would be provided with drainage capacity to deal with wash-down water, firefighting water and surface water run-off from the approaches that enter the tunnel. Captured water would discharge to a deep pump sump located at the lowest point of both tunnels and a main pump sump at the deepest parts of the ramps at the tunnel entrance points. A pumping station would also be required at each tunnel portal to manage surface water runoff from the tunnel approaches.

2.11.4 The maximum design speed for the tunnel would be 120 km/h (70 mph). Cross passages connecting each tunnel would be provided for emergency evacuation as well as maintenance works.

Tunnel Lighting

- 2.11.5 Tunnel lighting during operation (termed “normal lighting”) would be provided to ensure appropriate visibility during day and night for drivers in the threshold, transition, and exit zones of the tunnel.
- 2.11.6 Safety lighting would be provided to allow a minimum visibility for tunnel users to evacuate the tunnel in their vehicles in the event of a breakdown of the power supply.
- 2.11.7 Evacuation lighting, such as evacuation marker lights would be provided to guide tunnel users to evacuate the tunnel on foot, in the event of emergency.

Tunnel Ventilation

- 2.11.8 The assumed ventilation system for the tunnel is a unidirectional, longitudinal ventilation system. The system would utilise clusters of jet fans located along the entire length of each of the tunnel bores.
- 2.11.9 Ventilation during normal operation would generally be via the natural piston effect of the unidirectional traffic. However, a mechanical ventilation system may also be required to supplement the natural ventilation to ensure the emissions in the tunnel from the vehicles are below acceptable levels. The tunnel's Command and Control system would control the operation of the fans during normal operation, based on measured in-tunnel air quality measurements. The fans would operate sequentially to maintain the in-tunnel air quality.
- 2.11.10 The tunnel ventilation system would be subject to further design in conjunction with the air quality assessment to ensure that emissions are minimised as far as possible. It may be necessary for ventilation stacks to be constructed to disperse pollutants. They could be in the order of 25m high on top of the tunnel exit at each portal.
- 2.11.11 In the event of an emergency (fire), the ventilation system in the bore would maintain safe conditions upstream of the event by pushing smoke to the tunnel exit portal. Counter ventilation in the adjacent bore would prevent inflow of smoke at the tunnel portal. Ventilation Design Fire Load would be agreed in coordination with the Tunnel Design Safety Consultation Group (TDSCG); it is possible that a Fixed Fire Fighting System would be implemented.

Emergency Arrangements (Operation)

- 2.11.12 In coordination with the TDSCG, including the emergency services, it would be discussed whether special access to the tunnel portal would be provided to allow for quick first response from the local emergency service.
- 2.11.13 Emergency services would arrive following agreed procedures determined, based on emergency service crew safety and welfare. Crossing of the central reserve would be made possible outside each portal. This measure would allow emergency services to gain immediate access to either tunnel.

Service Building

- 2.11.14 At each of the tunnel portal locations a service building could be constructed to provide Mechanical, Electrical and Plumbing (MEP) and maintenance operations. The service building would include an office, pump rooms, water basin for firefighting, power supply and a local control room.
- 2.11.15 It is assumed that a control building is constructed to serve local tunnel control. There could also be a connection with a regional tunnel control centre as a backup protocol in case the local control centre has any issues. For maintenance purposes the control building would have parking and a connection with a maintenance access road.

2.12 Tunnel Construction

- 2.12.1 The tunnel would be excavated by a Tunnel Boring Machine (TBM) and lined with precast concrete segments erected behind the TBM. Segment design would be mainly driven by ground loads, construction loads and fire load.
- 2.12.2 It is assumed that the tunnel would be constructed with two TBMs. They could be driven from the north or south, but based on current information, it is considered more likely that it would be driven from the north although this would be confirmed through further design work. In order to power the TBMs, it would be necessary to construct a temporary sub-station. The temporary sub-station could become the permanent sub-station for the tunnel running once operational.
- 2.12.3 Based on current information either an Earth Pressure Balance (EPB) TBM or a Slurry TBM would be considered as options. Excavated material from tunnels and portals construction would be stored on site and then removed from site to designated areas. This material would consist predominantly of chalk. The consistency of the excavated material from an EPB TBM makes it manageable to be transported off site by wagons or conveyor from the tunnel face. An excavated material storage area on-site, would be required until the material is disposed off-site.
- 2.12.4 With a Slurry TBM, in which the excavation chamber is completely filled with bentonite for full tunnel face support during tunnelling, the excavated material from the TBM face is pumped through pipes into a Slurry Treatment Plant where bentonite and excavated material are separated. The Slurry Treatment Plant would reduce the water content of the slurry and remove the bentonite to produce chalk 'cakes'. These cakes would then be transported off site for re-use. A space for slurry storage and slurry preparing would be required during the construction phase as part of the on-site facilities.
- 2.12.5 The potential re-use and soil conditioning would be explored further, as well as potential options for excavated material disposal and re-use. Methods of transport of the excavated material are all under consideration but may be by road, river or rail. River transport would be by barges which could require new infrastructure in the River Thames

such as a jetty or potentially re-use of an existing jetty and rail transport would require rail siding construction works.

De-watering

- 2.12.6 During construction, control of groundwater at excavations for ramps and cut and cover tunnel sections, would be by temporary drainage (active pumping).
- 2.12.7 The temporary groundwater control measures would be designed to minimise environmental impact and would draw on the following: a hydrogeological assessment of the portals and surrounding area; designing construction to limit volumes of groundwater to be pumped and, where necessary, recharging clean groundwater back into the aquifer to limit drawdown of the water table outside of the development boundary.
- 2.12.8 The TBMs used for construction would be capable of coping with the ground and groundwater pressure without groundwater lowering and prevent water ingress. Permeation grouting, and/or similar ground improvement measures could be implemented for the construction of the cross passages and sumps to control water ingress, however, this would be dependent on the ground conditions at each point.

Third Party Asset Protection

- 2.12.9 During tunnel construction, settlement of the ground above the tunnel would occur due to the ground movement around the excavation at the TBM face.
- 2.12.10 Although the chosen route minimises the number of structures that could be affected, there are assets located within the settlement area of influence. In order to understand the risk of damage to nearby buildings and utilities, established methods of assessment would be used to assess the need for any mitigation works. This would follow a staged process to identify the extent of the area where settlement may occur due to the proposed works. Structures that may potentially be affected would be analysed using simple engineering models to determine the degree of damage that could reasonably be anticipated, based on consideration of the strains.
- 2.12.11 Detailed analysis of specific buildings or other infrastructure identified as being at risk would be carried out based on the initial analysis. In all cases, condition surveys would need to be undertaken prior to any work taking place, so that any effects of any settlement to buildings can be monitored and addressed as appropriate. This would produce a defects survey, comprising of a record of the existing condition of finishes and structures.
- 2.12.12 Depending on the findings of the assessment process, mitigation measures would be undertaken during construction to protect assets from the effects of ground movement. This could include measures to minimise ground movement from the tunnelling works themselves, based on accepted industry practice for tunnelling. Further measures could include ground treatment around the tunnelling operations to reduce ground movements by improving the engineering response of the

ground. These measures could include various forms of grouting to counteract the settlement or to create stiffer ground to reduce movement. Finally, structural measures requiring modification or strengthening of the asset to better resist or accommodate ground movements could be used.

2.13 Construction Works

- 2.13.1 The estimated overall construction duration is approximately five years, including an advanced works stage which would include mobilisation. A mobilisation period of nine months has been assumed post award of the construction contract. During this period, detailed design would be undertaken as well as utility diversions, fencing, site compounds, and access roads.

Haulage Routes and Construction Traffic Management

- 2.13.2 Access for construction vehicles to the site would be from the trunk road network on designated routes which would be clearly signposted. The division of the Project into two areas by the River Thames would probably dictate that routes to the Thurrock sites would be from the A13 and M25 and routes to the Kent sites would be from the A2.
- 2.13.3 Haul routes within the Project area would be dictated by the balance of cut and fill within the site areas. This itself would be dictated by the design of the new roads and the suitability of the materials arising and their suitability for beneficial re-use.
- 2.13.4 The main areas where the construction sites would interface with road users would be at locations where connections to the existing network would be created. In these locations, traffic management would be required to segregate the construction sites from road vehicles.

Construction Compound Locations

- 2.13.5 Three main compounds are currently being considered: one north of the River Thames, one south of the River Thames and one at a tunnel portal. This is where the central management functions will be carried out. The scale of the tunnelling works is such that a separate compound would be required at the portal where the TBMs are launched, equivalent to a main compound.
- 2.13.6 Satellite compounds will be placed along the route to support the three main compounds, these will provide welfare and accommodation, local to key parts of the works.
- 2.13.7 There are many factors which would contribute to the selection of both the main and to a lesser extent the satellite compounds:
- Immediate access to the trunk road network, M25 and/or A13 on the north side and A2 on the south side to enable ready access for site personnel and deliveries without unduly impacting on the local road network;
 - Impact on the local population by locating compounds away from densely populated areas where practicable;

- Efficient and convenient location(s) for vehicle recovery centres, for motorists stranded by accident or vehicle breakdown;
- Efficient and convenient location(s) for traffic management control;
- Provisional landowner approval (where this is deemed appropriate); and
- Reinstatement on completion, e.g. returning land to agricultural use can be quickly achieved.

Key Components of the Construction Compounds

2.13.8 Key components of the construction compounds would include:

- Administration and management offices;
- Welfare and staff accommodation facilities;
- Trunk road CCTV 24hr control facility;
- Rapid vehicle recovery 24hr facility (excluding tunnel compound);
- Staff and vehicle parking;
- Plant and equipment storage;
- Materials handling and production facilities;
- Concrete batching plant (if required);
- Waste recovery and management centre; and
- Topsoil storage, potentially in bunds around compound sites.

2.14 Demolition And Land Take

- 2.14.1 The Project would be developed to minimise the land required temporarily for construction. The right to compensation and methods / procedures for assessing appropriate levels of such, would be undertaken in accordance with the Compensation Code. Where appropriate, consultation with landowners, occupiers and agents would continue as the Project develops to manage and reduce impact on property owners as far as practicably possible.
- 2.14.2 The demolition requirements of the Project at present are outlined below. These are likely to change as the Project design evolves and every effort would be made to minimise impacts on properties, subject to other constraints, but these figures are representative of the scale of demolition likely to be required.
- 2.14.3 South of the River Thames there are 12 residential properties within the development boundary and 4 commercial properties would be affected. Most of the properties which may be affected are located at the proposed junction with the A2.
- 2.14.4 North of the River Thames there are 64 properties within the development boundary and 4 commercial properties would be affected. A large proportion of these properties would be acquired for the construction of the junction at the A13.

- 2.14.5 Along the route there is a large amount of agricultural land that would be affected and north of the River Thames the route would directly affect an area of Open Access Land, at Orsett Fen.
- 2.14.6 Not all of the properties within the development boundary would need to be acquired to construct the road, it is too early to say which properties would need to be demolished.

2.15 Services And Utility Diversions

- 2.15.1 The route would require a number of overhead high voltage electricity cables to be diverted both north and south of the River Thames. In addition, there are large gas mains (including those connecting to the National Grid pipeline in tunnel under the River Thames) and water mains that could require diversion or protection.
- 2.15.2 In addition to these, there could be smaller telecommunication cables, low voltage electricity cables, low pressure gas mains, small water mains and other utilities that may require diversion or protection works.
- 2.15.3 The full extents of diversions and mitigation measures would be determined as the Project development progresses and following discussions with the affected utility companies.

2.16 Contaminated Land

- 2.16.1 North of the River Thames, the route would pass through a known area of historic landfill, which could contain a range of contaminants at the location of the tunnel north portal.
- 2.16.2 Measures that would be explored for the Project in areas of contaminated land would include the selection of appropriate foundation techniques, as well as management of excavated materials, following the waste hierarchy to minimise the impact of contamination.
- 2.16.3 The specific engineering solutions that may be adopted for remediation where it is identified to be required would be dependent on the nature and distribution of contaminants identified from the investigation and monitoring. This may include encapsulation and/or treatment of contamination in situ or the isolation of works from sources or receptors to contamination. In all cases, the remediation would be designed to meet an appropriate standard in accordance with the relevant legislation.

2.17 Waste Management

- 2.17.1 The Project aim would be to minimise the volume of waste generated by applying the waste hierarchy (reduce - reuse – recycle - responsible disposal).
- 2.17.2 The Project will identify all wastes that are likely to be produced, the quantities likely to be generated and set out the approach for the control and sustainable management of excavated materials and waste from the construction, operation and maintenance of the Project.
- 2.17.3 Any waste disposal would be carried out in accordance with the *Waste (England and Wales) Regulations 2011 and Waste Management: The*

Duty of Care – A Code of Practice (1990) or in accordance with subsequent guidance.

- 2.17.4 Provision would be made for the correct storage and disposal of hazardous wastes as defined by and in accordance with the Hazardous Waste (England and Wales) Regulations 2005 and amendments.

Tunnel Arisings

- 2.17.5 Construction of the tunnel would produce a significant quantity of material arisings. Management of that material on-site would include on site treatment to facilitate transportation and potential re-use. Opportunities for re-use would be investigated in consultation with the Environment Agency to minimise the amount that requires disposal.
- 2.17.6 The opportunity to transport material by rail or water to reduce the number of construction movements by road will be considered. If transport by water was found to be practicable then this may require either the construction of a new jetty, or the modification of an existing jetty located on the River Thames. The nearest rail facilities to the tunnel are the Tilbury Loop in Thurrock and the North Kent Line in Kent. These would be investigated to identify if there is an opportunity to transport material by rail. If this was identified as feasible then new rail head facilities may be required. Haulage routes to the railhead and jetty facilities would be required, as well as large storage areas next to the jetty or rail head facilities.

Highways Construction Arisings

- 2.17.7 Construction of the highway would also require significant excavation of materials to create cuttings. Large amounts of materials would also be required to create embankments, as well as to create noise bunds and similar structures. During the design process, the cut/fill balance would be optimised to minimise the total demand for material exports and imports. However, it is likely that some arisings would also need to be disposed of. These arisings would be managed using the same framework as described above for the tunnel arisings.

2.18 User Charging

- 2.18.1 User charging would be applied for the Lower Thames Crossing, in line with current government policy. Work to assess user charging is ongoing.
- 2.18.2 The user charging proposals would be modelled in the strategic traffic model (see 2.19 below). A charging regime would form the basis of the scenarios adopted for the Project assessed in the ES.

2.19 Traffic Forecasting

- 2.19.1 The Lower Thames Area Model traffic model would be used to assess the strategic demand and assignment impacts of the Project. The Lower Thames Area Model is being developed to replace the older LTC v2 model and is using new travel demand data. The strategic model covers

the whole of the UK but the extent of the detailed network modelled area is shown in Plate 2-1.

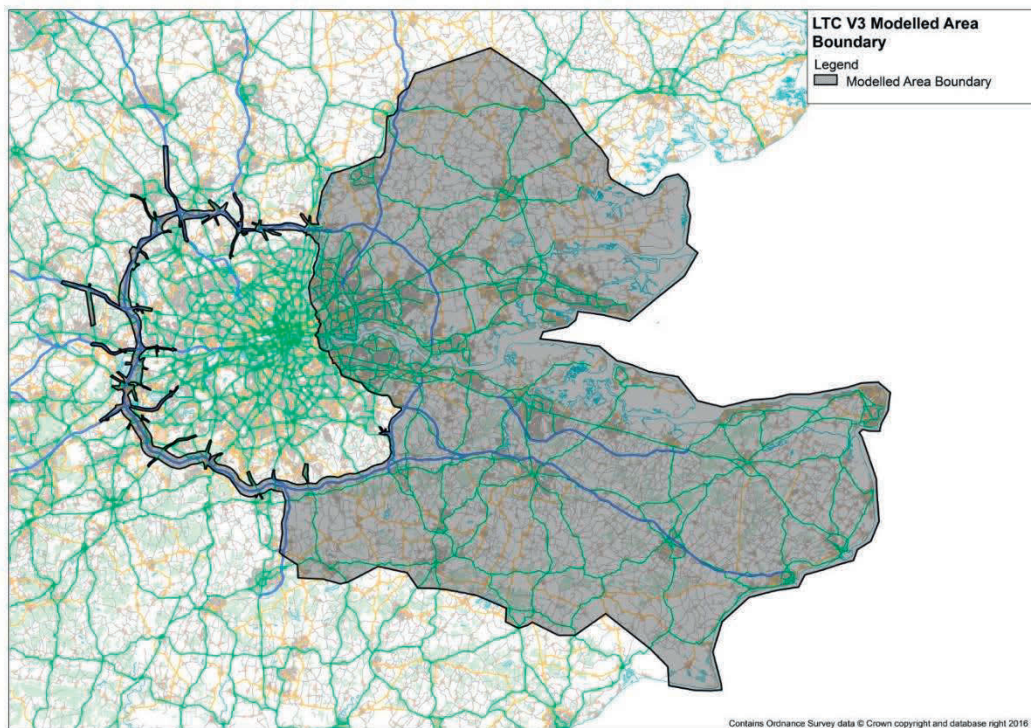


Plate 2-1: Detailed Highway Network Modelled Area In The Lower Thames Area Model

- 2.19.2 The Lower Thames Area Model validation base year is 2016. For the purposes of modelling, the following forecast years have been used:
- Opening year of 2026;
 - Intermediate year of 2031;
 - Design life year of 2041; and
 - Horizon year of 2051.
- 2.19.3 Future year traffic flows would be extracted from the model for the purposes of the different environmental assessment topics, for example, Air Quality, Noise and Vibration.
- 2.19.4 Whilst the scenarios to be modelled and then assessed in the ES would be discussed and agreed with consultees, it is currently anticipated that the traffic forecasting would be carried out for the following scenarios:
- 2016 Base model validation year (reflecting the existing situation);
 - 2026 (Opening Year) Without Project (but including any committed schemes that would open between 2016 and 2026);
 - 2026 (Opening Year) – With Project (and committed schemes that would open between 2016 and 2026);
 - 2031 (Intermediate Year) Without Project (but including any committed schemes that would open between 2016 and 2031);

- 2031 (Intermediate Year) – With Project (and committed schemes that would open between 2016 and 2031);
- 2041 (Design Life Year) Without Project (but including any committed schemes that would open between 2016 and 2041);
- 2041 (Design Life Year) – With Project (and committed schemes that would open between 2016 and 2041);
- 2051 (Horizon Year) Without Project (but including any committed schemes that would open between 2016 and 2051); and
- 2051 (Horizon Year) – With Project (and committed schemes that would open between 2016 and 2051).

2.19.5 Any environmental data required for years other than the specific modelled years would be derived via interpolation or extrapolation of the modelled years. If there are changes to the Project programme (for example a change in opening year), the modelled years would be modified accordingly.

2.19.6 Population and employment forecasts included within the models would reflect the latest National Trip End Forecasts (NTEM) and trips from local developments. Local developments would be categorised in the Uncertainty Log as either near certain, more than likely, reasonably foreseeable or hypothetical. The near certain and more than likely would provide the basis for the central (Core) forecasting work. Sensitivity tests would be conducted which reflect Low growth and High growth scenarios, incorporating different combinations of the possible future developments.

2.20 Environmental Design

2.20.1 The Highways England Licence (2015) sets out the Secretary of State's statutory directions and guidance to Highways England. It sets out what is expected of Highways England and how they must behave when discharging their duties delivering the vision and plans for the network, set out in the Road Investment Strategy 2015/16 – 2019/20 (Department For Transport, 2015).

2.20.2 Section 4.2g of the licence states that Highways England when exercising its functions and complying with its legal duties must act in a manner which it considers best calculated to: *“Minimise the environmental impacts of operating, maintaining and improving its network and seek to protect and enhance the quality of the surrounding environment”*. This requirement is further outlined in Section 5.23 of the licence.

2.20.3 Ensuring effective design which is informed by the EIA process is therefore essential. This project design is an iterative process which will take into consideration the key significant effects on environmental receptors and the mitigation proposed.

2.20.4 DMRB suggests design measures, which can be incorporated within highways design where appropriate, to mitigate impacts arising from

highways development. Dependent on the nature of the impact, the environmental design measures will address effects on different environmental receptors. Examples of these possible measures are detailed further through the relevant sections in Chapters 6-15 of this EIA Scoping Report.

2.21 The Rochdale Envelope

- 2.21.1 PINS Advice Note 9: Using the 'Rochdale Envelope' provides guidance regarding the degree of flexibility that may be considered appropriate within an application for development consent under the Planning Act 2008. The advice note acknowledges that there may be parameters of a Scheme's design that are not yet fixed and, therefore, it may be necessary for the ES to assess likely worst-case variations to ensure that the likely significant environmental effects of the Project have been assessed. This approach reflects the need for the project design to evolve over time following the established principle set out in the case of *R v Rochdale Metropolitan Borough Council ex p Milne (2000)* and *R v Rochdale Metropolitan Borough Council ex p Tew (1999)*.
- 2.21.2 Within this EIA Scoping Report, the early concept design for the Project is presented. The Project is to be developed further through the reference design and this would form the basis for the DCO application. Therefore, when presenting the Project design in the ES and the accompanying technical documents, the requirements of Advice Note 9 would be reflected. This would ensure that the likely significant effects of the Project are assessed. Furthermore, the reference design would be informed by the EIA with the design reflecting iterative working between the designers and the environmental specialists.

3 The Reasonable Alternatives Considered

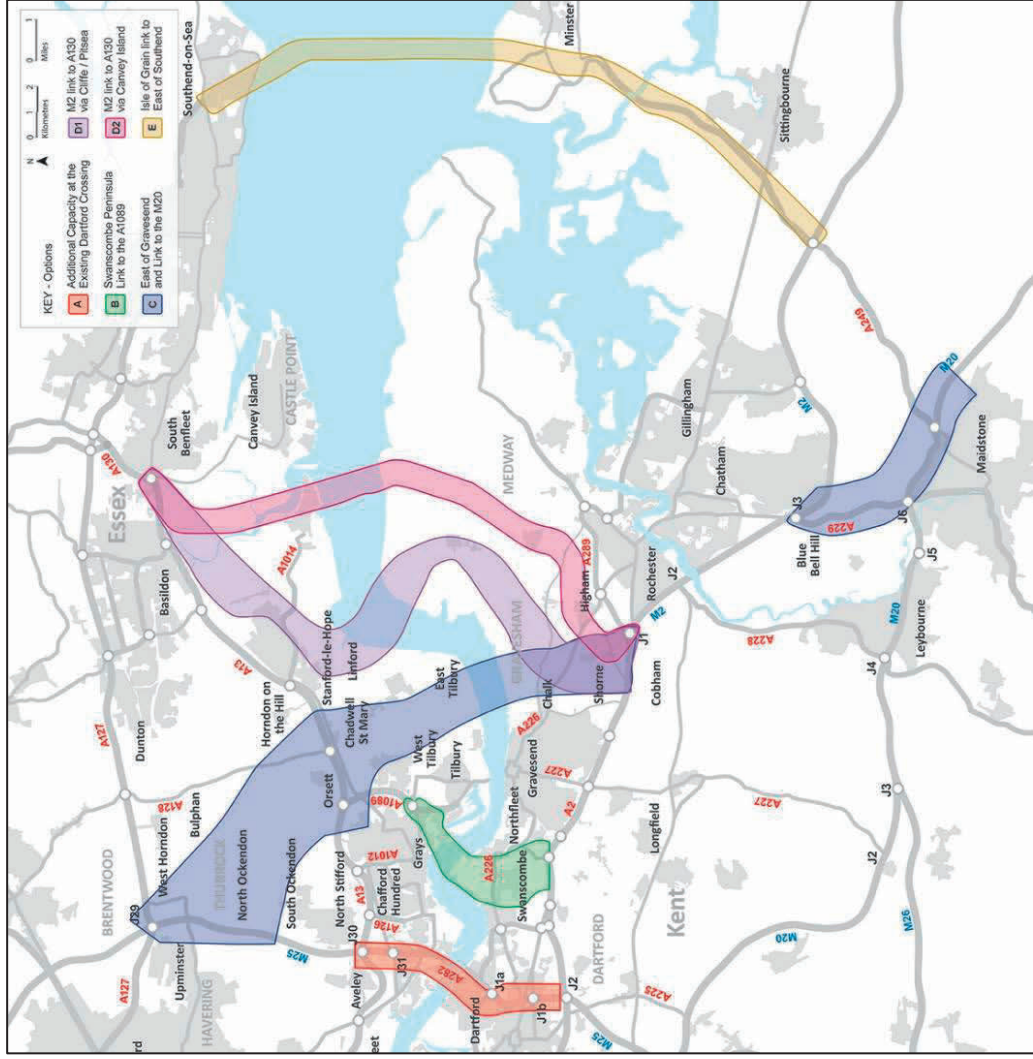
3.1 Introduction

3.1.1 This chapter outlines the reasonable alternatives that have been considered during the development of the Project. The section provides details of:

- The Department for Transport (DfT) studies in 2009 and 2012 that reviewed six potential crossing options and resulted in the selection of crossing options A and C being taken forward for further consideration.
- An overview of the option identification and selection process for Locations A and C that commenced in 2014 and the main reasons that resulted in the selection of the preferred route and the subsequent design development update that is the subject of this EIA Scoping Report.

Table 3-1: Six Options Investigated In The 2009 Dft Study

Six options were investigated as part of a 2009 Department for Transport (DfT) study into ways to address capacity constraints at the Dartford-Thurrock River Crossing.



- **A** – Additional capacity at the existing Dartford Crossing;
- **B** – Swanscombe Peninsula Link to the A1089;
- **C** – East of Gravesend and Link to the M20;
- **D1** – M2 Link to Canvey Island;
- **D2** – M2 Link to Canvey Island; and
- **E** – Isle of Grain Link to East of Southend.

Outcome of Options 2009 DfT Options Study (A-D)

The study concluded that three options (**A**, **B** and **C**) offered the greatest benefits in terms of relieving congestion at the existing crossing and should be assessed further.

Options **D** and **E** were discounted for the following reasons:

- Option **D** - The option would not meet the traffic objective to relieve congestion at the existing Dartford Crossing and provide free flowing north-south capacity. It would have poor to low value for money, limited safety benefits, and have significant environmental impacts including on SSSI. It would also require substantial areas of flood compensation.
- Option **E** - The option would provide very limited relief to the existing Dartford Crossing and would have poor to low value for money. There would be potential direct and indirect effects on a number of international and nationally important nature conservation sites including: Medway Estuary and Marshes Ramsar site and SSSI, Swale Ramsar site and SSSI, Foulness (Mid-Essex Coast Phase 5) Ramsar site and Special Protection Area (SPA) and the Foulness SSSI and the Essex Estuary Special Area of Conservation (SAC).

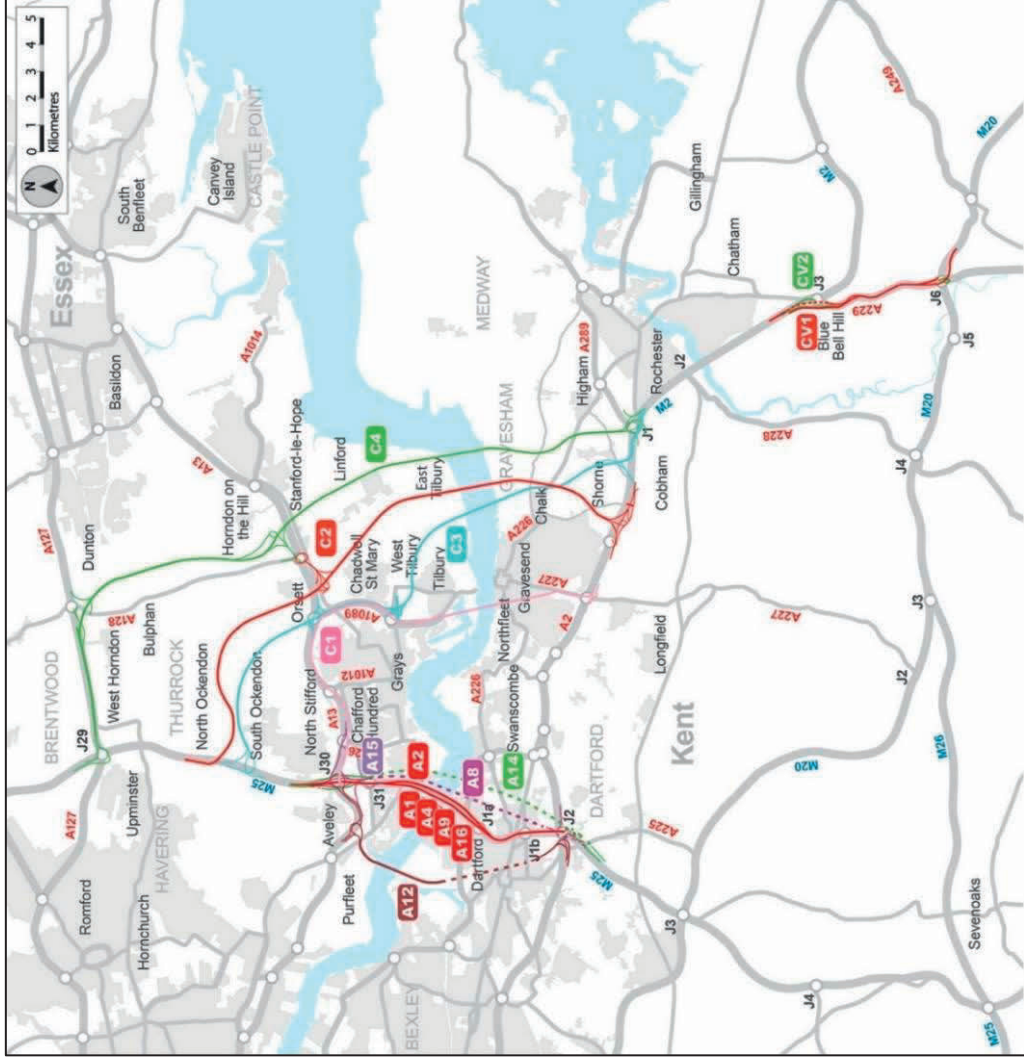
Outcome of Further Study by DfT in 2012 to investigate the three remaining location options (A, B and C) including C Variant.

The Secretary of State announced in December 2013 that Option B had the weakest case of the three locations and that the option should be discarded. Option B would jeopardise major redevelopment of the Swanscombe Peninsula and this option received limited support in the 2013 public consultation. The option covered a well-established urban area that would cause severance to the local community.

In 2014, the Government published its response to the 2013 consultation, confirming the need for an additional crossing between Kent and Essex. The response acknowledged that there was no preference at that stage on location, and that further work would be carried out to develop and appraise route options for both Location **A** and Location **C**, with or without **C Variant**. DfT then instructed Highways England to identify and appraise route options at Locations **A** and **C**.

Table 3-2: Option Identification And Selection Process For Locations A And C

The extent of the Study Area was determined ensuring that all possible options within Locations **A** and **C** were identified, whilst not encroaching within locations that had been eliminated in previous DfT studies, i.e. Locations **B**, **D** and **E**.

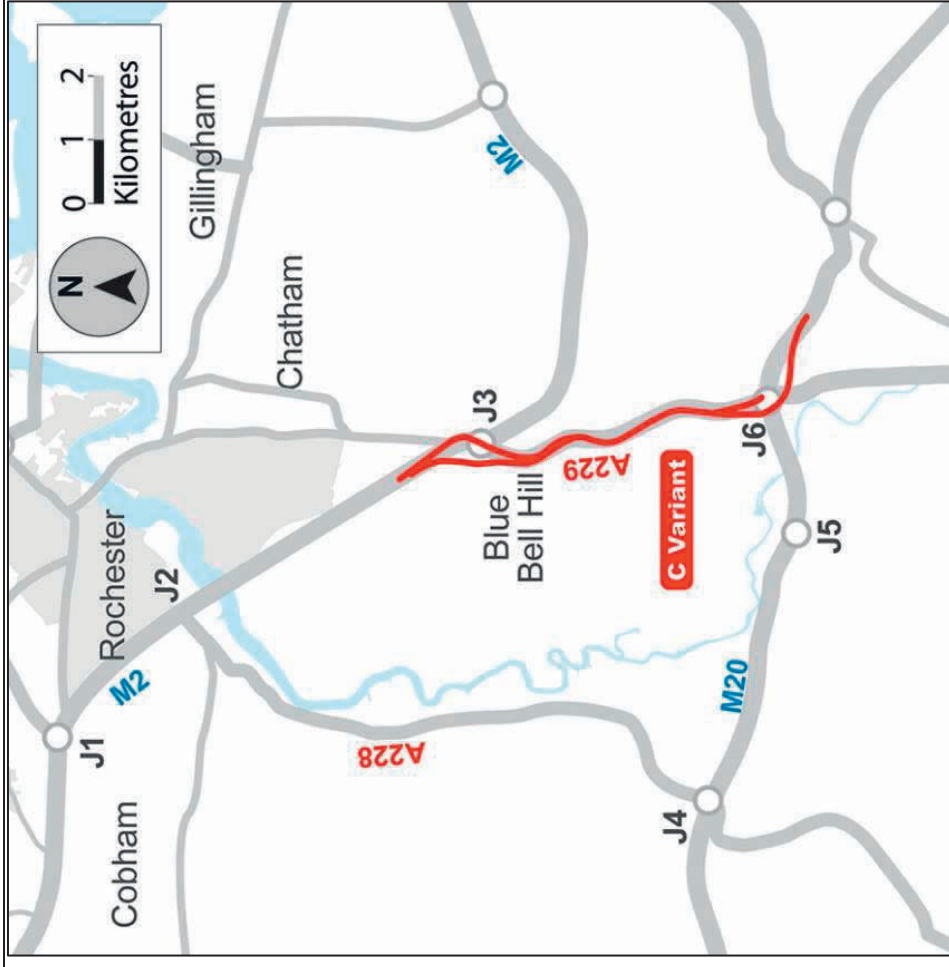


The longest comprised nine options at Location **A**, four at Location **C** and two for **C Variant**.

Routes Not Selected for Shortlist (Options Rejected from Longlist)	
Three route options and the section of Route Option C3 south of the River Thames connecting to the A2 were not considered viable. This also resulted in combination options C11 to C14 being rejected.	
Options Rejected	Reasons
A12 - Western Route Junction 2 to Junction 30 tunnel under Dartford with bridge over river	Costs. Poor economic benefits. Significant impact on planned development at Purfleet. Potential impact on a environmental designations.
A14 - Long tunnel south of J2 to north of J 30	Costs. Poor economic benefits,
A8 - Long tunnel Junction 2 to Junction 30	Costs. Significant impact on existing property.
C3 (Connection to A2)	Impact on an environmental designations.
A9 - Immersed tube west	High technical risks. Impact on current/planned infrastructure. Construction disruption.
A2 - Bridge east	Low value for money. Impact on commercial property. Impact on current/planned infrastructure. Impact on environmental designations.
A15 – Alternative Junction 30 improvement	Impact on current/planned infrastructure. High voltage cable diversions.
C1 – A2 Long tunnel under Gravesend and Tilbury docks. Widening of A13.	Low value for money. Poor resilience. Impacts impact on current/planned infrastructure.
C4 – Long tunnel, north west of East Tilbury then parallel to A128 and along A127 to Junction 29	High cost. Impact on environmental designations.
C Variant with A or C Option	Impact on environmental designations. Limitation in economic benefits.
A16 – Any C option combined with a two lane northbound tunnel at Dartford	Reduces value for money. Limited additional economic benefits.
As a result of Options C1 and C4 not being included in the shortlist combination options C7 , C15 , C16 , C17 and C18 were not selected as they included parts of these main options. As Option C2 was included in the shortlist the other combination options based on this option (C8 and C10) were not specifically ruled out. This is because they were sufficiently closely related to both Option C2 and Option C3 to provide potential future developments of these two route options.	

Table 3-3: C Variant

C Variant would be an online widening of the A229, including significant junction improvements at M2 Junction 3 and M20 Junction 6, as shown in Plate 3-8. It could be combined with any **C** option but was appraised in combination with Option **C2** with a bored tunnel crossing.



Location C

Overall, **C Variant** does not help to transfer traffic from the existing Dartford Crossing on to the new route at Location **C**, and has substantial impacts on the Kent Downs AONB;

Location A

Whilst **C Variant** was primarily intended to be combined with an option at Location **C** it would also be possible to combine it with an option at Location **A**.

A high-level appraisal of **C Variant** combined with Option A1 or A4 was carried out and this showed that it would provide no additional benefit compared to the **A** option without **C Variant**.

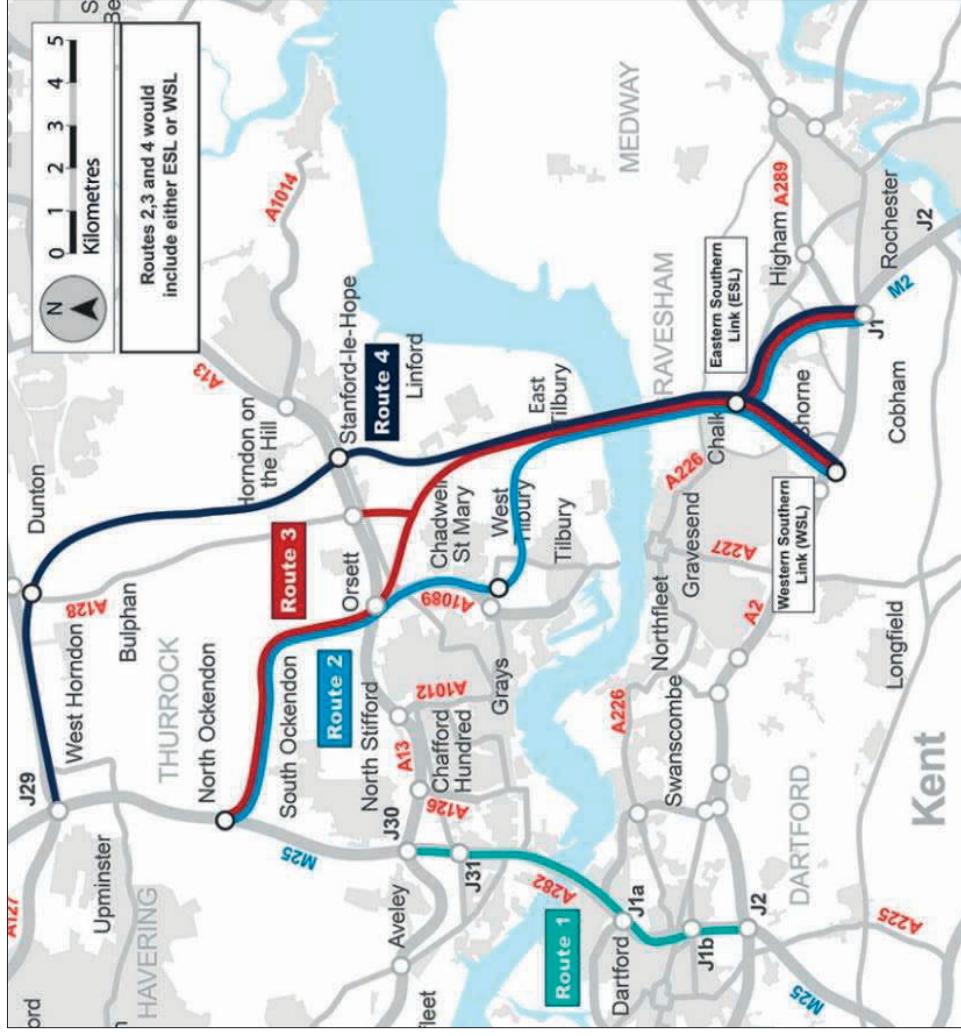
This option would have a high additional cost of £450m compared to Option **A1** or **A4**.

As a result, **C Variant** combined with an option at Location **A** was not selected for the shortlist.

As a result, **C Variant** was not selected for the shortlist as it does not materially add value to the Lower Thames Crossing scheme.

Table 3-4: Shortlist Routes

There were four principal shortlist routes, one at Location **A (1)** and three at Location **C (2,3,4)**. Each of these routes had several possible alternatives or sub-options. There were 3 crossing types **Bridge (BR)** (all routes); **Bored tunnel (BT)** (all routes); and **Immersed Tunnel (IT)** (Routes 2, 3 and 4). There were also two possible junctions with the A2/ M2 Western Southern Link (**WSL**); and Eastern Southern Link (**ESL**).



Routes Not Considered Viable
 Route 1 (**BR**)
 Route 1 (**BT**)

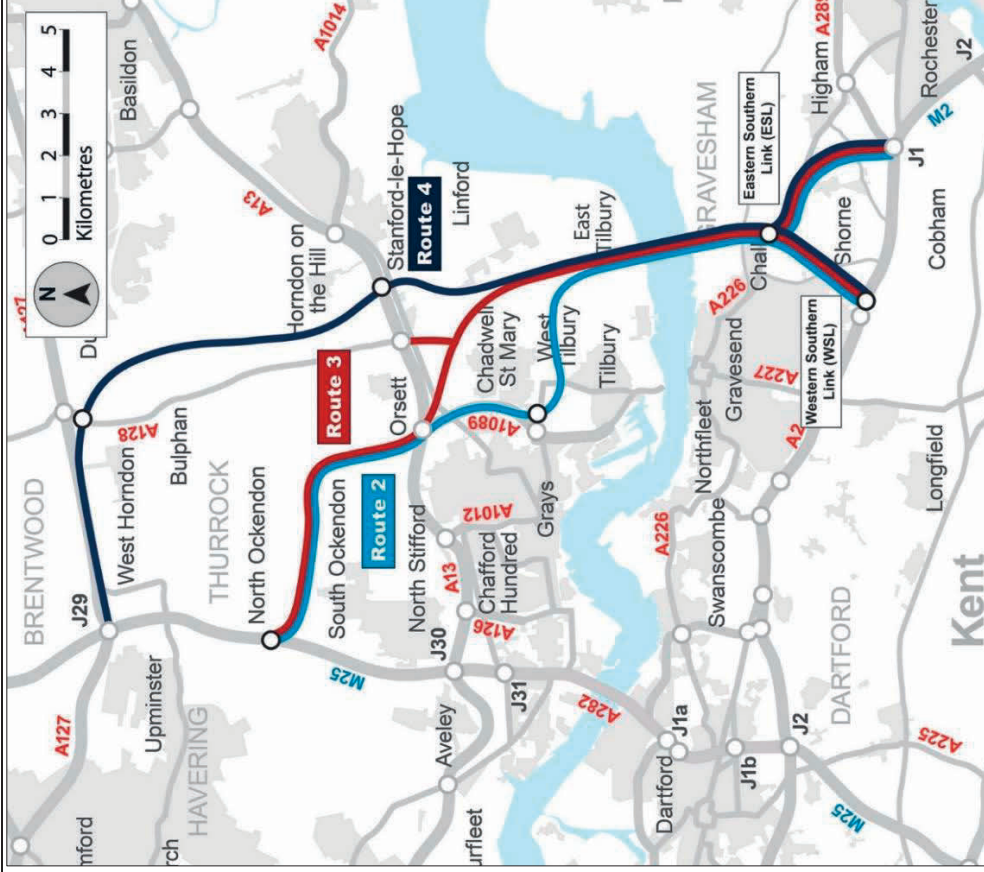
Performs poorly against the Project objectives and traffic related scheme objectives. Does not provide alternative route. Would take at least six years to construct with significant delay and disruption. Completed Project would still be subject to 50mph speed limit. Offers lower value for money than Location **C** options.

Route 2 WSL (**BR**),
 Route 2 WSL (**IT**),
 Route 2 ESL (**BR**),
 Route 2 ESL (**IT**),
 Route 3 WSL (**BR**),
 Route 3 WSL (**IT**),
 Route 3 ESL (**BR**),
 Route 3 ESL (**IT**),
 Route 4 WSL (**BR**),
 Route 4 WSL (**IT**),
 Route 4 ESL (**BR**),
 Route 4 ESL (**IT**)

There would be risk of significant effects to European Sites with both bridge and immersed tube solutions. The bored tunnel was therefore the only viable crossing alternative at Location **C** as it met the Project objectives and is the least environmentally damaging alternative.

Table 3-5: Public Consultation - Proposed Routes

Highways England proposed three routes north of the river and two routes south of the river. These were Routes 2, 3 and 4 each with a bored tunnel river crossing and either the WSL or ESL as shown in Plate 3-10 and set out in Table 3-8.



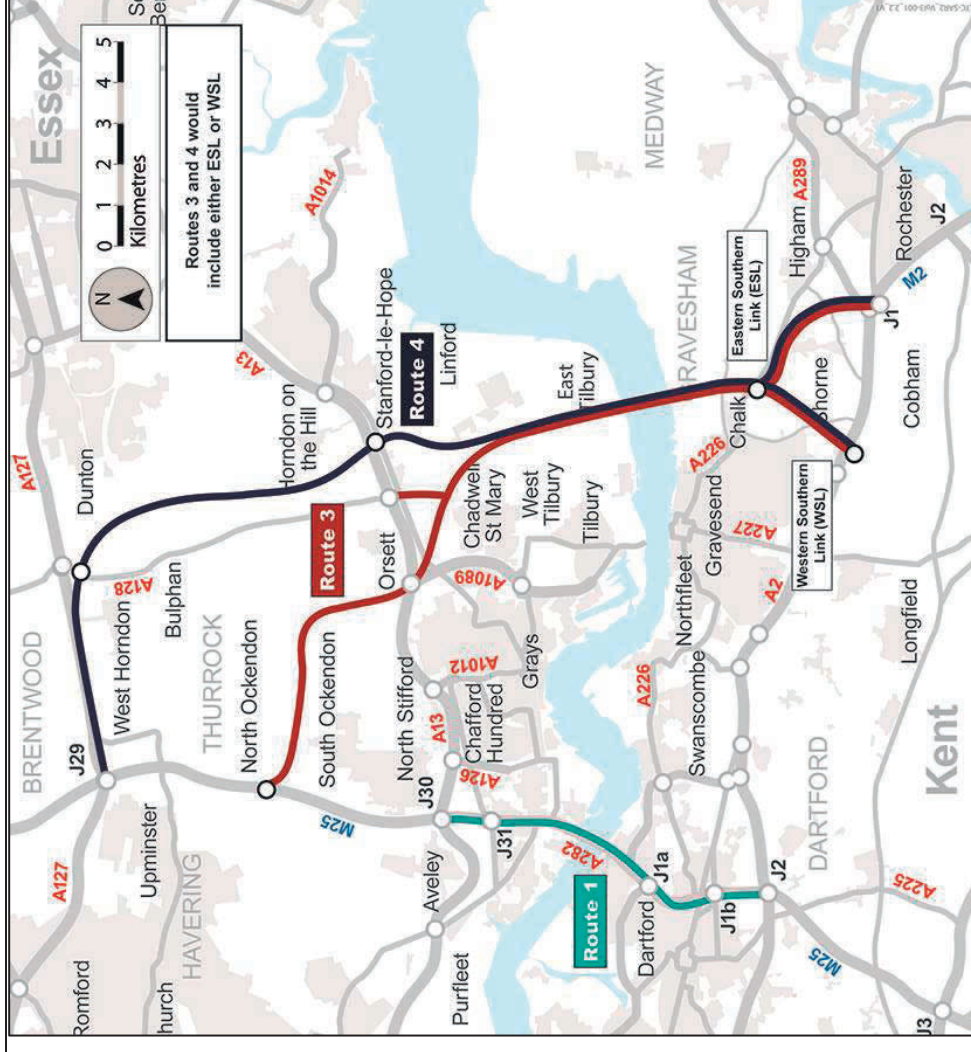
The Highways England proposed scheme for public consultation was **Route 3 with the ESL**. In summary, the proposal was made on the grounds that this option:

- Provided the best economic benefits of all the shortlist routes evaluated;
- Reduced traffic at Dartford and therefore reduced congestion;
- Could be constructed largely off-line avoiding the disruption which would be caused by on-line works at Location A or on the A1089 with Route 2 and A127 with Route 4;
- Provided network resilience through a second independent crossing of the Thames;
- Provided a “motorway-to-motorway” experience for drivers;
- Reduced the air and noise pollution along the existing A282 corridor at Dartford, whilst recognising that there were environmental impacts in the vicinity of the new Project,; and
- Provided a new strategic link to the local, regional and strategic road network, increasing network resilience.

Table 3-6: Selection Of The Routes For Further Appraisal Following Consultation

Following the 2016 public consultation the number of routes subject to further appraisal was reduced taking account of the public consultation responses.	
Fifteen of the shortlist alternatives were not subject to further appraisal.	
Route and Crossing Type	Reason for not selecting options
Route 1 (BT)	Route
Route 2 WSL (BR)	Route 2 was not included in the Post-Consultation Appraisal for the following reasons:
Route 2 WSL (BT)	Lack of support, Disruption during construction, Safety issues, Environmental concerns, Property impacts, Flooding impacts
Route 2 WSL (IT)	Crossing Type
Route 2 ESL (BR)	The appraisal of the crossing options at Location C concluded that the bored tunnel was the only viable alternative as it met the Project objectives and was the least environmentally damaging alternative.
Route 2 ESL (BT)	The bored tunnel crossing was therefore the option proposed by Highways England in the 2016 consultation for the Location C routes. Taking account of the responses to consultation, that conclusion did not change and so the bridge and immersed tunnel crossing options for Routes 3 and 4 were not selected for post consultation appraisal.
Route 2 ESL (IT)	
Route 3 WSL (BR)	
Route 3 WSL (IT)	
Route 3 ESL (BR)	
Route 3 ESL (IT)	
Route 4 WSL (BR)	
Route 4 WSL (IT)	
Route 4 ESL (BR)	
Route 4 ESL (IT)	

Table 3-7: Post-Consultation Appraisal Routes



The five routes subject to further appraisal were

- Route 1 Bridge;
- Route 3 with **WSL** and Bored Tunnel;
- Route 3 with **ESL** and Bored Tunnel;
- Route 4 with **WSL** and Bored Tunnel; and
- Route 4 with **ESL** and Bored Tunnel.

Reason for Route Selection after further appraisal

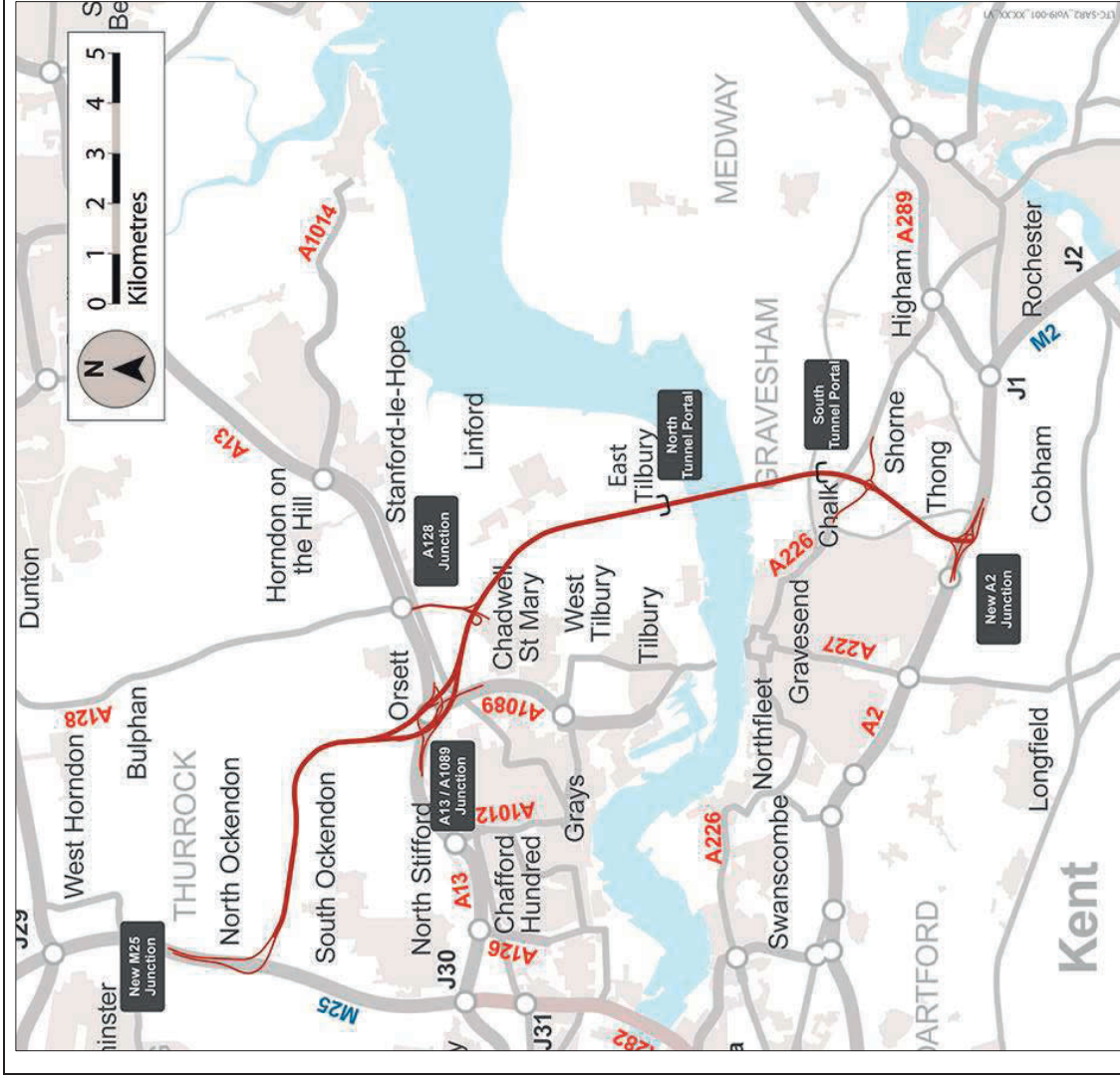
North of the River

Route 3 was selected as it is the shortest route at Location C. Route 3 would best meet the transport objectives of providing free-flowing north-south capacity, improving network resilience and improving road user safety. Route 3 also has the lowest capital cost, and offers the best value for money. It would also have lower overall environmental impacts than Route 4. Route 3 had greater support from the consultation responses, than Route 4.

South of the river

Further work concluded that the **WSL** would best meet the scheme objectives. The **WSL** would achieve the transport objectives and provide a high-quality solution. It would offer high value for money and would fully support wider regeneration and economic objectives, whilst having a materially lower impact than the **ESL** on the environment and local communities.

Table 3-8: The Preferred Route



The Preferred Route was Route 3 north of the River Thames, a future-proofed twin bored tunnel crossing of the river large enough to accommodate a dual three lane carriageway and the **WSL** south of the River Thames.

3.2 Preferred Route To The Design Development Update

3.2.1 Consultation responses have continued to inform design development and assessment. This has led to changes of specific sections of the route. The current alignment is shown in Plate 1-3 in Chapter 1, which presents the Project reported within this Environmental Scoping Report. The changes to alignment include;

M25

3.2.2 New junction design to cross under the M25 to reduce the visual impact. Widening of a section of the M25 to improve traffic flow.

Ockendon

3.2.3 Changed alignment to avoid going across the landfill

Access to the A13 and Tilbury

- A13 and A128

Redesigned the junction with the A13 to reduce congestion. This allows us to remove the A128 junction from the design.

- New junction near Tilbury

A new junction near east Tilbury and link road to Tilbury to improve traffic flow and provide an alternative route for HGVs.

A226 junction

3.2.4 Removal of this junction to reduce the traffic impact on local roads.

A2

3.2.5 New junction design and widening of A2 to M2, junction 1 to reduce congestion and improve traffic flow.

Future proofing

3.2.6 There will be 3 lanes rather than 2 for some or all of the route.

Tunnel portals

3.2.7 Work is ongoing to assess the length of the tunnel and where to locate the entrances.

4 Consultation

4.1 Introduction

4.1.1 This chapter briefly outlines the consultation that has been undertaken to date in relation to the Project's development during the identification and appraisal of options and the consultation that will continue as part of the preparation of the Environmental Statement.

4.2 Approach To Consultation

4.2.1 The Department for Transport held a non-statutory public consultation in 2013, which looked at the need for a new crossing and invited views on locations A (at the existing crossing), B (connecting the A2 and Swanscombe Peninsula with the A1089), C (east of Gravesend) and C Variant (widening of the A229 between the M2 and M20).

4.2.2 The Government published its response to their consultation in July 2014, confirming that there is a need for an additional crossing between Essex and Kent, but that there was no consensus about where it should be. The Government then commissioned Highways England to carry out a more detailed assessment of Locations A and C, with or without C Variant.

4.2.3 As part of this assessment, Highways England undertook a programme of engagement starting in September 2014 to determine constraints and priorities which would affect the identification and development of feasible options for a new Lower Thames Crossing. A planned and focused approach to engagement has been adopted to ensure high quality and meaningful engagement. This provided opportunities for sharing complex and technical information and facilitated relationship building with opportunities for further engagement. Key stakeholders for this purpose were local authorities, statutory and environmental bodies, statutory undertakers (utilities) and businesses which might be affected. The project also sought to engage council leaders and MPs in directly affected and neighbouring areas.

4.2.4 Highways England held a non-statutory consultation from 26 January to 24 March 2016. The proposed scheme and those shortlisted routes that performed satisfactorily against the scheme objectives and were considered viable, were presented at the consultation. The consultation also included information on those routes that were not considered viable and the reasons for those conclusions, together with the opportunity to comment on these issues and to propose other solutions.

4.2.5 The consultation aimed to inform as many people as possible about the scheme and obtain feedback on the proposals, and to identify any new and relevant information that should be taken into account in the decision-making process. Highways England then conducted further assessment of the route options, taking account of consultation responses, to inform the preferred route recommendation that was made to the Secretary of State for Transport.

- 4.2.6 The 2016 consultation was a non-statutory consultation. In planning and carrying out the consultation Highways England was guided by Government guidance on consultation, best practice and lessons learned from other major consultations, and the principles for a lawful consultation that have been established by the courts.
- 4.2.7 The consultation was widely publicised and a variety of material was made available, digitally and in hard copy form, to ensure the public had access to the information needed to consider the options presented and respond to the consultation accordingly. Highways England also held a total of 24 public information events in 20 locations in the Lower Thames area during the consultation period.
- 4.2.8 The consultation generated more than 47,034 responses, the largest ever for a UK road project. Responses were received from across the UK, with the largest proportion from south Essex, north Kent and the London boroughs. The vast majority of responses were received from individual members of the public; 523 responses were received on behalf of organisations and groups; 13,284 responses were received from 14 separate campaigns and three petitions were submitted. More than 33,000 people provided responses using the questionnaire.
- 4.2.9 Highways England appointed Ipsos MORI, an independent research and analysis organisation, to undertake analysis of responses and to prepare an independent report of their findings. As part of their independent assurance, the consultation questionnaire was reviewed by Ipsos MORI to ensure questions were impartial and not leading.
- 4.2.10 The consultation responses were taken into account in making a recommendation to Government about the choice of a Preferred Route to be taken forward to the next stage of development. Many of the comments received continue to help inform detailed design refinements as the scheme is developed in more detail.
- 4.2.11 The comprehensive programme of stakeholder engagement will continue through the lifetime of the Project. The scheme will be subject to a statutory consultation, which is planned for 2018, before the design is further developed and an application for development consent is made. Highways England will prepare a number of documents and plans showing the nature and location of the proposed scheme to inform the statutory consultation. This will include the Preliminary Environmental Information Report (PEIR) and the non-technical summary of the PEIR.

5 Environmental Impact Assessment Method

5.1 Introduction

5.1.1 This chapter outlines the purpose and main stages of the EIA process, explains the methodology that will be followed for the EIA for this Project, outlines how cumulative effects will be assessed and briefly introduces the process of Habitats Regulations Assessment (HRA) that will also need to be undertaken for this Project. The focus of the EIA methodology is ensuring a robust and proportionate approach.

5.2 The EIA Process

5.2.1 The aim of EIA is to protect the environment by ensuring that the decision maker, when deciding whether to grant permission for a project, which is likely to have significant effects on the environment, does so in the full knowledge of the likely significant effects, and takes this into account in the decision-making process. In general terms, the main stages of the EIA are as follows:

- Data Review - draw together and review available data;
- Scoping - identify significant issues and determine the subject matter of the EIA;
- Methodology – define methodologies using topic specific guidance and best practice techniques;
- Baseline Surveys – collate baseline data, undertake baseline surveys and monitoring to confirm the existing conditions;
- Consultation - seek feedback from consultees and the public in relation to key environmental issues, methodology adopted and design approaches;
- Assessment and iteration - assess likely effects of the Project, evaluate alternatives, provide feedback to design team on adverse impacts, incorporate mitigation, assess effects of mitigated development; and
- Preparation of the ES and the Non-Technical Summary.

5.2.2 Additionally, during the EIA process opportunities to deliver enhancements will be explored in consultation with appropriate stakeholders

5.2.3 To ensure the completeness and quality of ESs, the EIA Regulations (2017) require projects to outline that they have been prepared by a competent expert(s). This information would be provided within the ES for the Scheme.

5.2.4 Between production of this EIA Scoping Report and the submission of the ES with the DCO application, the PEIR will be produced. This is required for the statutory consultation and PINS Advice Note 7

Preliminary Environmental Information, Screening and Scoping (March, 2015) states:

- 5.2.5 *“The PEI is not expected to replicate or be a draft of the ES. However, if the applicant considers this to be appropriate (and more cost-effective) it can be presented in this way. A good PEI document is one that enables consultees (both specialist and non-specialist) to understand the likely environmental effects of the proposed development and helps to inform their consultation responses on the proposed development”.*

5.3 The EIA Regulatory Context

- 5.3.1 The legal basis for EIA is formed within the European Community Directive 85/337/EEC which sets out the requirements for the preparation of an EIA for certain types of projects where they are likely to have significant effects on the environment. The original 1985 Directive has been subsequently amended twice and those amendments were codified in Directive 2011/92/EU in December 2011. This has been further amended by Directive 2014/52/EU. This forms the EIA regime in Europe and is transposed into UK law for NSIPs in the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the 2017 EIA Regulations).

5.4 The Planning Act

- 5.4.1 Part 3 of the Planning Act 2008 and the subsequent amendments to section 22 of the Planning Act 2008 contained within the Highway and Railway (Nationally Significant Infrastructure Project) Order 2013, state a project qualifies as an NSIP if it consists of highway-related development. Highway-related development under this category needs to meet one of the following criteria.

- a) ‘construction of a highway in a case within subsection (2),*
- b) improvement of a highway in a case within subsection (3), or*
- c) alteration of a highway in a case within subsection (4).’*

- 5.4.2 Subsection 2 (below) further defines the clauses that enable the Project to meet the above criteria for construction of a highway.

‘(2) Construction of a highway is within this subsection only if the highway will (when constructed) be wholly in England and—

- a) the highway will (when constructed) be wholly in England,*
- b) the Secretary of State will be the highway authority for the highway, and*
- c) the area of development is greater than the relevant limit set out in subsection (4).*

- 5.4.3 Subsection 4 (below) clarifies the limits set out in subsection (2)(c):

(4) For the purposes of subsections (2)(c) and (3)(c) the relevant limit —

- a) in relation to the construction or alteration of a motorway, is 15 hectares,*

- b) in relation to the construction or alteration of a highway, other than a motorway, where the speed limit for any class of vehicle is expected to be 50 miles per hour or greater, is 12.5 hectares, and*
- c) in relation to the construction or alteration of any other highway is 7.5 hectares.'*

5.4.4 As the Project will comply with Subsection (4)(b) it satisfies the criteria to be defined as an NSIP and will be treated as a development for which a DCO is required as part 4 of the Planning Act 2008 enacts via the following:

“Consent under this Act (“development consent”) is required for development to the extent that the development is or forms part of a nationally significant infrastructure project.”

5.4.5 The preparation of an ES is one of the key stages in the EIA process. PINS which is responsible for examining an application for development consent, will use this information in making a recommendation to the Secretary of State about whether or not the Project should be consented. The Secretary of State will also rely upon the ES in coming to a decision on the Application.

5.4.6 In December 2014 the National Road and Rail Networks: NPSNN was published. The NPSNN sets out the policy which will be used by PINS and the Secretary of State (SoS) to make a decision on all major road and rail projects. The Applicant will have regard to this and the preparation of this EIA Scoping Report has been informed by the NPSNN. The NPSNN will also guide the design of the Project.

5.5 Guidance – Design and Assessment

5.5.1 The development of major highways, is governed through guidance and standards set out in 15 volumes of the DMRB.

5.5.2 Environmental design and mitigation guidance is provided within Volume 10 of the DMRB. Volume 11 of the DMRB provides guidance on EIA, including the level of assessment and reporting of environmental effects. Volume 11, Section 1, Part 1 of the DMRB supplemented by Interim Advice Note (IAN) 125/15 Environmental Assessment Update identifies the topics that should be considered when scoping an EIA:

- Air Quality;
- Cultural Heritage;
- Landscape;
- Biodiversity;
- Geology and Soils;
- Materials;
- Noise and Vibration;
- People and Communities;
- Road Drainage and the Water Environment;

- Cumulative Effects.

5.5.3 As per the revised EIA Regulations (2017), the changes in relation to the scoping and assessment are set out below:

- An assessment on climate will be reported in a separate ES chapter - refer to Chapter 15: Climate.
- An assessment on population would be reported as part of the people and communities ES chapter.
- An assessment on human health would be reported in the air quality, noise and vibration, road drainage and the water environment and the people and communities ES chapters.
- The assessment of heat and radiation required under the EIA Regulations 2017 is not relevant to the construction of the Project and therefore has been scoped out. The Project would not introduce any sources of radiation, and would generate limited amounts of heat from minor elements such as lighting.
- Major accidents and disasters will be considered within each topic chapter and will cover the vulnerability of the project to risks of major accidents and/or disasters and consequential changes in the predicted effects of that scheme on environmental topics. The ES will identify 'major' events that are relevant to and could affect the Project including both man-made and naturally occurring events. Where Major events are identified, the ES will describe the potential for any change in the assessed significance of the Project on relevant environmental topics in qualitative terms and report the conclusions of this assessment within the individual environmental topics. Mitigation measures would also be described.
- Provision of a description of, where appropriate, monitoring arrangements for significant effects on the environment. Monitoring would be reported within each topic specific chapter of the ES, where relevant.

5.5.4 The above requirements will be incorporated by Highways England into an updated version of Volume 11 of the DMRB, which will in turn inform the production of the ES if available at the time this is prepared. For example, it is anticipated that effects on human health will be addressed in the People and Communities assessment and that effects reported in other chapters for example, air quality, noise and vibration will be used to inform this assessment.

5.5.5 In addition to the DMRB guidance above, Highways England issues interim advice notes (IANs) when new guidance emerges which is yet to be incorporated in volumes 1-15 of DMRB.

5.5.6 There have been a number of recent updates to the DMRB in the form of IANs, should any IANs or revisions to DMRB be issued between scoping and reporting of the EIA, they will be used where appropriate.

5.5.7 Where DMRB does not provide topic specific guidance, alternative sources of guidance have been proposed for use in the assessments.

More details of the methods to be used for each individual topic are provided in chapters 6 to 15 of this EIA Scoping Report.

- 5.5.8 PINS also produces a series of Advice Notes that are intended to inform appropriate parties about a range of process matters in relation to the Planning Act 2008. These advice notes have been reviewed during preparation of this EIA Scoping Report in particular Advice Note 7: Preliminary Environmental Information, Screening and Scoping.

5.6 Study Areas

- 5.6.1 The study areas for the Project are individually defined for each environmental topic based on the geographical scope of the potential impacts on receptors/resources and the relevant topic specific criteria. The study areas will also rely upon the outcomes of the traffic modelling as some study areas will be defined using changes in traffic flows. The study areas for each topic are further described in Chapters 6 to 15.

5.7 Baseline Data Gathering

- 5.7.1 In order to assess the impacts on environmental receptors that would be caused by the Project, and to identify any potential significant effects, an understanding of the baseline environment without the Project is necessary.
- 5.7.2 To gather a fully comprehensive descriptive summary of the baseline, each individual topic will need to use data gathering methods which are appropriate to the topic and follow any topic specific guidelines. This will involve conducting desk studies, undertaking specialist surveys as appropriate and engaging with stakeholders both to agree those methods of data collection and also to obtain data they hold. The EIA Scoping Opinion will also inform the data gathering and the surveys that need to be undertaken.
- 5.7.3 When describing the baseline environmental conditions, it is important to identify the receptors that may be affected by the Project and also their 'value' and 'sensitivity'.

Future Baseline

- 5.7.4 For each of the environmental topics it is also necessary to project the baseline forwards and consider what changes there may be to the baseline conditions by the time construction of the Project commences. This is referred to as the 'Future Baseline' and is considered in each environmental topic chapter.

5.8 Assessment of Effects

Defining Assessment Years, Scenarios and Phases

- 5.8.1 The assessment of effects involves comparing the situation with and without the Project. Dependent upon the topic, the effects need to be assessed for the Do-Minimum and Do-Something scenarios in the baseline year and a future assessment year or a series of future assessment years (for example 15 years after 2026 which is the year of

opening for the Project, or the worst year in the first 15 years of operation, 2026-2041).

- 5.8.2 The year of construction start (2021) and year of opening (2026) is indicative of the current design proposals but may be refined further during further work.
- 5.8.3 The ES will assess the construction and operational effects of the Project. The construction of the Project is expected to last 6 years and this duration will be considered in the assessment. The highway element of the Project will have a maximum design life of 40 years and the tunnel a design life of 120 years.
- 5.8.4 Decommissioning of temporary construction elements of the Project (for example temporary jetties that may be constructed) is proposed to be considered as part of the assessment of construction effects.
- 5.8.5 The Project will be designed to maximise the scope for materials re-use in the event of decommissioning of its components, however due to the long design life of the Project (40 years for new carriageway construction and 120 years for a tunnel), it is not considered appropriate for decommissioning to form part of each environmental topic assessment.
- 5.8.6 The Materials chapter, which is scoped in Chapter 14 of this EIA Scoping Report, will however set to address how the construction and use of materials incorporated within the design will consider the potential for re-use.

Identifying Potential Impacts

- 5.8.7 A description of the likely significant environmental effects of the Project including the existence of the development, the use of natural resources and the emission of pollutants, the creation of nuisances and the elimination of waste, is required under Schedule 4 of the EIA regulations.
- 5.8.8 The effects may be negative or positive and can be described as:
- Direct or Primary Impacts: caused by activities which are an integral part of the Project resulting in a change in environmental conditions, for example loss of a hedgerow;
 - Indirect or Secondary Impacts: due to activities that affect an environmental condition or receptor, which in turn affects other aspects of the environment or receptors, for example settlement of a feature as a result of dewatering during construction;
 - Cumulative: comprising multiple effects from different sources within the Project, or in combination with other developments, on the same receptors;
 - Residual: effects that remain after the positive influence of mitigation measures are taken into account; or
 - Temporary: effects that would last for a limited duration, for example a closure of a footpath during part of the construction phase.
 - Transboundary: effects are considered in relation to the effects that the activities of one EEA state may have on the environment or

interests of another (please refer to Chapter 18: Transboundary Screening).

Assessing Significance

5.8.9 The advice note; DMRB HA 205/08 Assessment and Management of Environmental Effects, defines the criteria for assigning the significance of the potential environmental effect as a function of the ‘value’ of the receptor and the ‘magnitude’ or ‘scale’ of the impact. This is shown below by Table 5.1.

Table 5-1: Typical Matrix For The Assessment Of Significance Of Effects

Sensitivity / Value	Magnitude of Impact				
	No Change	Negligible	Minor	Moderate	Major
Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Large or Very Large
High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
Medium	Neutral	Neutral or Slight	Slight	Slight or Moderate	Moderate or Large
Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

5.8.10 In arriving at the significance of effect, the assessor will also consider whether the effect is positive or negative, permanent or temporary, direct, indirect, secondary, cumulative, short, medium or long-term as set out in paragraph 5.7.5.

5.8.11 This is the broad approach used when assessing significance of effects however for certain topics such as air quality and noise, the above criteria or approach is not used. Instead environmental impacts can be quantified against thresholds defined using numerical values to identify impacts. This quantification is done through calculations or computer modelling.

5.8.12 Although as a minimum, all impacts are defined according to the following broad descriptors:

- Adverse or beneficial (i.e. they are undesirable effects, or they represent an improvement over the baseline situation);
- Short-term or long-term (This is defined differently dependent on the topic it refers to and the sensitivity of the receptors);
- Construction or operational (i.e. caused by the construction of the Project, or by the operation of the Project after opening); and

- Significant or not significant.

5.8.13 The identification of the significance of the effect will differ between topics, with regards to scales, terminology, criteria and the overall approach. Volume 11 of DMRB provides information on determining this, however the specific significance criteria and methods proposed for each topic within the scope of this Project are explained further in chapters 6 to 15.

5.8.14 In addition to the above assessment process, the EIA Regulations require an assessment of what effects would be considered 'significant'. This assessment will be based on professional judgement, and the reasoning behind such assessment will be clearly outlined in the ES.

5.9 Mitigation Measures, Enhancements, Residual Effects And Monitoring

5.9.1 Mitigation of adverse environmental effects will be an iterative part of the Project development following the hierarchy below:

- Avoidance – incorporate measures to avoid the effect, for example, alternative design options or modifying the Project programme to avoid environmentally sensitive periods.
- Reduction – incorporate measures to lessen the effect, for example, fencing off sensitive areas during construction, use of a Construction Environmental Management Plan (CEMP).
- Compensation and/or Remediation – where it is not possible to avoid or reduce a significant effect then offsetting measures should be considered, for example the provision of replacement of habitat to replace that lost to the Project.

5.9.2 There may be a requirement for a range of mitigation measures and as the Project develops they will be discussed with statutory consultees and third parties. Only those mitigation measures that are either a firm commitment or likely to be delivered will be considered in the assessment.

5.9.3 There may also be scope for enhancement measures to be delivered through the Project that may not be targeted at a specific adverse environmental impact. These should be identified as beneficial impacts of the Project.

5.9.4 Impacts that remain after mitigation are referred to as residual impacts. The assessment of the significance of the residual effects after mitigation is therefore the key outcome of the EIA.

5.9.5 A monitoring strategy will be contained in the ES and there will be clear objectives outlined for those significant environmental effects that remain following mitigation.

5.10 Assessment Of Cumulative Effects

5.10.1 The assessment of cumulative effects will identify where two or more sources of impact interact, to give rise to impacts on environmental

resources or receptors. There are two types of cumulative effects which are assessed:

- The combined action of interrelated Project specific environmental effects causing impacts on a single resource/receptor.
- The combined action of the Project and other planned developments environmental effects in combination on a single resource/receptor.

5.10.2 The approach to assessing cumulative effects is based upon the Cumulative Effects Assessment (CEA) PINS Advice Note 17. This sets out a staged process for CEA in NSIPs. The scope of the approach and how it will be applied to this Project is provided in Chapter 16.

5.11 Equalities Impact Assessment

- 5.11.1 In England and Wales, the Equality Act 2010 places a duty on the applicant to ensure that equality is considered as part of their service delivery. This means there are duties to ensure the Strategic Road Network (SRN) is accessible, and that economic and social opportunities are maximised for all users.
- 5.11.2 The Equality, Diversity and Inclusion sifting Tool, (EDIT) is a tool that has been used to help the Applicant's project teams make an informed decision about the extent to which equality, diversity and inclusion (EDI) are relevant to the Project.
- 5.11.3 In August 2016, a Stage 1: Initial sift, was undertaken which used high level project knowledge and a series of specially designed EDI 'hotspot' maps. The aim was to determine whether EDI was relevant to the Project. The result of Stage 1 identified that the Project warranted a more detailed consideration and required a Stage 2: Full sift. Stage 2 involved a full assessment of the Project using the EDIT tool to identify in more detail whether EDI is relevant to the Project. Stage 2 looked at details about the Project design considerations, existing evidence from other assessments or consultation undertaken, and the potential construction effects associated with delivery.
- 5.11.4 Following the completion of Stage 2, it was confirmed that EDI issues are likely to be a factor in the effective delivery of the Project. Therefore, an Equality Impact Assessment (EqIA) will be prepared in parallel to the ES.
- 5.11.5 The Applicant currently uses EqIA to assess projects considered likely to have a disproportionate impact on different sections of society. EqIA, when used in conjunction with EDIT, provides a good way of evidencing the decision-making processes to support compliance with the Equality Act 2010 and Public Sector Equality Duty.

5.12 Habitats Regulations Assessment

5.12.1 The Lower Thames Crossing Habitats Regulations Assessment: Part One Appropriate Assessment, was produced in March 2016. This report followed on from the Habitats Regulations Assessment (HRA) Screening

Report that was prepared for the long list of options in accordance with PINS Advice Note 10.

5.12.2 The purpose of the Part One Appropriate Assessment document was to provide sufficient data associated with each of the shortlisted options at Locations A for Route 1 (Dartford) and Location C for Routes 2, 3 and 4 (Gravesend), and also the crossing type (bridge, bored tunnel and immersed tube tunnel). This was then used to inform the route selection process and to provide a document that could be developed into the Appropriate Assessment for the Project. As part of the EIA process, further desk studies, detailed field surveys and stakeholder engagement will be planned in such a way that sufficient information is gained to inform the HRA process.

5.12.3 The Part One Appropriate Assessment has already identified European designated sites which are potentially affected by the Project. These include (refer to Figure 9.1, within Appendix F, for the location of the sites listed below):

- The Thames Estuary and Marshes Special Protection Area (SPA) which is both a marine and terrestrial site located on the outer Thames Estuary covering an area of 4839 ha. The majority of this site located on the south bank of the estuary, while the site also covers a small part of the northern bank of the outer estuary opposite Cliffe pools. This area also forms part of the Thames Estuary and Marshes Ramsar site designation;
- The North Downs Woodlands Special Area of Conservation (SAC), which is located south of Cobham and in-between the A227 and the A228 trunk roads. The site is designated for its terrestrial habitats and covers an area of approximately 288 ha; and
- Holehaven Creek Site of Special Scientific Interest (SSSI) and potential SPA (pSPA), which is noted for its assemblage of over 8000 waterfowl during the winter. It is 272 ha in size and lies on the northern side of the River Thames opposite Cliffe.

5.12.4 If the Appropriate Assessment concludes that the integrity of the European Site either alone or in combination with other projects / plans in respect of the sites structure and function and its conservation objectives would be adversely affected with mitigation in place, further work would be required. It would need to be demonstrated that there are no alternatives to achieve the Project which would avoid adverse impacts to the integrity of the European Site. Where no alternative solutions exist an Imperative Reasons of Overriding Public Interest (IROPI) case for the Project would need to be prepared. In the event that the Project is then deemed to proceed, compensatory measures would need to be determined.

5.12.5 As outlined in the 2017 EIA Regulations there will be clear co-ordination between the ES and the HRA process.

6 Air Quality

6.1 Introduction

6.1.1 This chapter outlines the proposed scope of work relating to the approach to the assessment of the Project on local air pollutant emissions and potential effects on air quality during both the construction and operational phases.

6.1.2 The aims of this chapter are to:

- Detail the requirements of the NNPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or surveys work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess effects on air quality;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

6.1.3 The key pollutants in relation to road assessments are nitrogen dioxide (NO₂) and particles (PM₁₀). These pollutants are most important in relation to human health with NO₂ being the pollutant that results in the most difficulty in achieving Air Quality Strategy Objectives (AQSO) and European Union (EU) Limit Values, described further in Section 6.6.

6.1.4 There may be interrelationships related to the potential effects on air quality and other disciplines. Therefore, please refer to the following chapter:

- Chapter 9 Nature Conservation

6.2 NPSNN Requirements

6.2.1 The NPSNN sets out the Government's policies to deliver the development of NSIPs on the national road and rail networks in England. The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications. The air quality aspects of the NPSNN are presented from Paragraphs 5.3 through to Paragraph 5.15.

6.2.2 The NPSNN provides information regarding what should be included in the applicant's assessment in Paragraphs 5.6 to 5.9. Paragraph 5.7 states that;

The ES should describe:

- Existing air quality levels;

- Forecasts of air quality at the time of opening, assuming that the Project is not built (the future baseline) and taking account of the impact of the Project; and
- Any significant air quality effects, their mitigation and any residual effects, distinguishing between the construction and operation stages and taking account of the impact of road traffic generated by the Project.

6.2.3 Paragraph 5.11 states that air quality considerations are likely to be particularly relevant where schemes are proposed:

- Within or adjacent to AQMA; roads identified as being above Limit Values or nature conservation sites (including Natura 2000 sites and SSSIs, including those outside England)
- Where changes are sufficient to bring about the need for a new AQMA or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites

6.2.4 The Project is located close to AQMAs that could be affected by the operation of the Project; these include the AQMAs of Havering, Gravesham, Thurrock, Sevenoaks, and Dartford which are discussed in section 6.4 and are shown on Figure 6.1, within Appendix F.

6.2.5 In relation to decision-making, Paragraphs 5.12 and 5.13 provide advice to the Secretary of State (SoS) who is responsible for the decisions and who will consider their advice when determining whether a scheme should receive consent:

“The Secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and / or where they lead to a deterioration in air quality in a zone/agglomeration.

The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the scheme will:

- *Result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant; or*
- *Affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to the European Commission at the time of the decision”.*

6.2.6 DMRB Volume 11, Section 3, Part 1 and associated Interim Advice Notes (IAN) are the guidance documents used when assessing the impacts of road schemes. Undertaking the assessment in accordance with this guidance will ensure that the assessment complies with the requirements of the NPSNN. It will also allow the determination of whether the Project’s impacts on air quality are considered significant, and whether there is a risk of the Project impacting on the ability of areas to achieve compliance with the EU Ambient Air Quality Directive (2008/50/EC). The details of the assessment methodology are provided in Section 6.7.

6.3 Consultations Undertaken And Proposed

- 6.3.1 The proposed air quality assessment methodology for the construction and operational phase including details of the Project monitoring survey (Section 6.5) were presented at EIA meetings held with London Borough of Havering (11 July 2017), Gravesham Borough Council (20 July 2017) and Thurrock Borough Council (25 July 2017) for the Local Authorities consideration.
- 6.3.2 Consultation has been undertaken with the local authorities shown in Table 6-1 in order to gather baseline air quality monitoring data for NO₂ and PM₁₀. Furthermore, local authorities which are within the extent of the Project air quality monitoring survey outlined in Section 6.5 (denoted by asterisks in Table 6-1) have been consulted regarding the proposed monitoring survey and locations of monitoring sites. In addition, it was agreed with Dartford Borough Council (25 July 2017) and Thurrock Borough Council (11 Aug 2017) that Project survey diffusion tubes could be co-located with an automatic air quality monitoring station within each borough.

Table 6-1: Consultations Undertaken

Local Authority	Purpose of Consultation
Ashford Borough Council	Collection of Air Quality Monitoring Data (All Local Authorities Shown).
Basildon Borough Council*	
Brentwood Borough Council*	
Broxbourne Borough Council	Notification of Project Air Quality Survey and Monitoring Locations by Email (Local Authorities denoted by *).
Castle Point Borough Council*	
Chelmsford City Council	
Dartford Borough Council*	
Enfield London Borough Council	
Epping Forest District Council	
Gravesham Borough Council*	
Havering London Borough Council*	
Hertsmere Borough Council	
Maidstone Borough Council	
Medway Council*	
Mole Valley District Council	
Reigate and Banstead Borough Council	
Sevenoaks District Council*	
Swale Borough Council	
Tandridge District Council	

Local Authority	Purpose of Consultation
Thurrock Borough Council*	
Tonbridge and Malling Borough Council*	
Welwyn Hatfield Borough Council	

6.3.3 Consultation has been undertaken with Natural England regarding the assessment of the impacts on Statutory Ecological sites (SPA, SSSI, SAC and Ramsar), including ecological sites to be considered in the air quality monitoring survey and assessment. It was agreed that the assessment should consider impacts on sites within 200m (as per DMRB) of the route alignment, and on other sites that could be affected by Project associated changes in traffic, including Darenth Wood SSSI and Wouldham to Detling Escarpment SSSI.

6.4 Baseline Information Obtained And Surveys Undertaken

6.4.1 Baseline air quality information has been gathered from Local Authorities and from Highways England. The Project passes through a number of AQMAs designated by Gravesham and Havering. The AQMAs have been designated as exceeding both the annual mean NO₂ objective of 40 µg/m³ and the 24 hour PM₁₀ objective of 50 µg/m³. Depending on the change in traffic flows there is the potential for impacts on AQMAs designated in the wider area such as those designed by Dartford Borough Council.

6.4.2 In addition to the information on AQMAs the local authority air quality monitoring data was collected between 2009 and 2016 from the local authorities listed in Table 6-1. Highways England has undertaken monitoring close to the Project. The baseline monitoring indicates that there are exceedances throughout the air quality study area.

6.4.3 As part of the reporting on compliance with the Ambient Air Quality Directive 2008/50/EC, the Department for Environment, Food and Rural Affairs (Defra) is responsible for reporting the date that zones and agglomerations will become compliant with the EU Limit Values (as described in Section 6.6). Defra use their Pollution Climate Mapping (PCM) model to determine when the zone/agglomeration will become compliant. The Project is located in the Eastern and South Eastern Zones as shown in Figure 6.1 within Appendix F. The UK Plan for tackling roadside nitrogen dioxide (NO₂) concentrations was published by Defra in July 2017. This includes the latest PCM model results for a number of scenarios: Baseline (assuming no measures), with Clean Air Zone (CAZ) and CAZ plus additional measures. The latest data from Defra will be obtained when undertaking the compliance risk assessment during the EIA assessment for the Project. The Baseline dataset will be utilised for the purpose of this assessment.

6.5 Other Baseline Information To Be Obtained

- 6.5.1 An NO₂ diffusion tube monitoring survey is being undertaken for a 12-month period at locations representative of public exposure. The surveys are being undertaken within the extents of the local authorities listed in Table 6-1. In addition, a review of the Affected Road Network (ARN) (roads with a traffic change that exceeds the DMRB criteria described in paragraph 6.7.33) is being undertaken to identify whether there are any gaps in the current baseline air quality monitoring that will be required to feed into the assessment. Monitoring is also being undertaken close to ecological sites to inform the baseline and model verification to support the calculations of nitrogen deposition and NO_x concentrations for comparison against the appropriate air quality standards.

6.6 Key Environmental Receptors And Their Value

- 6.6.1 For the pollutants of concern (NO₂ and PM₁₀), there are two sets of ambient air quality criteria for the protection of public health, namely those set by the EU and transposed to UK law by The Air Quality Standards Regulations 2010 and those criteria implementing the UK National Air Quality Strategy (AQS). Both sets of criteria are presented in Table 6-2. The AQS objectives for the protection of ecosystems and vegetation are also provided in Table 6-3 as there are a number of sensitive ecological sites in the vicinity of the Project (Figure 9.1: Nature Conservation - Designated Sites and Functional Habitat, within Appendix F).

Table 6-2: Air Quality Strategy Objectives For Human Health

Air Quality Objectives and European Directives for the protection of human health					
Air Quality Strategy Objectives				EU Limit Values	
Pollutant	Concentration	Averaging Period	Attainment Date	Concentration	Compliance Date
NO ₂	200 µg.m ⁻³	1-hour mean (not to be exceeded more than 18 times per year)	31 December 2005	200 µg.m ⁻³ (18 Exceedances)	1 January 2010
	40 µg.m ⁻³	annual mean	31 December 2005	40 µg.m ⁻³	1 January 2010
PM ₁₀	50 µg.m ⁻³	24-hour mean (not to be exceeded more than 35 times per year)	31 December 2010	50 µg.m ⁻³ (35 Exceedances)	1 January 2005
	40 µg.m ⁻³	annual mean	31 December 2004	40 µg.m ⁻³	1 January 2005

Table 6-3: Vegetation And Ecosystems

Air Quality Objectives and European Directives for the Protection of Vegetation and Ecosystems					
Air Quality Objectives				EU Limit Values	
Pollutant	Concentration	Averaging Period	Compliance Date	Concentration	Compliance Date
NO _x	30 µg/m ³	annual mean	31 st December 2000	30 µg/m ³	19 th July 2001

- 6.6.2 The criteria set out in the AQS include standards and objectives for local authorities to work towards achieving. These apply in locations with “relevant public exposure”, which are defined in the Defra technical guidance LAQM.TG (16) as locations where members of the public are likely to be exposed for a period of time similar to the averaging period of the objective (i.e. 24 hours for PM₁₀). An annual mean objective applies for example at the facade of residential properties.
- 6.6.3 The thresholds set by the EU are legally binding, mandatory limit values (LV) requiring national Government compliance. Failure to attain compliance throughout the zone/agglomeration by the specified date can lead to infraction proceedings by the EU against the Member State.
- 6.6.4 Local air quality criteria relevant to the air quality assessment for the Project are summarised in Table 6-2 (these correspond to the AQSO). It should be noted that PM_{2.5} is not currently assessed and reported as part of the DMRB HA207/07 air quality assessment, so only NO₂ and PM₁₀ are to be included in the air quality assessment for the Project.

Receptors

- 6.6.5 Receptors that are potentially sensitive to changes in air quality are defined in DMRB HA207/07 as housing, schools, hospitals and designated species or habitats within a designated ecological site located within 200m of the Project’s ARN (see paragraph 6.7.34) or construction sites. DMRB specifies the distance of 200m as a maximum extent because at distances greater than this pollutant concentrations return to background levels. The assessment will need to consider the Project’s impacts at representative sensitive human health receptors and ecological receptors (e.g. housing, schools, hospitals, Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI) etc.) within this study area.

6.7 Methodology

Guidance

6.7.1 Potential effects on local air quality resulting from both the construction and operation of the Project would be assessed in accordance with the guidance outlined in DMRB HA207/07, associated Interim Advice Notes (IANs) and Defra's Local Air Quality Management Technical Guidance (LAQM.TG (16)). Relevant guidance documents are listed below:

- HA207/07 Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 1, May 2007;
- IAN 170/12 v3 Updated air quality advice on the assessment of future NO_x and NO₂ projections for users of DMRB Volume 11, Section 3, Part 1 'Air Quality, November 2013 (or latest update available at the time of the assessment);
- IAN 174/13 Updated advice for evaluating significant local air quality effects for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), June 2013 (or latest update available at the time of the assessment);
- IAN 175/13 Updated advice on risk assessment related to compliance with the EU Directive on ambient air quality and on the production of Scheme Air Quality Action Plans for users of DMRB Volume 11, Section 3, Part 1 Air Quality (HA207/07), June 2013 (or latest update available at the time of the assessment);
- IAN 185/15 Updated traffic, air quality and noise advice on the assessment of link speeds and generation of vehicle data into 'speed-bands' for users of DMRB Volume 11, Section 3, Part 1 'Air Quality and Volume 11, Section 3. Part 7 Noise (January 2015); and
- Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16)), where appropriate.

6.7.2 As required by the DMRB the air quality assessment will be based on the most likely forecast traffic flows.

Construction

Construction Dust

6.7.3 The construction dust assessment will be undertaken in accordance with Volume 11, Section 3, Part 1 of the DMRB HA207/07. DMRB requires that the locations of sensitive receptors within 200m of the construction site be identified, and best practice mitigation measures be recommended for inclusion in the CEMP.

Construction Vehicle Emissions

6.7.4 Due to the length of the construction period, which is anticipated to be 6 years, an assessment of the impact on the change in traffic flows during the construction activities may be required. The criteria in DMRB as described in paragraph 6.7.33, where there is a change of daily Heavy Duty Vehicle (HDV, which include Heavy Goods Vehicles (HGV), buses and coaches) flows of greater than 200 Annual Average Daily Traffic

(AADT), or a change in daily traffic flows of greater than 1,000 AADT during the construction phase, will be used to define whether an assessment will be required.

- 6.7.5 If the number of HDVs and Light Duty Vehicles is less than the stated criteria, or if there are no sensitive receptors (such as residential properties, schools and designated sites) within 200m of the affected roads, then the local air quality effect of the Scheme can be considered not significant and no further air quality assessment is required. The distance of 200m is specified in the DMRB as pollutant concentrations return to background concentrations at distances greater than this.
- 6.7.6 If the number of construction vehicles exceeds the criteria, an assessment using a dispersion model would be required to determine whether mitigation measures should be put in place to reduce the impact from construction vehicle exhaust emissions.
- 6.7.7 In addition to the transportation of materials by road there is also the potential to import and export material by river or rail. Potential impacts will be assessed qualitatively based on the number of vessel movements, local site conditions and the location of sensitive receptors within 200m, and by applying professional judgement. It is however unlikely that there will be significant emissions from vessel or rail movements.

Operation

- 6.7.8 The DMRB guidance requires a number of different types of operational assessments to be undertaken including;
- Local air quality assessment (predicting concentrations of pollutants for comparison against the AQS Objectives at sensitive receptors e.g. residential, schools and ecological sites, with and without the Scheme), the results of which are used in the assessment of the Schemes significance;
 - Regional assessment (change in emissions as a result of the Scheme including carbon);
 - WebTAG assessment (overall change in human exposure to air pollution as a result of the Scheme); and
 - Assessment of the risk of the Scheme impacting on the UK's ability to comply with the EU Air Quality Directive (EU Limit Values).
- 6.7.9 The air quality assessment considers the impacts on both AQS Objectives (does the Project lead to a significant impact on air quality at individual properties?) and EU Limit Values (will the Project impact on Defra's plans to achieve compliance with the Limit Values?).
- 6.7.10 Whilst AQS Objectives and EU Limit Values are identical in relation to the concentrations that are applied (as presented in Table 6.2), they are different and it is important to understand how they are interpreted and therefore assessed in different ways. Local authorities are required to demonstrate best efforts to achieve the AQS Objectives whereas the UK government is legally required to achieve the EU Limit Values.

6.7.11 Reporting against compliance with EU Limit Values is undertaken by Defra and reported nationally at a zonal/agglomeration level. Zones/agglomerations only comply when everywhere in the zone is below the EU Limit Value. This is the basis of Defra's reporting, which is designed to determine what the maximum concentration is within the zone and determine the date by which the zone will comply with the Limit Value. A compliance risk assessment in accordance with IAN 175/13 will be undertaken to determine whether the Project will have an impact on compliance with the EU Air Quality Directive. This assessment is described in more detail at Paragraph 6.7.23 onwards.

6.7.12 AQS Objectives are assessed at a more local level where an AQMA can be designated as a result of exceedance at individual properties. The local air quality assessment is undertaken to determine whether the Project's impacts on AQS Objectives are considered significant (in accordance with IAN 174/13). This assessment is described in more detail at Paragraph 6.7.13 onwards.

Local Air Quality Assessment (AQS Objectives)

6.7.13 DMRB requires either a simple or detailed air quality assessment (a combination of assessments can also be used) to be undertaken. Given the risk that receptors could exceed the AQS Objectives, a detailed assessment will be required. The Atmospheric Dispersion Modelling System (ADMS-Roads) software will be used to determine the effect of the Project.

6.7.14 The key scenarios to be modelled are:

- The existing base situation, which will be used for model verification purposes;
- Do-Minimum Scenario, which assumes that the Project will not be in operation in the opening year but accounts for committed developments in the future (expected to be 2026); and
- Do-Something Scenario, which assumes that the Project will be in operation in the opening year and also accounts for committed developments in the future (expected to be 2026).

6.7.15 The local air quality assessment compares current and predicted air quality concentrations against the AQS Objectives as presented in Table 6.2. To determine whether the Scheme will have a significant impact on air quality, the local assessment results are utilised in accordance with IAN 174/13.

6.7.16 The local air quality results are also used to assess whether the Project represents a risk to compliance with the EU Ambient Air Quality Directive. The assessment utilises information published by Defra (namely their PCM modelled data) to determine whether compliance with the EU Limit Values will be affected by the Project in accordance with IAN 175/13, as described at Paragraph 6.7.23 onwards.

Regional Assessment

6.7.17 The regional assessment is a requirement of DMRB and is undertaken to determine the total change in emissions in the opening year and design

year as a result of the Project. The regional emissions of NO_x are also used in the WebTAG appraisal to determine the economic value of changes in air quality as a result of the Project for the purposes of the Project's business case.

6.7.18 The assessment of the contribution of the Project to regional air quality is based on the total annual emission of pollutants over the road network. The pollutants considered are:

- NO_x;
- PM₁₀; and
- Carbon Dioxide (CO₂).

6.7.19 The latest version of the Defra Emission Factor Toolkit (EFT) will be used in the regional assessment calculations which uses the traffic characteristics (flows, average vehicle speeds and percentage HDVs for each period) and road length for each affected road in the Study Area.

WebTAG appraisal (plan level)

6.7.20 The DMRB states that the assessment of air quality in relation to highways schemes should also report the results of local air quality WebTAG appraisal (plan level), as completed in line with the guidance set out by the Air Quality Sub Objective, TAG Unit A3.

6.7.21 The plan level methodology within the WebTAG guidance aims to quantify the change in exposure at properties in the opening year as a result of schemes. This is done by calculating the change in concentrations at receptors adjacent to all roads included in the ARN as determined for the local air quality assessment. The methodology follows several steps including:

- identification of the ARN, which is the same as the DMRB local air quality affected road network; and
- calculation of an overall assessment score for NO₂ and PM₁₀.

6.7.22 The results of the WebTAG assessment are reported in the ES and used in the Project's Business Case.

Compliance with the EU Directive on ambient air quality

6.7.23 IAN 175/13 provides the guidance that should be followed to determine whether the test in paragraph 5.13 of the NPSNN is met.

6.7.24 It is important to note that Defra assesses and reports to the European Commission on the status of air quality in the UK, by reference to the Limit Values for each pollutant, in accordance with EU Ambient Air Quality Directive (2008/50/EC). For the purposes of Defra assessment and reporting, the UK is divided into 43 zones and agglomerations (hereafter referred to as zones). The main pollutant of concern with respect to compliance is NO₂.

6.7.25 The assessment of compliance with the Directive is undertaken using both monitoring (Defra AURN Network) and modelling from Defra's PCM model. To determine the study area for the compliance risk assessment, the ARN for the local air quality assessment is compared with the PCM

model network as modelled by Defra. Where the two networks overlap, this is known as the compliance risk road network (CRRN) and forms the basis of the assessment of compliance risk. The Defra PCM modelling is at a much larger scale than the Scheme modelling given that roads are modelled nationally within it. The Scheme modelling is much more locally focused and, as such, is verified at a local level rather than a national level. Consequently, there are differences in the results. However, as the Defra PCM modelling is used to inform compliance, it has to be used as the basis to determine whether the Project is a risk to compliance.

- 6.7.26 Defra utilises the PCM model to report for the purposes of compliance with the EU Ambient Air Quality Directive 2008/50/EC. The model provides predicted concentrations for each link in a number of years at five year intervals. The most recent iteration of the PCM model will be used to complete the compliance risk assessment.
- 6.7.27 The impact of the Project (i.e. the change in concentrations at receptors) on compliance is undertaken in accordance with IAN 175/13, whereby the concentrations in the Defra PCM model for the opening year of the Scheme are used to determine which roads exceed the EU Limit Value.
- 6.7.28 IAN 175/13 provides the flow chart reproduced in Plate 6-1 to help determine the compliance risk of the Project.

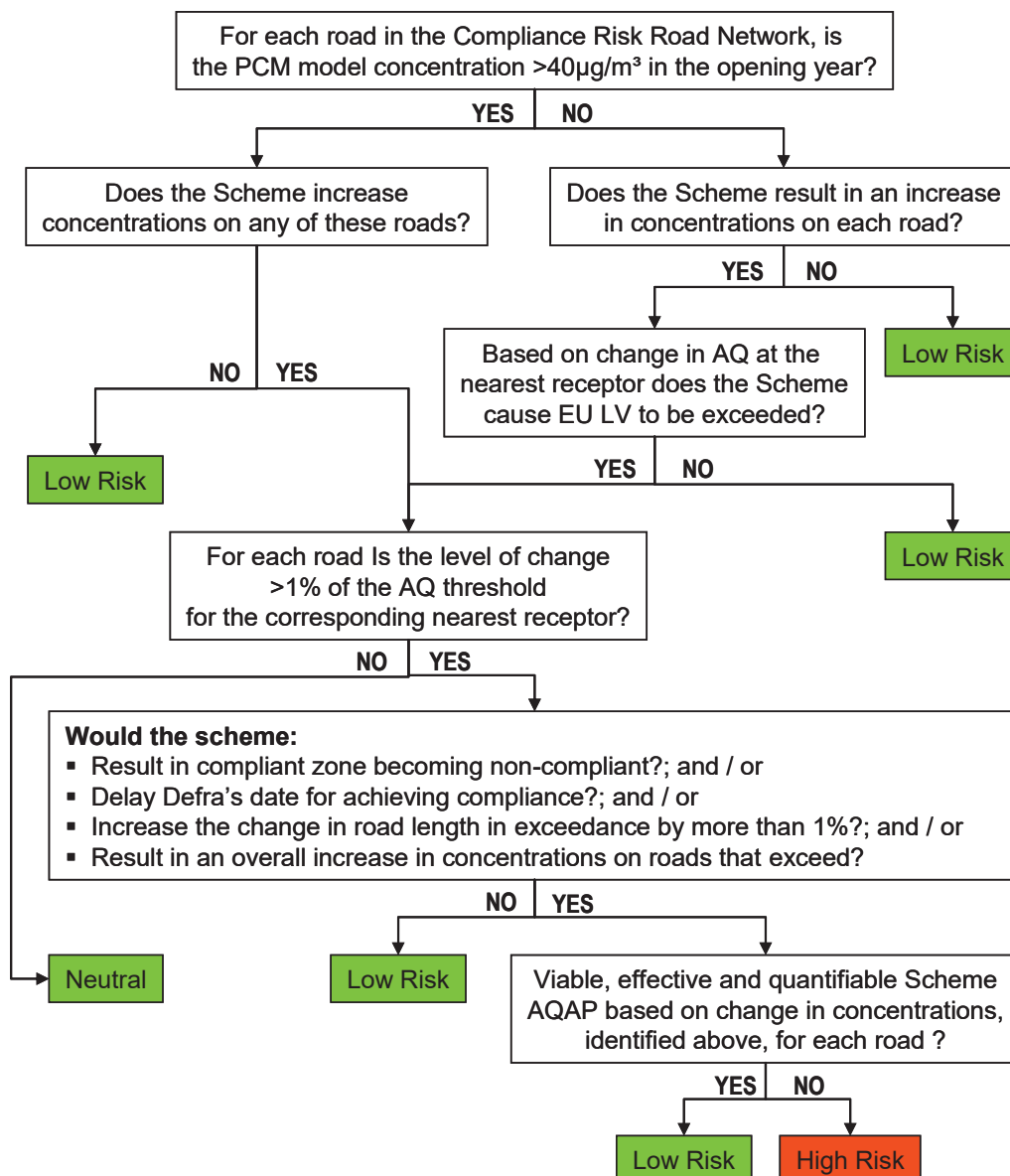


Plate 6-1: Compliance Risk Assessment Flow Chart

- 6.7.29 A zone can only become compliant when locations throughout the zone meet the relevant EU Limit Value. IAN175/13, however, considers the impact of a scheme on the individual links in the PCM model within the zone. Mitigation is required where a scheme results in an overall worsening on links that exceed the EU limit Value (specifically a greater number of links which are projected to be above the EU Limit Value (40µg/m³ for annual mean NO₂) and experience a deterioration in air quality as a result of the Scheme). In those circumstances, mitigation is required in the form of a Scheme Air Quality Action Plan (SAQAP).
- 6.7.30 Therefore, an SAQAP may be required even if a scheme does not affect the worst link in the zone.
- 6.7.31 If a scheme is assessed as having a high risk of non-compliance, the IAN provides guidance on the production of an SAQAP containing actions designed to further mitigate impacts and so reduce the risk of the scheme impacting on compliance.

- 6.7.32 Defra periodically updates the PCM modelling; therefore the latest information available at the time of the assessment will be utilised.

Study Area for the Air Quality Assessment

- 6.7.33 The study area for the local air quality assessment is defined using the traffic change-based criteria defined in the DMRB. The opening year Do-Something traffic scenario will be compared to the opening year Do-Minimum traffic scenario. Roads that meet the criteria are defined as 'affected roads', all of which together comprise the ARN. Concentrations of NO₂ and PM₁₀ will be predicted at sensitive receptors located within 200m of these roads.

- 6.7.34 The DMRB traffic change (affected road) criteria are as follows:

- road alignment will change by 5m or more; or
- daily traffic flows will change by 1,000 AADT or more; or
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more; or
- daily average speed will change by 10 km/hr or more; or
- peak hour speed will change by 20 km/hr or more.

- 6.7.35 The criteria presented above will be applied to the traffic reliability area (TRA), which is the area that the traffic engineers are confident that the traffic data is robust. The TRA will be developed with input from the air quality specialists to ensure that the TRA is robust and ensures that the significance of the scheme impacts can be determined.

Assessment Periods/Scenarios

Construction

- 6.7.36 Given the length of the construction period a quantitative assessment of the impact of the construction vehicles on the local road network may be required. If air quality dispersion modelling of construction vehicle emissions is required (should the construction traffic trigger the criteria in DMRB), the construction year that generates the most traffic will be used to determine the worst-case construction impacts.

Operation

- 6.7.37 In accordance with DMRB the opening year will be used to undertake the predictions for the local assessment.
- 6.7.38 In addition to the opening year the regional assessment will utilise the design year traffic data to generate emissions that will be reported in the ES.

Future Baseline

- 6.7.39 The future baseline (i.e. the Do-Minimum scenario) will utilise the traffic data provided by the traffic team for the opening year. Highways England provides a template indicating the format in which the traffic data needs to be delivered for utilisation in the dispersion model.
- 6.7.40 The latest speed band emissions (in accordance with IAN 185/15) will be used to generate emissions for the traffic flows in the opening year 2026

which are included in the air quality model to predict pollutant concentrations in the opening year.

- 6.7.41 As there is evidence showing that emissions from vehicles, particularly diesels, do not perform to their prescribed European standards (although it is acknowledged that here is limited evidence on Euro 6/VI performance in the real world, given they have only recently entered the fleet) it is now agreed amongst many air quality professionals that future predictions of NO₂ concentrations may be underestimated based on the use of the Defra modelling tools alone. Highways England issued advice in IAN 170/12v3 which is to be followed when undertaking assessments in accordance with DMRB. The latest version of this advice will be used to ensure that the future baseline projections presented in the air quality assessment ensuring that the modelling is not overly optimistic.
- 6.7.42 Whilst there is an expectation that there will be a substantial improvement in real world emissions from Euro 6/VI vehicles compared to previous Euro standards, the IAN makes allowance for potential under-estimates in the emissions from the latest Euro 6/VI vehicles currently entering the UK fleet.

Significance Criteria

- 6.7.43 The guidance in IAN174/13 will be used to determine whether the Project impacts are considered significant. It is noted that there are other guidance documents in relation to the evaluation of significance in air quality assessments, namely the Institute of Air Quality Management (IAQM) Land-Use Planning and Development Control: Planning for Air Quality January 2017. The IAQM guidance makes clear, however, that it is not appropriate to follow this methodology in the context of road schemes. Paragraphs 6.4 and 6.5 of the IAQM guidance state:

“As set out in the introduction in Chapter 1, this guidance document is not intended to replace guidance that exists for certain types of development, notably:

- *industrial developments that require a Permit;*
- *highways schemes promoted by Highways England; or*
- *activities associated with sources of dust (e.g. mineral extraction, waste handling, construction) or odours.*

Separate guidance is available for these sources. Clearly, where new developments are located in the vicinity of such sources, the potential impacts of their operation on the proposed development will need to be considered.

The guidance provided by the Environment Agency and Highways England has a formal status, reflecting the connections these organisations have with Government departments. This EPUK/IAQM guidance has no such status and is not intended as a substitute for the formal guidance.”

- 6.7.44 IAN 174/13 provides the framework and methodology for using the outputs from the air quality model at sensitive receptors to determine

whether an impact is significant. Should a significant impact be assessed that cannot be mitigated, the NPSNN directs the decision maker to give substantial weight to air quality impacts when determining whether a scheme should be granted consent. The IAN was prepared in order to determine the significance of air quality effects and establish whether a significant impact is triggered for the purposes of paragraph 5.12 of the NPSNN (as discussed in the NPSNN section of this report).

- 6.7.45 IAN 174/13 of this assessment requires that those receptors which are predicted to exceed the AQS Objectives in the opening year either with or without the Scheme are used to inform the evaluation of significance. The change in air pollutant concentrations predicted at these receptors (either an improvement or deterioration), is relevant to the determination of whether the Scheme impacts are significant.
- 6.7.46 Table 6-4 presents the magnitude of change criteria presented in the IAN, and can be applied to annual average NO₂ and PM₁₀ concentrations.

Table 6-4: Magnitude Of Change Criteria (Highway England IAN 174/13)

Magnitude of Change in Concentration (µg/m ³)	Value of Change in Annual Average NO ₂ and PM ₁₀
Large (>4)	Greater than full Measure of Uncertainty (MoU) value of 10% of the air quality objective (4µg/m ³).
Medium (>2)	Greater than half of the MoU (2µg/m ³), but less than the full MoU (4µg/m ³) of 10% of the air quality objective.
Small (>0.4)	More than 1% of objective (0.4µg/m ³) and less than half of the MoU i.e. 5% (2µg/m ³). The full MoU is 10% of the air quality objective (4µg/m ³).
Imperceptible (≤ 0.4)	Less than or equal to 1% of objective (0.4µg/m ³).

- 6.7.47 The results from the air quality dispersion model at receptors will be used to populate Table 6-5 to inform the overall significance of the Project’s impacts on air quality. Only receptors which exceed the AQS Objective (annual mean of 40µg/m³ for NO₂ and PM₁₀) in either the with or without scheme scenarios are used to inform the evaluation of significance. The greater the change, the more certainty there is that there would be an impact on air quality attributable to the Scheme in operation. Following the DMRB methodology, there remain residual uncertainties as to the impact of the Project on air quality, referred to in the IAN as the Measure of Uncertainty (MoU). This is due to the inherent uncertainty in air quality monitoring, modelling and in the modelled traffic data used in the air quality assessment.
- 6.7.48 Where the differences in concentrations are less than 1% of the air quality threshold (e.g. less than or equal to 0.4µg/m³ for annual average

NO₂), the changes at these receptors are considered to be imperceptible as defined in the IAN, and are scoped out of the evaluation on significance. It should be noted that, although those receptors with a change of 0.4 µg/m³ or less are scoped out of the evaluation of significance, they are still reported in the air quality assessment.

- 6.7.49 Any changes in concentrations above the threshold of imperceptibility are assigned to one of the six categories presented in Table 6-5. The total number of receptors are then aggregated, in order to calculate the number of receptors in each of the six categories.
- 6.7.50 The IAN provides guidelines on the number of receptors for each of the magnitude of change categories that might result in a significant effect, as presented in Table 6-5. These are guideline values only, and are to be used to inform professional judgement in determining whether the Project would generate significant air quality effects.

Table 6-5: Guideline To Number Of Properties Constituting A Significant Effect (Highways England IAN 174/13)

Magnitude of Change in Annual Average NO ₂ or PM ₁₀ (µg/m ³)	Number of Receptors with:	
	Worsening of air quality objective already above objective or creation of a new exceedance	Improvement of an air quality objective already above objective or the removal of an existing exceedance
Large (>4)	1 to 10	1 to 10
Medium (>2)	10 to 30	10 to 30
Small (>0.4)	30 to 60	30 to 60

- 6.7.51 Where the number of receptors fall below the lower guideline bands to inform significance, the Project is deemed not to have a significant impact. For example, 20 small worsenings would unlikely be classed as significant. If the number of receptors affected is greater than the upper guideline bands (>60 Small, >30 Medium and >10 Large) then the Project is more likely to have a significant impact on air quality. Projects which affect receptors within the guideline bands require justification based on professional judgement to determine whether the impact is significant.
- 6.7.52 For ecological receptors, IAN 174/13 and the DMRB are used to determine whether the Project is likely to have a significant impact. DMRB HA 207/07 Annex F outlines the approach for the air quality assessment of ecologically designated sites. Compliance with the directive assessed in accordance with IAN 175/13 also informs the judgement on whether the Project is likely to have a significant impact.

6.8 Description Of Possible Significant Effects On Receptors

Construction

- 6.8.1 There is some potential for adverse effects during Project construction in relation to construction dust and vehicle emissions. However, any effects on air quality would be temporary (i.e. during the period of the construction works only) and could be suitably minimised by the application of standard and appropriate mitigation measures.

Operation

- 6.8.2 The Project has the potential to affect local air quality, during operation in the following ways:

- Air quality could be affected (positively or negatively) by changes in vehicle activity (flows, speeds and composition) as a result of the Project; and
- Air quality could also be affected by any changes to the distance between sources of emissions and air quality sensitive receptors, both from the offline new route and changes to the existing road network to accommodate the Project.

- 6.8.3 The Project is likely to impact on roads that are within AQMAs and the assessments undertaken during the options appraisal have indicated that there is the potential for exceedances of the annual mean NO₂ UK AQS objective. The Project has the potential to improve air quality in the AQMA designated by Dartford Borough Council on the A282, as a result of traffic being switched from the A282 to the Project. The new road layout as a result of the Project will also be included in the air quality assessment to determine the impact of the new road layout on sensitive receptors.

6.9 Potential Mitigation Measures

Construction

- 6.9.1 Mitigation measures to control dust and emissions would be required during the construction phase.
- 6.9.2 In relation to construction dust, industrial best practice mitigation measures would ensure that construction dust does not result in a significant impact. These measures would be included in the CEMP.
- 6.9.3 Mitigation measures could include regular inspections and plan site layout so that dust causing activities located away from receptors to the extent practicable.
- 6.9.4 In relation to mitigating the impact from construction vehicles, measures could include utilising other forms of transport such as river and rail to move materials to reduce road transport emissions.

Operation

- 6.9.5 Should a significant impact be assessed in accordance with IAN 174/13, a SAQAP would be required to reduce the Project impacts. The SAQAP

would include appropriate mitigation measures in areas where receptors are being significantly affected.

6.10 Aspects/Impacts Scoped Out Of The EIA

6.10.1 Both the construction and operational impacts of the Project would be assessed therefore no aspect will be scoped out of the assessment.

6.11 Any Other Information

6.11.1 At this stage, there is no further information to report.

7 Cultural Heritage

7.1 Introduction

7.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on cultural heritage during both the construction and operational phases.

7.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or surveys work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess effects on heritage assets;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

7.1.3 Under the guidance provided in DMRB, Cultural Heritage is divided into three sub-topics:

- Archaeological Remains – the material remains of human activity from the earliest periods of human evolution to the present;
- Historic Buildings – architectural or designed or other structures with a significant historical value; and
- Historic Landscapes – the current landscape, whose character is the result of the action and interaction of natural and/or human factors.

7.1.4 There may be interrelationships related to the potential effects on cultural heritage with other disciplines, comprising:

- Chapter 8: Landscape;
- Chapter 10: Geology and Soils;
- Chapter 12: Noise and Vibration; and
- Chapter 14: Road Drainage and the Water Environment.

7.2 NPSNN Requirements

7.2.1 The NPSNN December 2014 provides planning guidance for promoters of Nationally Significant Infrastructure Projects on road and rail networks. It defines considerations around the Historic Environment and heritage assets, both designated and non-designated, including requirements to

assess their significance including any contribution made by the setting. Such assessments shall be based upon documentary research, desk-based assessment and where necessary field evaluations.

- 7.2.2 The Secretary of State should consider the impact of the proposed development on the heritage assets, giving great weight to the assets' conservation and taking into account the desirability of sustaining and, where appropriate, enhancing the significance of said heritage assets, the contribution of their settings and the positive contribution that their conservation can make to sustainable communities - including their economic viability.
- 7.2.3 The NPSNN states that:
"The Secretary of State should also take into account the desirability of new development making a positive contribution to the character and local distinctiveness of the historic environment."
- 7.2.4 *"Any harmful impact on the significance of a designated heritage asset should be weighed against the public benefit of development, recognising that the greater the harm to the significance of the heritage assets, the greater the justification that will be needed for any loss."*
- 7.2.5 *"Given that heritage assets are irreplaceable, harm or loss affecting any designated heritage asset should require clear and convincing justification. Substantial harm to or loss of a grade II Listed Building or a grade II Registered Park or Garden should be exceptional. Substantial harm to or loss of designated assets of the highest significance, including World Heritage Sites, Scheduled Monuments, grade I and II* Listed Buildings, Registered Battlefields, and grade I and II* Registered Parks and Gardens should be wholly exceptional."*
- 7.2.6 Where the Project would lead to substantial harm or total loss of significance of a designated heritage asset, the NPSNN states that:
"the Secretary of State should refuse consent unless it can be demonstrated that the substantial harm or loss of significance is necessary in order to deliver substantial public benefits that outweigh the loss or harm, or alternatively that all of the following will apply:
- *The nature of the heritage assets prevents all reasonable uses of the site*
 - *No viable use of the heritage asset itself can be found in the medium term through appropriate marketing that would enable its conservation*
 - *Conservation by grant funding or some form of charitable public ownership is demonstrably not possible*
 - *The harm or loss is outweighed by the benefit of bringing the site back into use."*
- 7.2.7 Where the Project would lead to less than substantial harm to the significance of a designated heritage asset, the NPSNN states that:
"..this harm should be weighed against the public benefits of the proposal, including securing its optimum viable use."

- 7.2.8 The Secretary of State may impose a requirement to prevent the loss of a heritage asset occurring until the relevant development or part of development has commenced.
- 7.2.9 Proposals that enhance or better reveal the significance of the historic environment and the settings of heritage assets should be treated favourably.
- 7.2.10 Where the loss of the whole or part of a heritage asset's significance is justified, the Secretary of State may impose requirements for fully recording and documenting the asset and its significance, and depositing in an archive, prior to it being lost.
- 7.2.11 All archaeological and historic building investigation will be undertaken to approved project designs (otherwise known as Written Schemes of Investigation). Where there is a high probability of undiscovered heritage assets with archaeological interest, the Secretary of State will require appropriate procedures for their identification and treatment both prior to and during the construction phase.

7.3 Consultations Undertaken And Proposed

Consultations completed to date

- 7.3.1 Meetings were held with Historic England during the development and appraisal of options. Engagement and consultation also occurred with the local authorities. This included collation of baseline cultural heritage data, refer to Section 7.4 for the data that was collated.
- 7.3.2 On 21 March 2017 a meeting was held with SEBs, including Historic England, to outline the EIA approach and the EIA Scoping Report, prior to its submission to PINS. Historic England expressed agreement with the approach to Cultural Heritage as outlined for the EIA Scoping Report. The meeting covered the existing pre-Preferred Route Announcement (PRA) route options. Consequently, the meeting could not discuss approaches to the assessment of the preferred option in any detail.
- 7.3.3 On 26 June 2017 a meeting was held with Kent County Council, which the Heritage Conservation Manager for the Council attended. The approach to Cultural Heritage assessment was presented and the proposed study area for non-designated assets, of 500m, was requested to be increased to 1km. This study area will be refined where possible to focus on the assets most likely to experience a potential effect. This was down to the fact that it gives an infrastructure scheme of this scale the appropriate level of archaeological context from the study of existing data. This scale of study area has been used for other DMRB assessed schemes. The Cultural Heritage methodology has been amended in line with these comments. The need for detailed assessment of the route was confirmed by the Heritage Conservation Manager and the outline approach to such assessment was confirmed.

Consultations proposed

- 7.3.4 During the preparation of the detailed assessment the following consultation would be undertaken:
- Historic England Inspector of Ancient Monuments for the South East of England;
 - Historic England Regional Planning Advisors;
 - Kent Archaeology Services – County Archaeologist and relevant district planning advisors, who cover Gravesham and Medway councils;
 - The archaeological planning advisory team within Place Services at Essex County Council who deliver historic environment advice to Thurrock and Brentwood councils;
 - Gravesham Borough Council Conservation team;
 - Medway Council Conservation Team;
 - Thurrock Borough Council Conservation team;
 - Greater London Archaeology Advisory Service (GLAAS) (regarding the part of the Project that lies in the London Borough of Havering);
 - The National Trust; and
 - Marine Management Organisation (for any in-river works).

7.4 Baseline Information Obtained/Surveys Undertaken

7.4.1 Baseline data has been gathered from stakeholders and is described below:

- The National Heritage List for England for information on statutorily designated heritage assets (scheduled monuments, listed buildings, registered battlefields and sites included on the Register of Historic Parks and Gardens), (Historic England);
- Heritage assets recorded in the Historic Environment Record (HER) data (Kent County Council, Essex County Council and GLAAS);
- Conservation area boundary data (Local Planning Authorities); and
- Historic Landscape Character data (Kent County Council and Essex County Council).

7.4.2 The following Table 7-1 details the cultural heritage datasets received to date (note that these will be updated as the assessment progresses).

Table 7-1: Datasets Held For Cultural Heritage

Discipline Area	Dataset	Date Received	Originator
Heritage	Aerial Cropmark Plot in the A13 Corridor	Apr-15	Essex County Council

Discipline Area	Dataset	Date Received	Originator
Heritage	Aerial Cropmark plot western side of A13	Apr-15	Essex County Council
Heritage	Aerial Cropmarks Eastern side of A13	Apr-15	Essex County Council
Heritage	Archaeological Potential Areas	Apr-15	Medway Unitary Authority
Heritage	Archaeological Priority Areas	Feb-15	London Borough of Havering
Heritage	Archaeological Priority Areas for: Bexley/Greenwich/Havering/Greater London	Feb-15	Historic England
Heritage	Archaeological Priority Zones	Feb-15	London Borough of Havering
Heritage	Archaeological Sites	Feb-15	Thurrock Unitary Authority
Heritage	Conservation Areas	Apr-15	London Borough of Bexley
Heritage	Conservation Areas	Apr-15	London Borough of Bromley
Heritage	Conservation Areas	Dec-14	Tonbridge & Malling Borough Council
Heritage	Conservation Areas	Mar-15	Maidstone Borough Council
Heritage	Conservation Areas	Apr-15	Medway Unitary Authority
Heritage	Conservation Areas	Jan-15	Sevenoaks District Council
Heritage	Conservation Areas	Nov-14	Gravesham Borough Council
Heritage	Conservation Areas	Mar-15	Basildon Borough Council
Heritage	Conservation Areas	Mar-15	Brentwood Borough Council
Heritage	Conservation Areas	Dec-14	London Borough of Barking and Dagenham

Discipline Area	Dataset	Date Received	Originator
Heritage	Conservation Areas	Feb-15	London Borough of Havering
Heritage	Essex Historic Environment Monument Full Report	Apr-15	Essex County Council
Heritage	Grade I Listed Buildings	Aug-14 and Sep-17	Historic England
Heritage	Grade II Listed Buildings	Aug-14 and Sep-17	Historic England
Heritage	Grade II* Listed Buildings	Aug-14 and Sep-17	Historic England
Heritage	Listed Buildings	Mar-15	Maidstone Borough Council
Heritage	Listed Buildings	Apr-15	Medway Unitary Authority
Heritage	Listed Buildings	Feb-15	London Borough of Havering
Heritage	Nominated World Heritage Site	Apr-15	London Borough of Bromley
Heritage	Registered Parks and Gardens	Aug-14 and Sep-17	Historic England
Heritage	Scheduled Monuments	Mar-15	Maidstone Borough Council
Heritage	Scheduled Monuments	Apr-15	Medway Unitary Authority
Heritage	Scheduled Monuments	Feb-15	London Borough of Havering
Heritage	Scheduled Monuments	Aug-14 and Sep-17	English Heritage
Heritage	Sites of Archaeological Significance	Apr-15	London Borough of Bromley
Heritage	Thames Crossing Historic Environmental Record (HER)	Apr-15	Kent County Council

Discipline Area	Dataset	Date Received	Originator
Heritage	Thames Crossing Historic Landscape Characterisation Record (HLC)	Apr-15	Kent County Council
Heritage	Thames Crossing Historic Landscape Characterisation Record Report	Apr-15	Kent County Council
Heritage	The Palaeolithic Resource In The Medway Gravels Report (Essex) - March 2007	Apr-15	Medway Unitary Authority
Heritage	The Palaeolithic Resource In The Medway Gravels Report (Kent) - March 2007	Apr-15	Medway Unitary Authority
Heritage	Thurrock HEC Report 2009	Apr-15	Essex County Council
Heritage	Historic England Archive Aerial Photograph Cover Search	July-17	Historic England
Heritage	Historic England Archive monument and event data	July-17	Historic England
Heritage	National Mapping Programme data	July-17	Historic England
Heritage	Greater London HER: monument and event full reports, archaeological priority areas shapefile, HLC (for part of the Borough of Havering)	July-17	Greater London Archaeological Advisory Service
Heritage	Essex HER: monument and event full reports, historic environment character zones, HLC	July-17	Essex County Council
Heritage	Kent HER: monument and event full reports, conservation areas, HLC, historic parks and gardens, protected military remains,	Aug-17	Kent County Council

Discipline Area	Dataset	Date Received	Originator
	Medway Valley Palaeolithic Project, archaeological reports		

7.5 Other Baseline Information To Be Obtained

7.5.1 The assessment would include the collation and review of the following information in Table 7-2.

Table 7-2: Type And Source Of Baseline Information To Obtain

Cultural Heritage Sub-Topic	Baseline information / source
Archaeological remains (terrestrial and marine)	National Heritage List for England for data on designated heritage assets (Historic England)
	Kent, Essex and Greater London Historic Environment Records (Kent County Council, Essex County Council and GLAAS)
	Historic England Archive
	Historic Ordnance Survey and other cartography, including tithe and estate maps (British Library; County and Local Authority Record Offices)
	London Archaeological Archive and Research Centre
	National Mapping Programme (Historic England)
	Local and regional histories and historic documents of relevance (County and Local Authority Record Offices, Local Studies Libraries)
	British Geological Survey borehole and geological data
	2011 Aggregates Levy Sustainability Fund resource study produced by London Borough of Havering and Museum of London Archaeology (MOLA)
	MOLA's Archaeological Landscapes of East London synthesis
	LiDAR data (Environment Agency)
Historic buildings	National Heritage List for England (Historic England)
	Local Authority conservation area appraisals
	Local authority lists of "locally listed" buildings

Cultural Heritage Sub-Topic	Baseline information / source
	<p>Local Authority local plans for example for information in relation to conservation areas.</p> <p>Ordnance survey plans (regressive) and other historic maps</p> <p>Aerial photographs (Historic England Archive, Essex and Kent County Councils)</p> <p>Victoria County History (British history online)</p> <p>Historic England Archive</p> <p>National Archives of England, Kew</p> <p>Local Authority archive centres</p> <p>London Metropolitan archives</p> <p>Readily available online sources (Heritage Gateway, http://www.visionofbritain.org.uk/)</p> <p>Past environmental impact assessments / professional reports of the area</p> <p>Consultation with Historic England regarding any proposed listings.</p>
Historic Landscapes	<p>Historic Landscape Characterisation Mapping sourced from the HERs</p> <p>Local authority planning documents regarding non-statutory designations for historic landscape</p> <p>Draw upon information collated in relation to landscape character as reflected in Chapter 8: Landscape.</p> <p>Aerial photographs where available (at online data sources for viewing or those held by Highways England).</p> <p>Baseline data available for review in EnvIS</p> <p>Modern land use and thematic mapping (e.g. Phase 1 Habitat Survey as referred to in Chapter 9: Nature Conservation)</p> <p>Geological, soil, hydrological and topographical mapping as outlined in Chapter 10: Geology and Soils</p> <p>Comprehensive historic mapping (e.g. Enclosure Awards, Estate Maps and Tithe Maps)</p> <p>Zones of visual influence and visual receptors (winter/summer/day/night)</p>

Cultural Heritage Sub-Topic	Baseline information / source

7.6 Key Environmental Receptors And Their Value

- 7.6.1 A preliminary assessment of the value of heritage assets within the study area was undertaken during the options appraisal based on the guidance provided in DMRB HA208/07 to establish the value for archaeological remains, historic buildings and the historic landscape.
- 7.6.2 This preliminary assessment is presented below based on a five-point scale of Very High, High, Medium, Low, Negligible and Unknown, according to the guidance provided. An extract from the guidance is presented in Tables 7-3 to 7-5.
- 7.6.3 From the sources consulted there are the following number of designated and non-designated heritage assets within the study area (refer to Section 7.7 for study areas):
- Non-designated assets within the 1km study area:
 - A total of 1258 non-designated heritage assets (both non-listed historic buildings and archaeological remains); and
 - A total of 434 Historic Landscape Character units, representing 54 different character types.
 - Designated assets within the 1km study area:
 - A total of 17 scheduled monuments;
 - A total of 178 listed buildings;
 - A total of 14 Conservation Areas; and
 - A total of 2 registered parks and gardens.
- 7.6.4 The locations of designated archaeological remains and historic buildings are shown in Figure 7.1, within Appendix F. Known non-designated archaeological remains have not been reproduced for the scoping report. The data is too substantial and would require considerable time and effort in reproduction and appraisal. The information has therefore been summarised, and will be detailed in the assessments.
- 7.6.5 The locations of all historic landscape character units are not mapped at this stage but would be as part of the assessment in the Desk-Based Assessment (DBA) and ES.
- 7.6.6 The NPSNN uses the term ‘significance’ in relation to the value of heritage assets, however, the DMRB term ‘value’ will be retained in order to avoid confusion with the terminology for impact assessment, and particularly ‘significance of effect’. The value of the heritage assets will then be used to inform the assessment completed for the ES.

7.6.7 The following key heritage assets or groups of heritage assets have been identified during the collation and review of initial baseline data, these are also shown on Figure 7.1 (in Appendix F):

Very High Value

Archaeological Remains

- No very high value archaeological remains have been identified.

Historic Buildings

- No very high value historic buildings have been identified.

Historic Landscapes

- No very high value historic landscapes have been identified.

High Value

Archaeological Remains

A number of sites incorporating high value archaeological remains have been identified, including:

- Earthworks near church, West Tilbury (scheduled monument);
- Crop mark complex, Orsett (scheduled monument);
- Bishop Bonner's Palace, Orsett (scheduled monument);
- Springfield style enclosure south of Hill House (scheduled monument);
- Causewayed enclosure and Anglo Saxon cemetery at Heath Place (scheduled monument);
- Roman barrow 280m north east of South Ockendon Hall (scheduled monument);
- Gatehouse and moat of South Ockendon Old Hall (scheduled monument); and
- There are also a number of entries in the Kent and Essex HERs that are associated with high value archaeological remains. However, there is insufficient information at this stage regarding their nature and condition to ascribe a value to them.

Historic Buildings

- Shornemead Fort, near Gravesend (non-designated asset – of potential schedulable quality);
- East Tilbury Battery (scheduled monument);
- Coalhouse Fort battery and artillery defences, near East Tilbury (scheduled monument);
- Tilbury Fort (scheduled monument);
- Second World War anti-aircraft battery at Bowaters Farm (scheduled monument);
- Church of St Giles and All Saints, Orsett (Grade I listed);

- Church of St Nicholas, South Ockenden (Grade I listed);
- Church of St Mary Magdalene, North Ockenden (Grade I listed);
- Church of St Mary, Chalk (Grade II* listed);
- Orsett House, Orsett (Grade II* listed);
- Church of St James, West Tilbury (Grade II* listed);
- Marshall's Cottages, West Tilbury (Grade II* listed);
- West Tilbury Conservation Area;
- East Tilbury Conservation Area; and
- Orsett Conservation Area.

Historic Landscapes

- Cobham Hall Registered Park and Garden (Grade II* listed) lies at the southern end of the Project. The northern edge of the designation lies within the redline boundary.

Medium Value

Archaeological Remains

- The Kent and Essex HERs contain numerous entries that may relate to medium value archaeological remains. However, there is insufficient information regarding their nature and condition to ascribe a value to them at this stage.

Historic Buildings

- Thong Conservation Area;
- Grade II listed buildings in the vicinity of Chalk;
- The Mount, Cobham (Grade II listed);
- White Horse Cottage, Thong (Grade II listed);
- Buckland, Buckland (Grade II listed);
- Grade II listed buildings at West Tilbury;
- Grade II listed buildings at East Tilbury;
- Grade II listed buildings to the north of Chadwell St Mary;
- Grade II listed buildings around Orsett;
- Moat Bridge and Gatehouse at South Ockendon (Grade II listed); and
- 28 Grade II listed buildings lie along The Street in Cobham, approximately 100-200m outside the Project study area. These include The Owletts; a Grade II listed National Trust property.

Historic Landscapes

- Areas of medium value historic landscape have been identified at Shorne Marshes, between Chalk and Thong, between West Tilbury

and East Tilbury, East Tilbury Marshes, to the east of Chadwell St Mary, and to the north and east of South Ockenden; and

- The Belhus Park Registered Park and Garden (Grade II listed) lies outside of the 1km study area and has not been subject to preliminary assessment as part of this scoping study.

Low Value

Archaeological Remains

- The Kent and Essex HERs contain numerous entries that may relate to low value archaeological remains. However, there is insufficient information at this stage regarding their nature and condition to ascribe a value to them.

Historic Buildings

- Numerous low value (unlisted) historic buildings have been identified many of which are located within settlements such as Chadwell St Mary, Orsett and South Ockenden.

Historic Landscapes

- Areas of low value historic landscape have been identified to the south of Thong and to the north east of Grays.

Unknown Value

Archaeological Remains

7.6.8 Potential for unknown archaeological remains within the study area:

- Based on the concentration of known sites, the potential for unknown archaeological remains to be present in the study area is considered to be high;
- The area of floodplain in the vicinity of the crossing points, north and south, have potential to contain water-logged organic remains dating from the Mesolithic period onwards, which may be of national and European significance;
- The gravel terraces either side of the river have very high potential to contain evidence of human activity. Some of this potential will date to the Palaeolithic period in the area of the north and south tunnel portals;
- Near surface deposits within gravel terraces on higher ground may contain archaeology from the later prehistoric and historic periods, or as multi-period sites, scattered throughout the landscape. These may predominantly be located south of Chalk on the Kent side of the Thames and inland of Buckland and Chadwell St Mary and near Mardyke on the Essex side;
- In the area of North Ockenden there is high potential for buried archaeological remains of the later prehistoric era onwards, which may be of national significance (based on nearby recent excavations); and

- As part of the next stage DBA, zones of high/medium/low archaeological risk (potential for discoveries) will be noted and identified, the scale of risk predicted, and a strategy for managing that risk will be created. As per DMRB, a statement of confidence will be provided and the risk will be integrated into the Highways England risk assessment process.

7.6.9 The above assessment of values may change during the following stages, upon completion of further studies.

7.7 Methodology

Guidance

7.7.1 As part of the cultural heritage assessment a DBA will be produced; this will form the baseline of the ES. The impact assessment will follow the methodology set out in Volume 11, Section 3, Part 2 'Cultural Heritage' (HA 208/07) of the DMRB. This will be reported in the ES.

7.7.2 The Cultural Heritage assessment will also be undertaken in accordance with the following legislation, best practice guidance and standards:

Legislation

- Ancient Monuments and Archaeological Areas Act 1979 (amended by the National Heritage Act 1983 and 2002); and
- Planning (Listed Buildings and Conservation Areas) Act 1990 (amended by the Enterprise and Regulatory Reform Act 2013).

Best Practice Guidance

- Historic England (2007) Assessing the Effect of Road Schemes on Historic Landscape Character;
- Historic England (2008) Conservation Principles, Policies and Guidance for the Sustainable Management of the Historic Environment;
- Historic England (2011) Seeing the History in the View. A Method for Assessing Heritage Significance within Views;
- Historic England (2015) Historic Environment Good Practice Advice in Planning Note 2 'Managing Significance in Decision-Taking in the Historic Environment';
- Historic England (2015) Historic Environment Good Practice Advice in Planning Note 3 'The Setting of Heritage Assets';
- RICS (2009) Historic Building Conservation guidance note;
- BS 7913 (2013) Guide to the Conservation of Historic Buildings;
- Society for the Protection of Ancient Buildings: Principles and Philosophy; and
- Chartered Institute for Archaeologists (2014) 'Code of Conduct' and 'Standard and guidance for Historic Environment Desk-Based Assessment'.

Proposed Assessment Methodology

- 7.7.3 In the terminology used by HA208/07 a Detailed Assessment for archaeological remains, historic buildings and historic landscapes would be undertaken, comprising:
- Desk-Based Assessment; and
 - Site based evaluation.
- 7.7.4 The DBA would present detailed information on baseline conditions and the assessment of value, and would include:
- Updated data from the relevant HERs across the appropriate study areas;
 - Inspection of aerial photographs, held by the Historic England Archive, and LIDAR sources;
 - Inspection of additional sources held by the HERs within the respective local administration bodies (Kent, Essex, Thurrock, Gravesham, Havering), such as reports on previous investigations, and local and regional cultural heritage literature held in their further information files;
 - Inspection of sources held by the respective Centres for Archives (Kent, Essex, Thurrock, Gravesham, Brentwood, Medway, Havering), including historic Ordnance Survey and pre-Ordnance Survey mapping, and local and regional cultural heritage literature;
 - A walkover survey to determine the effects of the Project on archaeological remains, historic buildings and historic landscapes;
 - Information on Historic Landscape provided in the relevant Historic Landscape Characterisation; and
 - Consultation with appropriate heritage advisors to identify the need for, nature, scope and scale of site-based evaluation required in support of the application.
- 7.7.5 Following the data collation and analysis phase, accessible portions of the study area would be the subject of a walkover survey undertaken in order to 'ground truth' heritage asset record data, identify previously unrecorded heritage assets and identify area where recent impacts may have compromised the survival of known and currently unknown heritage assets. The results of the walkover survey would be incorporated into the DBA.
- 7.7.6 Following production of the DBA, it will be necessary to undertake a site based evaluation consisting of intrusive and non-intrusive field surveys to provide further information regarding the presence, nature and condition of known and currently unknown heritage assets. These works would be undertaken where the DBA has been unable to provide sufficient information to allow the significance of effect arising from impacts associated with the Scheme to be adequately predicted. These surveys would include:

- Visual inspection, by foot, of listed buildings, unlisted buildings of heritage value, conservation areas and historic landscapes;
- Geophysical survey (along the proposed open cut and fill sections of the route and working areas);
- Geoarchaeological sampling (along the proposed route, to identify areas of potential presence of important Geoarchaeological and Paleo environmental remains);
- Archaeological evaluation trenching (based on the results of geophysical survey);
- Aerial photogrammetric survey;
- The examination of marine-based geophysical data from within the River Thames by a marine archaeological specialist to locate potentially significant anomalies; and
- The assessment of setting of heritage assets to determine the extent of scheme inter-visibility (the existence and extents of views between the scheme and the assets) and the potential change to the setting. Liaison with the Project's Landscape Architecture team to define the Zone of Visual Influence (ZVI) will assist this. The ZVI is the area around the Project where assets have a theoretical inter-visibility with it.

- 7.7.7 Assessment would be undertaken by a combined team of specialists in archaeology, historic buildings and historic landscapes to identify any potential impacts on assets inside the study area; additional assessment would be undertaken to establish if there are impacts outside the study area. Any sites thus identified will then be assessed accordingly.
- 7.7.8 Archaeological surveys would be undertaken by suitably qualified and experienced organisations and in accordance with the relevant guidance documents produced by the Chartered Institute for Archaeologists, Historic England and the Historic Environment Services of Kent and Essex County Councils. The scope and methodologies of any further surveys would be agreed with Historic England and the Historic Environment Services of Kent and Essex County Councils prior to field surveys being undertaken. All reports detailing the results of field surveys will be included within the ES as technical appendices.
- 7.7.9 The results of the DBA and any subsequent field surveys would seek to establish the impacts of the Project and assist with the identification and agreement of appropriate mitigation.
- 7.7.10 Should there be a requirement for in-river structures, either permanent or temporary during the construction period, or dredging of the riverbed it may be necessary to assess potential impacts on heritage assets on the riverbed (e.g. currently unknown archaeological remains) or in the river gravels. These impacts may arise during the construction of in-river structures (e.g. new jetties, works to existing jetties, temporary works to strengthen the railway, flood defence monitoring, ground improvement etc.) or during their operation through scour and propeller wash. There

may, therefore be a requirement for appropriate marine surveys to inform the assessment although this would be informed by the collation of desk-based information, details of any proposed in-river infrastructure and engagement with consultees.

Assessment of Noise/Traffic Impact

- 7.7.11 The scope of the noise and vibration assessment is addressed in Chapter 12: Noise and Vibration of this EIA Scoping Report. As appropriate and in consultation with relevant organisations, monitoring would be used to understand and assess the potential effects on cultural heritage resources.

Study Area for the EIA

- 7.7.12 The study area would cover an area of 1km from the application site boundary for non-designated and designated assets. This study area will be refined where possible to focus on the assets most likely to experience a potential effect. It is considered that a study area of this size is appropriate to determine the potential for the Project to have a direct physical impact on heritage assets (i.e. within or adjacent to the application boundary) and to highlight any assets that may experience impacts to their setting without including large numbers of assets that are not relevant to the assessment. Where assets of particular significance are highlighted by consultees as being of relevance to the assessment but fall outside of the defined study area these will also be considered.
- 7.7.13 A ZVI (as defined for the Landscape and Visual Impact Assessment) will be established. This will be used to identify receptors within the study area where visual relationships might be an issue, in addition to specific, additional receptors outside the study area, which could experience significant impacts from the Project through changes in their setting. Where the ZVI is less than 1km the study area will be refined. The ZVI and photomontages produced for the landscape assessment will form a key element in the assessment of setting for the DCO submission. They will be used for slightly different purposes and therefore results reported in the two assessments may be slightly different, although not contradictory.

Assessment Periods/Scenarios

- 7.7.14 The assessment would cover the construction and operational phases.

Future Baseline

- 7.7.15 Due to the nature of the cultural heritage resource it is unlikely that the future baseline would change to any great degree, although Historic England would be consulted regarding any potential changes to the status of Heritage Assets (e.g. new listings/de-listings, new archaeological discoveries) and Local Planning Authorities would be consulted regarding the changes to the status of any conservation areas (e.g. changes to existing boundaries, new conservation areas etc).

Significance Criteria

- 7.7.16 The following section outlines the criteria that would be used to determine the assessment of residual effects on heritage assets.

7.7.17 Assessments of value consider how far heritage assets contribute to an understanding of the historic environment, through their individual or group qualities, either directly or potentially. These are professional judgements, but they would also be guided by legislation, national policies, acknowledged standards, designations, criteria and priorities.

7.7.18 Table 7-3 presents the values that would be assigned to archaeological assets (taken from the DMRB).

Table 7-3: Cultural Heritage Assessment - Criteria For Determining The Value (Significance) Of Archaeological Assets

Value	Example
Very High	World Heritage Sites (including nominated sites) Assets of acknowledged international importance Assets that can contribute significantly to acknowledged international research objectives
High	Scheduled Monuments (including proposed sites) Undesignated assets of Schedulable quality and importance Assets that can contribute significantly to acknowledged national research objectives
Medium	Designated or undesignated assets that contribute to regional research objectives
Low	Designated and undesignated assets of local importance Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives
Negligible	Assets with very little or no surviving archaeological
Unknown	The importance of the resource has not been ascertained

7.7.19 Table 7-4 presents the values that would be assigned to built heritage assets (taken from the DMRB).

Table 7-4: Cultural Heritage Assessment – Criteria For Determining The Value (Significance) Of Built Heritage Assets

Value	Example
Very High	Structures inscribed as of universal importance as World Heritage Sites Other buildings of recognised international importance

Value	Example
High	<p>Scheduled Monuments with standing remains Grade I and Grade II* Listed Buildings</p> <p>Other Listed Buildings that can be shown to have exceptional qualities in their fabric or historical associations not adequately reflected in the listing grade</p> <p>Conservation Areas containing very important buildings</p> <p>Undesignated structures of clear national importance</p>
Medium	<p>Grade II Listed Buildings</p> <p>Historic (unlisted) buildings that can be shown to have exceptional qualities in their fabric or historical associations</p> <p>Conservation Areas containing buildings that contribute significantly to its historic character</p> <p>Historic townscape or built up areas with important historic integrity in their buildings, or built settings (e.g. including street furniture and other structures)</p>
Low	<p>'Locally Listed' buildings</p> <p>Historic (unlisted) buildings of modest quality in their fabric or historical association</p> <p>Historic townscape or built up areas of limited historic integrity in their buildings or built settings (e.g. including street furniture and other structures)</p>
Negligible	<p>Buildings of no architectural or historical note; buildings of intrusive character</p>
Unknown	<p>Buildings with some hidden (i.e. inaccessible) potential for historic significance</p>

7.7.20 Table 7-5 presents the values that would be used for historic landscape assets (taken from the DMRB).

Table 7-5: Cultural Heritage Assessment - Criteria For Determining The Value (Significance) Of Historic Landscape Assets

Value	Example
Very High	World Heritage Sites inscribed for their historic landscape qualities Historic landscapes of international value, whether designated or not Extremely well preserved historic landscapes with exceptional coherence, time-depth, or other critical factor(s)
High	Undesignated historic landscapes of outstanding interest Undesignated historic landscapes of high quality and importance, and of demonstrable national value Well preserved historic landscapes, exhibiting considerable coherence, time-depth or other critical factor(s)
Medium	Undesignated historic landscapes that would justify special historic landscape designation, landscapes of regional value Averagely well-preserved historic landscapes with reasonable coherence, time-depth or other critical factor(s)
Low	Robust undesignated historic landscapes Historic landscapes with importance to local interest groups Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations
Negligible	Landscapes with little or no significant historical interest

7.7.21 The determination of magnitude of impact would be based on the vulnerability of the heritage asset, its current state of survival/condition and the nature of the impact upon it. The survival and extent of archaeological deposits is often uncertain and consequently, the magnitude of impact can be difficult to predict with any certainty.

7.7.22 Table 7-6 presents the magnitude of impact criteria related to archaeological assets (taken from the DMRB).

Table 7-6: Cultural Heritage Assessment - Criteria For Determining The Magnitude Of Impact On Archaeological Assets

Magnitude of Impact	Example
Major	Change to most or all key archaeological materials, such that the resource is totally altered Comprehensive changes to setting
Moderate	Changes to many key archaeological materials, such that the resource is clearly modified Considerable changes to setting that affect the character and significance of the asset
Minor	Changes to key archaeological materials, such that the asset is slightly altered Slight change to setting that affects its significance
Negligible	Very minor changes to archaeological materials, or setting
No Change	No change

7.7.23 Table 7-7 presents the magnitude of impact criteria related to historic buildings (taken from the DMRB).

Table 7-7: Cultural Heritage Assessment - Criteria For Determining The Magnitude Of Impact On Built Heritage Assets

Magnitude of Impact	Example
Major	Change to key historic building elements, such that the resource is totally altered
Moderate	Change to many key historic building elements, such that the resource is significantly modified Changes to the setting of an historic building, such that it is significantly modified and its significance is affected
Minor	Change to key historic building elements, such that the asset is slightly different Change to setting of an historic building, such that it is noticeably changed and its significance is affected
Negligible	Slight changes to historic building elements or setting that hardly affect it
No Change	No change to fabric or setting

7.7.24 Table 7-8 presents the magnitude of impact criteria related to historic landscapes (taken from the DMRB).

Table 7-8: Cultural Heritage Assessment - Criteria For Determining The Magnitude Of Impact On The Historic Landscape

Magnitude of Impact	Example
Major	Change to most or all key historic landscape elements, parcels or components; extreme visual effects; gross change of noise or change to sound quality; fundamental changes to use or access; resulting in total change to historic landscape character unit.
Moderate	Changes to many key historic landscape elements, parcels or components, visual change to many key aspects of the historic landscape, noticeable differences in noise or sound quality, considerable changes to use or access; resulting in moderate changes to historic
Minor	Changes to few key historic landscape elements, parcels or components, slight visual changes to few key aspects of historic landscape, limited changes to noise levels or sound quality; slight changes to use or access: resulting in limited changes to historic landscape character.
Negligible	Very minor changes to key historic landscape elements, parcels or components, virtually unchanged visual effects, very slight changes in noise levels or sound quality; very slight changes to use or access; resulting in a very small change to historic landscape character.
No Change	No change to elements, parcels or components; no visual or audible changes; no changes arising from in amenity or community factors.

Significance of Effects Criteria

7.7.25 The matrix presented in Table 7-9 outlines how value and magnitude of impact would be used to determine the significance of the effect. However, the matrix is not intended to 'mechanise' judgement of the significance of effect but to act as a check to ensure that judgements regarding value, magnitude of impact and significance of effect are reasonable and balanced. In order to allow for professional judgement, in some cases the matrix allows a choice of significance of effect when a magnitude of impact and a value are combined. In these cases, the individual attributes of a specific asset, along with any relevant site-specific factors and consideration of other influencing elements, have been taken into account when considering which is the most appropriate significance of effect.

7.7.26 The NPSNN refers to the term 'substantial harm', which would be considered to constitute an effect of 'very large adverse' significance. 'Harm' would be considered to be an effect of 'large adverse' significance. Both terms and their application to assessment of this Project would be discussed in more detail with Historic England.

Table 7-9: Cultural Heritage Assessment - Criteria For Determining The Significance Of Effects

Value	<u>Very High</u>	Neutral	Slight	Moderate/ Large	Large/ Very	Very Large
	<u>High</u>	Neutral	Slight	Slight/ Moderate	Moderate/ Large	Large/ Very Large
	<u>Medium</u>	Neutral	Neutral/ Slight	Slight	Moderate	Moderate/ Large
	<u>Low</u>	Neutral	Neutral/ Slight	Neutral/ Slight	Slight	Slight/ Moderate
	<u>Negligible</u>	Neutral	Neutral	Neutral/ Slight	Neutral/ Slight	Slight
	<u>No Change</u>	<u>Negligible</u>	<u>Minor</u>	<u>Moderate</u>	<u>Major</u>	
<u>Magnitude of Impact</u>						

7.8 Description of Possible Significant Effects on Receptors

Construction

7.8.1 Physical impacts can result in the partial or complete removal of an asset during construction of a road, tunnel and any associated activities. All such impacts would occur during construction, and would be long-term in nature. Such impacts can include:

- Partial or total removal of heritage assets;
- Compaction of archaeological deposits by construction traffic and structures;
- Changes in groundwater levels leading to the drying out of waterlogged archaeological deposits;
- Subsidence or damage to Listed Buildings and archaeology as a result of vibrations from the Tunnel Boring Machine; and
- The removal of elements of historic landscape that might mark a piecemeal degradation in the survival of the asset.

7.8.2 Impacts on the setting of heritage assets can result from the construction and/or operation of a new road and tunnel. In most cases, they would be long-term in nature. They would commence during construction and continue during operation, although the degree of impact may vary between phases. Such impacts can include:

- Interruption or improvement of important views to or from an asset;
- Introduction or removal of large, prominent or intrusive structures within the setting of an asset;

- Introduction or removal of visual intrusion, such as moving vehicles, the presence of road signs or lighting;
- Significant changes in noise, dust, odour or air quality affecting the appreciation of their heritage context, or affecting the physical condition of structural fabric;
- Severance or restoration of relationships between associated assets; and
- Adverse or beneficial impacts on amenity and/or economic viability.

Operation

7.8.3 Operational impacts are those that would arise from the use of the road once built. Operation of the Project has the potential to result in direct/indirect impacts on heritage assets and their setting. In many cases, these would be long-term in nature. These impacts would commence during construction of the Project and continue during operation. However, the degree of impact may vary between phases. Such impacts can include:

- Changes to the surroundings of heritage assets or the general character of their setting;
- Changes to access or the viability of heritage assets;
- Proposals which may lead to increased pollution, dust, noise, vibration, visual intrusion by traffic, new lighting or the possibility of collision damage;
- Requirements for access for routine operational maintenance, diversions, or other traffic management operations; and
- Changes in groundwater levels leading to the drying out of waterlogged archaeological deposits, for instance due to maintenance (or absence of) drainage ditches.

7.8.4 Adverse impacts on the setting of heritage assets resulting from operation of the Project can be mitigated through design. This may include measures such as consideration of the horizontal or vertical alignment of the Project to reduce its visual prominence, careful siting of lighting or signage, the use of noise fencing, or maintenance of access routes to a historic building to maintain its viability. Further mitigation can be provided through the use of landscape mitigation measures such as bunding, planting, or cladding of highways structures. These measures can help to minimise the visual prominence of the Project and aid its integration with the surrounding landscape.

7.8.5 There is the potential for beneficial impacts outside of the study area, with some improvements in traffic levels and air quality anticipated in Dartford due to traffic transferring onto the Project. This may bring potential benefits to conservation areas and listed buildings through amelioration of the deteriorating effects of traffic pollution. This would require further assessment. There may be similar benefits to

conservation areas and listed buildings in and around the study area, more locally, which again require further assessment.

7.9 Potential Mitigation Measures

7.9.1 Mitigation measures would be developed as part of the design process and informed by the on-site evaluation. Due to the nature of heritage assets it may not be possible to avoid or mitigate all impacts however, mitigation measures may include:

- Amendment of designs to reduce impacts, where reasonably practicable;
- Recording of archaeological features; and
- Physical screening of construction or operational activities.

7.9.2 Mitigation aims to avoid or lessen a negative impact on the resource. The primary presumption is preservation in situ, although some degree of impact may be unavoidable and thus mitigation would be required. Mitigation measures are a hierarchy from 'best', being prevention of impacts at source i.e. through design or avoidance, to "worst" offsetting impacts that cannot be avoided by providing improvements elsewhere.

7.9.3 Potential design stage measures would include intrusive and non-intrusive investigations of archaeological, built heritage and historic landscape assets in order to inform a robust programme of mitigation.

7.9.4 Regarding archaeological remains, for impacts that cannot be avoided mitigation would include the various measures available to preserve the resource by record.

7.9.5 Measures to mitigate the impacts on setting would be set out in detail by the Landscape and Visual discipline, and would include measures to incorporate mitigation in hard and soft landscape design.

7.9.6 Regarding historic buildings, if their total loss is unavoidable mitigation measures would include preservation of the structure by record.

7.9.7 Mitigation may be necessary for the Project's operational phase to counter secondary impacts such as increased noise, air pollution and night-time light levels.

7.9.8 Mitigation of impacts to historic landscape character units are generally very limited, but there are opportunities to avoid or minimise changes to character through design.

7.10 Aspects/Impacts Scoped Out Of The EIA

7.10.1 At this stage no heritage impacts have been scoped out of the EIA.

7.11 Any Other Information

7.11.1 At this stage there is no further information to report.

8 Landscape

8.1 Introduction

- 8.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on the landscape and townscape resource, and visual amenity during both construction and operational phases.
- 8.1.2 The aims of this chapter are to:
- Detail the requirements of the NPSNN for the assessment;
 - Present the consultations undertaken and proposed;
 - Explore the baseline information that has been collected to date;
 - Provide information on what would be collated through further desk study or surveys work;
 - Identify the key receptors that would be considered in the EIA;
 - Detail the methodology that would be used to assess effects on landscape and townscape assets;
 - Outline the potential significant effects that would occur;
 - Describe the potential mitigation measures; and
 - Identify (and justify) any aspects/impacts scoped out of the assessment.
- 8.1.3 The landscape and townscape resource are considered to be entities in their own right. These are areas and places which have evolved over time and their inherent features give them their distinctive character. Visual amenity is a linked but separate resource which considers the views experienced by people within the landscape and townscape resource.
- 8.1.4 The importance and value of the landscape and townscape resource is considered at the international, national, regional and local level and is embodied in the overarching European Landscape Convention as *“an area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors.”*
- 8.1.5 There may be interrelationships related to the potential effects on landscape and other disciplines comprising:
- Chapter 7 Cultural Heritage;
 - Chapter 9 Nature Conservation; and
 - Chapter 12: Noise and Vibration.

8.2 NPSNN Requirements

- 8.2.1 The NPSNN sets out the Government’s policies to deliver the development of NSIPs on the national road and rail networks in England.

The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications. The need to consider the likely significant effects on the landscape and townscape resource, and visual amenity is identified in Paragraph 5.144. This paragraph also makes reference to the following;

- Guidelines for Landscape and Visual Impact Assessment, 3rd Edition, April 2013;
- Natural England profiles for National Character Areas;
- Reference to any landscape character assessment and associated studies; and
- Relevant local development plans and policies.

8.2.2 In regard to Paragraph 5.144 the DMRB Volume 11, Section 3, Part 1 and associated Interim Advice Notes (IAN) are the guidance documents used when assessing the impacts of road schemes. Undertaking the assessment in accordance with this guidance will ensure that the assessment complies with the requirements of the NPSNN. It will also allow the determination of whether the scheme impacts are considered significant on the landscape and townscape resource and on visual amenity. The details of the assessment methodology are provided in Section 8.7.

8.2.3 The NPSNN provides information regarding what should be included in the applicant's assessment in Paragraphs 5.145 to 5.146. These paragraphs state that;

8.2.4 The assessment should consider:

- *Significant effects during construction and operation on landscape components and landscape character (including historic landscape characterisation);*
- *Visibility and conspicuousness of the project during construction and operation and potential impacts on views and visual amenity; and*
- *Any noise, light pollution effects, including on local amenity, tranquillity and nature conservation.*

8.2.5 With reference to Paragraph 5.145, the assessment of effects on the historic landscape will form part of Chapter 7: Cultural Heritage. However, the landscape assessment, when determining the value of the landscape resource, would consider the presence of cultural heritage assets as part of this process.

8.2.6 With reference to Paragraph 5.146, light pollution effects would be based on the Institution of Lighting Engineers (2005) 'Guidance Notes on the Reduction of Obtrusive Light' guidelines which identify Environmental Zones that define the broad night-time characteristics of areas in terms of relative brightness or darkness. In addition, impacts on tranquillity would consider the combined effects of traffic noise and visual intrusion for rural recreational receptors within and in the setting to the Kent Downs AONB and those adjacent to the Thames Estuary.

- 8.2.7 The Project sits partly within and in the setting to the Kent Downs Area of Outstanding Natural Beauty. Paragraph 5.147 states the applicant's assessment must comply with the following:
- *The duties in Section 11A of the National Parks and Access to the Countryside Act 1949; and*
 - *Section 85 of the Countryside and Rights of Way Act 2000.*
- 8.2.8 For significant road widening or the building of new roads within an AONB, Paragraph 5.148 states that the applicant must fulfil the following requirements:
- *Defra's English national parks and the broads: UK Government Vision and circular document or successor documents.*
- 8.2.9 In relation to decision-making, Paragraph 5.149 requires the assessment to consider the following;
- *The nature of the existing landscape likely to be affected;*
 - *The nature of the effect likely to occur;*
 - *Designed carefully, having regard to siting, operational and other relevant constraints; and*
 - *Avoid or minimise harm to the landscape, providing appropriate mitigation.*
- 8.2.10 In relation to decision-making in an AONB, Paragraph 5.150 states that the SoS has a statutory duty to have regard to in decisions because of;
- *Great weight given to conserving landscape and scenic quality; and*
 - *Specific statutory purposes which help ensure their continued protection.*
- 8.2.11 Further advice to the decision maker (the SoS), which should be used when determining whether a scheme should receive consent within an AONB and outside the designation which might affect it, are provided in Paragraphs 5.151 to 5.155;
- "The Secretary of State should refuse development consent within these areas except in exceptional circumstances and where it can be demonstrated it is in the public interest. Consideration should include an assessment of;*
- *Cost of and scope of developing outside the area; and*
 - *Any detrimental effect on the environment, the landscape and recreational facilities and the extent to which they can be moderated.*
 - *Need for the development and the impact on the local economy;*
- There is a strong presumption against any significant road widening or the building of new roads in an Area of Outstanding Natural beauty unless it can be shown there are compelling reasons for the new or enhanced capacity and with any benefits significantly outweighing the costs;*

Where consent is given in these areas the SoS should be satisfied that the applicant has ensured that the project shall be carried out to high environmental standards and where possible includes measures to enhance other aspects of the environment;

The duty to have regard to the purposes of the nationally designated area also applies when considering applications for projects outside the boundaries these areas which may have impacts on them; and

The fact a proposed project will be visible from within a designated area should not in itself be a reason for refusing consent”.

- 8.2.12 In relation to decision-making in other areas, Paragraph 5.157 states that the SoS should consider the Project:
- *Is designed carefully, having regard to siting, operational and other relevant constraints; and*
 - *Avoids adverse effects on landscape or minimises harm to the landscape, including by appropriate mitigation.*
- 8.2.13 In relation to decision-making on visual impact, Paragraph 5.158 states:
- *The SoS will have to judge whether the visual effects on sensitive receptors, such as local residents; and other receptors such as visitors to a local area outweighs the benefits of the development.*
- 8.2.14 In relation to landscape and visual mitigation, Paragraphs 5.160 and 5.161 state:
- *Adverse landscape and visual effects may be minimised by appropriate siting of infrastructure, design (including choice of materials) and landscaping schemes; and*
 - *It may be appropriate to undertake landscaping off site, although if such landscaping is proposed to be consented by the development consent order, it would have to be included within the order limits of the application.*

8.3 Consultations Undertaken And Proposed

- 8.3.1 The landscape, townscape and visual amenity, baseline data collection during the options phase involved consultation with the stakeholders and local authorities listed in Table 8-1. For the EIA these stakeholders and local authorities will be contacted to discuss and agree landscape, townscape and visual desk based data, landscape characterisation, other developments to be considered as part of either the future baseline data or to form part of any cumulative assessment, representative viewpoints and photomontages and the setting to the Kent Downs AONB.

Table 8-1: Consultations Undertaken

Stakeholder / Local Authority	Purpose of Consultation
Natural England	26/07/2017 - Telecon to discuss the LVIA approach to the Project and the main elements to be considered in the scoping report. It was agreed that a draft Zone of Theoretical Visibility (ZTV) would be submitted to NE and a joint NE / AONB site meeting should be arranged to discuss / agree representative viewpoints.
Kent Downs AONB Unit	14/06/2017 - Bilateral meeting which included discussion on the LVIA approach to the Project. It was agreed that a draft ZTV would be submitted to the AONB unit and a site meeting should be arranged to discuss / agree representative viewpoints. The AONB unit confirmed that they will be publishing a landscape characterisation study of the AONB in Autumn 2017. The AONB unit confirmed that they would expect to see photomontages prepared as part of the PEIR submission.
Kent County Council	27/06/2017 EIA presentation meeting which included an outline of the LVIA approach to the Project. It was agreed that a draft ZTV would be submitted to KCC for initial review. KCC informed the meeting that the Saxon Shore Way will become part of the England Coast Path.
Gravesham Borough Council	20/07/2017 EIA presentation which included an outline of the LVIA approach to the Project.
Thurrock Council	25/07/2017 EIA presentation which included an outline of the LVIA approach to the Project.
London Borough of Havering	11/07/2017 – EIA presentation which included an outline of the LVIA approach to the Project. It was agreed that a draft ZTV would be submitted to KCC for initial review.

8.4 Baseline Information Obtained/Surveys Undertaken

- 8.4.1 During the options phase, baseline landscape, townscape and visual amenity information was gathered from Natural England, the Kent Downs AONB Unit and Local Authorities. The Project would traverse four

National Character Areas (NCA) and pass through or near to 19 local authority local character areas. These are listed in Table 8-2. The local character areas are shown on Figure 8.2 in Appendix F.

- 8.4.2 The Project would lie within and pass close to the nationally designated Kent Downs AONB. This area includes the designated Grade II* Cobham Hall Registered Park and Garden. This part of the AONB is experienced by visitors to Shorne Woods Country Park and by users on the National Cycle Route 177 and the regionally important Timeball and Telegraph Trail long distance path (LDP).
- 8.4.3 Outside the AONB, it is considered the setting to it extends up to the River Thames. Within this area the Project would pass through green belt and near to areas and features which are designated for their biodiversity and heritage value (see Chapter 7: Cultural Heritage and Chapter 9: Nature Conservation), including Ancient Woodland, Sites of Special Scientific Interest, local nature reserves, scheduled monuments, listed buildings and conservation areas. This area is also experienced by the local residents at the urban edge, and within a rural village and isolated rural properties, by users of National Cycle Route (NCR) 1, which follows the alignment of the Thames and Medway Canal, and NCR 177, visitors to the Woodland Trust's Ashenbank Wood, the Forestry Commission's Jeskyns Community Woodland, users of the Saxon Shore Way LDP and the local footpath network and bridleways. Other recreational facilities within the AONB setting include the Southern Valley golf course.
- 8.4.4 On the north side of the River Thames the Project would pass through green belt and near to areas and features which are designated for their biodiversity and heritage value including Sites of Special Scientific Interest, local nature reserves, scheduled monuments, listed buildings and conservation areas. This area is also experienced by the local residents at the urban edge, within villages and isolated rural properties, by users of National Cycle Route NCR 13, which follows the north bank of the Thames, users of Common Land (Orsett Fen and West Tilbury Marshes), visitors to Coalhouse Fort and the Thames Chase Community Forest, users of the Saxon Shore Way LDP and the local footpath network, green lanes and bridleways. Other recreational facilities include Orsett golf course and Stubbers outdoors pursuit centre.

8.5 Other Baseline Information To Be Obtained

- 8.5.1 A further desk based study would be undertaken to identify Tree Preservation Orders which could be affected by the Project. Landscape, townscape and visual surveys and baseline photography would be undertaken during winter and summer and at night-time to verify the desk based data, to identify the extent and conditions of existing landscape features, character and tranquillity, including background noise data on rural recreational receptors within the Kent Downs AONB, its setting and near to the Thames Estuary, capture seasonal changes in the screening and filtering of intervening vegetation and night time lighting, the Zone of Visual Influence within a 2km distance of the

application boundary and visual receptors which may be affected by it and the identification and photography of representative viewpoints and photomontages which would inform part of the assessment visualisations.

8.6 Key Environmental Receptors And Their Value

8.6.1 The key landscape and townscape resources and their value are set out in Table 8-2 and indicated on Figure 8.1, within Appendix F.

Table 8-2: Landscape And Townscape Resource

Landscape	Stakeholder / Local Authority	Value / Importance
Kent Downs AONB NCA 119: North Downs <i>Local Character Areas</i> Shorne Woods Ashenbank and Cobham Parklands	Natural England / Kent Downs AONB Unit	High / national
Setting to the Kent Downs AONB NCA 113: North Kent Plain <i>Local Character Areas</i> Ashenbank and Cobham Parklands Higham Arable Farmland Istead Arable Farmlands	Natural England / Kent Downs AONB Unit / Gravesham Borough Council / Kent County Council	High / national
Setting to the Kent Downs AONB NCA 81: Greater Thames Estuary <i>Local Character Areas</i> Shorne and Higham Marshes Green belt	Gravesham Borough Council / Kent County Council	High / National
NCA 81: Greater Thames Estuary <i>Local Character Areas</i> C3: Mucking Marshes C5: Tilbury Marshes Green belt	Thurrock Council	Medium / regional
NCA 111: Northern Thames Basin <i>Local Character Areas</i>	Thurrock Council / London Borough of Havering	Medium / regional

Landscape	Stakeholder / Local Authority	Value / Importance
D4: White Crofts / Orsett Heath Urban Fringe D5: Linford / Buckingham Hill Urban Fringe D6: Chadwell Escarpment Urban Fringe D7: West Tilbury Urban Fringe <i>The Landscape of the Fanns</i> Belhus Lowland Quarry Farmland Brentwood Wooded Hills Orsett Lowland Farmland Thurrock Reclaimed Fen Green belt		
NCA 111: Northern Thames Basin <i>Local Character Areas</i> E2: South Ockenden urban Area E4: Grays / Chadwell St Mary Urban Area	Thurrock Council	Low / local

8.6.2 The key visual amenity receptors and their value are set out in Table 8-3 and indicated on Figure 8.1, within Appendix F.

Table 8-3: Visual Amenity Receptors

Visual Receptor	Stakeholder / Local Authority	Value / Importance
Kent Downs AONB Shorne Woods Country Park Cobham Park Timeball and Telegraph LDP National Cycle Route 177	Natural England / Kent Downs AONB Unit	High / regional
Setting to the Kent Downs AONB National Cycle Route 1 National Cycle Route 177	Natural England / Kent Downs AONB Unit / Gravesham Borough Council / Kent County Council	High / national
Setting to the Kent Downs AONB Thong Village	Gravesham Borough	High / regional

Visual Receptor	Stakeholder / Local Authority	Value / Importance
Chalk Gravesend Urban Edge Open Access Land - Ashenbank Wood Jeskyns Community Woodland PRoW	Council / Kent County Council	
Setting to the Kent Downs AONB Southern Valley Golf Course	Gravesham Borough Council / Kent County Council	Medium / regional
Setting to the Kent Downs AONB Residential properties at Chalk and Gravesend Urban Edge	Gravesham Borough Council / Kent County Council	High / local
Setting to the Kent Downs AONB NCA 81: Greater Thames Estuary Saxon Shore Way LDP (Future England Coast Path) National Cycle Route 1 / Thames and Medway Canal Towpath PRoW	Gravesham Borough Council / Kent County Council	High / national
NCA 81: Greater Thames Estuary National Cycle Route 13 Coalhouse Fort Common Land (West Tilbury Marshes) PRoW	Thurrock Council	High / regional
NCA 111: Northern Thames Basin Thames Chase Community Forest Common Land (Orsett Fen) PRoW Green Lanes Bridleways	Thurrock Council / London Borough of Havering	High / regional
NCA 111: Northern Thames Basin Orsett Golf course Stubbers Adventure Centre	Thurrock Council /	Medium / regional

Visual Receptor	Stakeholder / Local Authority	Value / Importance
NCA 111: Northern Thames Basin Scattered rural residential and urban edge properties Urban open space	Thurrock Council	High / local

8.7 Methodology

Guidance

8.7.1 Potential effects on the landscape and townscape resource and visual amenity receptors resulting from both the construction and operational phase of the Project would be assessed in accordance with the guidance outlined in the DMRB Volume 11, associated Interim Advice Notes (IANs) and other relevant guidance. Relevant guidance documents are listed below:

- Highways Agency (2008) HA 205/08: DMRB Volume 11, Section 2, Part 5: Assessment and Management of Environmental Effects;
- IAN 135/10 sets out the requirements for Highways England and the Service Providers for the assessment and reporting of the effects of highways projects on landscape character and on views from sensitive visual receptors. It has been prepared in accordance with the principles set out in DMRB Volume 11 Section 2 providing a methodology for considering the significance of identified effects;
- Institute of Environmental Management and Assessment and the Landscape Institute (2013) Guidelines for Landscape and Visual Impact Assessment Third edition; and
- Landscape Institute (2011) Advice Note 01/11 'Photography and Photomontage in Landscape and Visual Impact Assessment'.

8.7.2 It is anticipated that IAN 135/10 will be replaced in 2018.

8.7.3 The guidance requires a number of different types of assessments to be undertaken including:

- Construction assessment on the landscape, townscape resource and on visual amenity receptors (assuming construction activities during peak period and night time construction activities and associated lighting);
- Operational assessment on the landscape, townscape resource and on visual amenity receptors, at Year of Opening (Winter) and Design year 15 (Summer) when landscape planting mitigation would be reasonably effective;
- Operational assessment on the night time landscape resource and views using the Institution of Lighting Professionals guidelines which identify Environmental Zones that define the broad night-time characteristics of areas in terms of relative brightness or darkness;

- Operational assessment on tranquillity (traffic noise and visual intrusion) of recreational receptors within the Kent Downs AONB and its setting, the Saxon Shore Way LDP (Future England Coast Path); National Cycle Route 1 and 13 and the tourist attraction at Coalhouse Fort; and

Construction Phase

8.7.4 IAN 135/10 identifies the following landscape, townscape and visual amenity construction impacts to be examined:

- Details contained in the Project design that could cause temporary or permanent direct impacts, such as the location of any demolition and other construction activity and vegetation clearance; and
- Works such as site compounds, borrow pits, access routes and numbers of heavy construction vehicles etc.

Operational Phase

8.7.5 IAN 135/10 identifies the following landscape, townscape and visual amenity operational impacts to be examined:

- Details contained in the Project design that could cause short term to permanent direct impacts such as the nature and extent of proposed land take, the location of any elevated parts of the works, visible cuttings or structures located on ridgelines, vegetation clearance;
- The height, scale, form (and lighting) of any gantries and road signs, together with other operational elements associated with the Project such as service areas, laybys, treatment lagoons, drainage features, noise barriers etc.;
- The impact of traffic, including the proportion or frequency of high sided vehicles, and of vehicle headlights at night;
- Lighting, both as a permanent visual feature during the day and as a potentially intrusive element at night; and
- Aspects of the Project that have the potential for indirect impacts, such as changes to the economic viability of the area and consequential impacts such as hedgerow removal and field amalgamation.

Study Area for the EIA

8.7.6 The criteria in IAN 135/10 for the landscape and townscape study area should cover the application site and the wider landscape context within which the Project may influence landscape and townscape character. The study area should also include the full extent of neighbouring areas and /or features of special value such as landscape, heritage and biodiversity designations, community facilities and cultural recognition.

8.7.7 The criteria in IAN 135/10 for the visual amenity study area should extend to the whole of the area from which the Project could be visible; and

8.7.8 For the purposes of the landscape, townscape and visual amenity assessment a study area extending out 2km on either side of the

application boundary is considered appropriate. The ZVI used in the landscape and visual amenity assessment would also be utilised in the cultural heritage assessment to identify any other significant cultural heritage features that have the potential to experience a setting effect and so should be included within the assessment.

Assessment Periods/Scenarios

Construction Phase

8.7.9 It is anticipated the construction period will be 6 years duration. IAN 135/10 requires the assessment to take account of the following;

- Assume a maximum visibility or maximum perceived change situation (i.e. when construction activity is at its peak for any given view), and
- Noting how long that period would be likely to last.

Operational Phase

8.7.10 IAN 135/10 requires the assessment to be undertaken for both day and night time situations using the following scenarios:

- In the winter of the year of opening (to represent a maximum effect situation, before any planted mitigation can take effect), taking account of the completed project and the traffic using it; and
- In the summer of the fifteenth year after project opening, (to represent a least effect scenario, where any planted mitigation measures can be expected to be reasonably effective), taking account of the completed project and the traffic using it.

Future Baseline

8.7.11 The future baseline (i.e. the Do-Minimum scenario) will take account of potential changes in the day and night time landscape and townscape resource and visual amenity through a review of new planning applications and other proposed developments which are consented within the study area. In terms of the impact of traffic this will utilise the traffic data provided by the traffic team for the opening year (2026) and in design year (2041).

Significance Criteria

8.7.12 The guidance in IAN135/10 or any subsequent update of this document will be used to determine whether the Project impacts are considered significant.

8.7.13 For effects on the landscape and townscape resource, the assessment of their significance is determined by considering the magnitude of impact arising from the Project on each of the features and elements that make up the character of the resource, bearing in mind the value of the landscape (and/or of specific features and elements), and the ability of the landscape to accommodate change of the type proposed (i.e. its sensitivity).

- 8.7.14 For effects on visual amenity, the assessment of their significance is determined by considering the sensitivity of the visual receptor to the magnitude of impact on visual amenity arising from the Project.
- 8.7.15 The magnitude of impact on the landscape and townscape resource and visual amenity is the degree of change that would arise if the Project were to be completed (i.e. 'Do-Something'), as compared with a 'Do-Minimum' situation. Factors to consider are the scale of the impact, the nature of the impact, whether it is an adverse or beneficial change, and the timescale involved (i.e. temporary, short, medium or long term / permanent).
- 8.7.16 Indicative criteria guidance in IAN 135/10 for the landscape and townscape resource and for visual amenity are provided in Tables 8-4 and Table 8-5 respectively. IAN 135/10 makes it clear that they are not prescriptive and in making judgements the landscape professional needs to be able to demonstrate to others a consistent and justifiable argument.

Table 8-4: Landscape And Townscape Resource - Magnitude And Nature Of Impact And Typical Descriptors

Magnitude of Impact	Typical Criteria Descriptors
Major Adverse	Total loss or large-scale damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic conspicuous features and elements.
Moderate Adverse	Partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic noticeable features and elements.
Minor Adverse	Slight loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
Negligible Adverse	Barely noticeable loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
No Change	No noticeable loss, damage or alteration to character or features or elements.
Negligible Beneficial	Barely noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Minor Beneficial	Slight improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.

Magnitude of Impact	Typical Criteria Descriptors
Moderate Beneficial	Partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.
Major Beneficial	Large scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous features and elements, or by the addition of new distinctive features

Table 8-5: Visual Amenity - Magnitude And Nature Of Impact And Typical Descriptors

Magnitude of Impact	Typical Criteria Descriptors
Major	The Project, or a part of it, would become the dominant feature or focal point of the view.
Moderate	The Project, or a part of it, would form a noticeable feature or element of the view which is readily apparent to the receptor.
Minor	The Project, or a part of it, would be perceptible but not alter the overall balance of features and elements that comprise the existing view
Negligible	Only a very small part of the Project would be discernible, or it is at such a distance that it would form a barely noticeable feature or element of the view
No Change	No part of the Project, or work or activity associated with it, is discernible.

8.7.17 Landscape sensitivity will depend on the character of the receiving landscape, the nature of the proposed project and the type of change. Visual sensitivity is categorised by the sensitivity of the visual receptor, and will include people in their homes, users of PRoW and other areas of open space or recreational landscapes, people at work and people travelling along roads or railway lines. Indicative sensitivity criteria guidance for the landscape and townscape resource and for visual amenity set out in IAN 135/10 are provided in Table 8-6 and Table 8-7 respectively. As with the determination of magnitude of impact, these are not prescriptive and in making judgements the landscape professional needs to be able to demonstrate to others a consistent and justifiable argument.

Table 8-6: Landscape And Townscape Resource – Sensitivity And Typical Descriptor And Examples

Sensitivity	Typical Descriptors and examples
High	<p>Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically, these would be;</p> <ul style="list-style-type: none"> • Of high quality with distinctive elements and features making a positive contribution to character and sense of place. • Likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale. • Areas of special recognised value through use, perception or historic and cultural associations. • Likely to contain features and elements that are rare and could not be replaced.
Moderate	<p>Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically, these would be;</p> <ul style="list-style-type: none"> • Comprised of commonplace elements and features creating generally unremarkable character but with some sense of place, locally designated, or their value may be expressed through non-statutory local publications. • Containing some features of value through use, perception or historic and cultural associations. • Likely to contain some features and elements that could not be replaced.
Low	<p>Landscapes which by nature of their character would be able to accommodate change of the type proposed. Typically, these would be;</p> <ul style="list-style-type: none"> • Comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place. • Not designated. • Containing few, if any, features of value through use, perception or historic and cultural associations. • Likely to contain few, if any, features and elements that could not be replaced.

Table 8-7: Visual Amenity – Sensitivity And Typical Descriptors

Sensitivity	Typical Descriptors
High	<ul style="list-style-type: none"> Residential properties. Users of PRoW or other recreational trails (e.g. National Trails, footpaths, bridleways etc.). Users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (e.g. Country Parks, National Trust or other access land etc.).
Moderate	<ul style="list-style-type: none"> Outdoor workers Users of scenic roads, railways or waterways or users of designated tourist routes. Schools and other institutional buildings, and their outdoor areas.
Low	<ul style="list-style-type: none"> Indoor workers Users of main roads (e.g. trunk roads) or passengers in public transport on main arterial routes. Users of recreational facilities where the purpose of that recreation is not related to the view (e.g. sports facilities).

- 8.7.18 In terms of the significance of the effect, IAN 135/10 indicates;
- A major magnitude of change on a highly sensitive receptor will produce an effect of high significance;
 - A minor magnitude of change on a less sensitive receptor will produce an effect of low or negligible significance; and
 - Major changes for less sensitive receptors and minor changes for more sensitive receptors could also produce significant levels of effect.

8.7.19 IAN 135/10 notes:

“that it is not possible to set out a precise formula for the determination of the significance of effect as every case is different, and it is therefore important that the significance level determined is supported by reasoned justification in the form of a written explanation (supported by photographs and other illustrations as appropriate), so that the basis for the assessment is clear. This is particularly important where a choice of categories is given in the matrix (e.g. where a highly sensitive receptor experiences a moderate magnitude of impact, justification for the assessment of either a moderate or large degree of significance should be given)”.

8.8 Description Of Possible Significant Effects On Receptors

Construction Phase

- 8.8.1 There is potential for significant adverse effects during the Project construction in relation to landscape character, including the high sensitivity landscape which forms the setting to the Kent Downs AONB and land identified as green belt within the rural urban fringe and high sensitivity visual amenity receptors including residential properties, visitors to heritage assets, users of the national cycle route network, LDPs, the PRow network and common land. These effects, taking account of the duration of the construction period would vary between temporary, short and medium term (i.e. during the period of the construction works only).

Operational Phase

- 8.8.2 There is potential for significant short to long term and permanent adverse effects during the Project operation in relation to landscape character, including the high sensitivity landscape which forms the setting to the Kent Downs AONB and land identified as green belt within the rural urban fringe and high sensitivity visual amenity receptors including residential properties, visitors to heritage assets, users of the national cycle route network, LDPs, the PRow network and common land. Some of these effects would be suitably minimised by the application of standard and appropriate mitigation measures (see paragraphs 8.7.23 and 8.7.24).
- 8.8.3 As per IAN 135/10 the requirement of all landscape and townscape resources and visual amenity receptors within the Zone of Visual Influence i.e. the area of land from which there could be a view of any part of the Project, will be identified and where change on the landscape and townscape resource and visual amenity would occur. At this stage, it is anticipated the extent of the study area will be 2km from the application boundary.

8.9 Potential Mitigation Measures

Construction Phase

- 8.9.1 A number of standard mitigation measures are available to help screen or minimise the visual intrusion of construction activities on nearby visual receptors and would be included in the CEMP as required. These could include;
- Appropriate siting of compound buildings and construction access routes, tall structures i.e. batching plants and silos, and working and storage areas away from residential properties where possible, and to avoid and protect areas of mature vegetation which would help to screen the work;
 - The creation of grassed earth storage mounds and appropriate hoarding (perimeter security fencing);

- Introduce a night time lighting strategy to avoid light pollution such as offsite glare and light spill in relation to night time working areas compounds; and
- Reinstatement of construction areas outside the operational areas of the Project to agricultural use and/or for nature conservation interest.

Operation Phase

8.9.2 A number of mitigation measures would be investigated to help integrate the Project with the landscape and townscape resource, including minimising impacts on tranquillity for recreational areas from noise and visual intrusion and to screen or minimise the visual intrusion in views from visual receptors. A number of these measures would also form part of the mitigation for other chapters such as nature conservation, cultural heritage and noise and will be based on DMRB Volume 10, Good Roads Guide. These measures would be incorporated into the Environmental Masterplan and could include;

- New tree and shrub planting using species appropriate to the area and to achieve their environmental objective;
- Retention of existing features such as established trees and hedgerows to aid integration;
- Creation of false cuttings i.e. the creation of artificial earthworks to help screen the Project, typically between 2 and 4m high;
- Re-grading engineered earthworks to smooth flowing contours and / or shallow slopes so that they can be returned to agriculture and thereby reducing the overall footprint of the Project and aid integration, visual; screening or to aid woodland establishment;
- Maximise the use of cuttings deeper than 4m to help screen traffic, particularly high side vehicles;
- Opportunities for green bridges to aid human and nature conservation connectivity and within the Green Belt help maintain separation between settlements;
- Offsite planting (but included within the application boundary) to screen more distant views from high sensitivity locations and visual receptors; and

8.10 Aspects/Impacts Scoped Out Of The EIA

8.10.1 At this stage, it is anticipated that both the construction and operational impacts of the Project will be considered as part of a detailed assessment and therefore no aspect will be scoped out of the assessment.

8.11 Any Other Information

8.11.1 At this stage, there is no further information to report

9 Biodiversity

9.1 Introduction

9.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on biodiversity and nature conservation during both construction and operational phases.

9.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or surveys work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess effects on biodiversity and nature conservation;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

9.1.3 Government policy for the natural environment is contained within the Natural Environment White Paper (NEWP) (2014), which aims to reduce overall biodiversity loss, support healthy, well-functioning ecosystems and to establish coherent ecological networks.

9.1.4 Legislative provisions at both the international and national level that have potential to influence planning decisions affecting biodiversity are set out in the Government Circular: Biodiversity and Geological Conservation – Statutory Obligations and their Impact within the Planning System (ODPM 06/2005, Defra 01/2005). This circular complements the national planning policy in the NPPF.

9.1.5 There are interrelationships between the Biodiversity and other environmental topics comprising:

- Chapter 6 Air Quality;
- Chapter 12 Noise and Vibration; and
- Chapter 14 Road Drainage and the Water Environment.

9.2 NPSNN Requirements

9.2.1 The NPSNN sets out the Government's policies for the development of NSIPs on the national road and rail networks. In delivering new schemes, the Government expects applicants to avoid and mitigate

environmental impacts in line with the principles set out in the NPPF and the Government's planning guidance.

9.2.2 The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications. The biodiversity and ecological conservation aspects of the NPSNN are presented from Paragraph 5.20 to Paragraph 5.38. In addition, the general assessment principles, which include the requirements for EIA and Habitats Regulation Assessment (HRA), both of which are pertinent to biodiversity and ecological conservation, are included in Section 4 - Assessment Principles, (Paragraph 4.15 to Paragraph 4.21 and Paragraph 4.22 to Paragraph 4.27 (respectively)). This also includes the consideration of alternatives, as required for both EIA and HRA.

9.2.3 The NPSNN provides information regarding what should be included in the applicant's assessment in Paragraph 5.22 and Paragraph 5.23, which state that:

"Where the project is subject to EIA the applicant should ensure that the environmental statement clearly sets out any likely significant effects on internationally, nationally and locally designated sites of ecological or geological conservation importance (including those outside England) on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity and that the statement considers the full range of potential impacts on ecosystems.

The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests".

9.2.4 The NPSNN Paragraph 5.24 advocates the application of the Government's guidance on Biodiversity as set out under Biodiversity 2020: A Strategy for England's Wildlife and Ecosystem Services (Defra 2011) for such projects. Impacts from developments also need to be viewed in the context of climate change, and the potential impacts that this may have on biodiversity should be considered as part of any assessment. Failure to address the impacts associated with climate change will result in significant impacts on biodiversity.

9.2.5 The NPSNN Paragraph 5.25 also stresses the need, subject to specific policies, that development should:

- Avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives.
- Consider the use of biodiversity offsetting, as part of compensation proposals (as a last resort), where this is required to counteract significant impacts on biodiversity which cannot be avoided or mitigated.

9.2.6 The NPSNN provides guidance for decision-making in relation to important sites and protected and notable species and habitats in Paragraph 5.27 to Paragraph 5.35. The Applicants' assessment should cover all designated sites of international (including European), national

(e.g. SSSIs, Marine Conservation Zones (MCZs)) and local importance (local wildlife sites, local nature reserves, local geological sites and Natural England's Nature Improvement Areas), protected species (e.g. European protected species, species protected under the Wildlife and Countryside Act as amended) and species with their own legislation (e.g. the Protection of Badgers Act 1992). In addition, habitat and other species of principal importance (e.g. irreplaceable habitats such as ancient woodland and veteran trees) as well as biodiversity and geological interests within the wider environment that may be affected by a scheme should be considered as part of the assessment.

- 9.2.7 It provides additional guidance with respect to the most important sites for biodiversity, i.e. those designated by international convention (e.g. Ramsar sites) and European Habitats and Bird Directives (Special Protection Areas (SPA) and Special Areas of Conservation (SACs)). Paragraph 5.27 states that: *“the Habitats Regulations (2010) provide statutory protection for European sites.”* The NPPF states that the following wildlife sites should receive the same level of protection as European sites:
- Potential Special Protection Areas (pSPAs) and possible Special Areas of Conservation (pSACs)
 - Listed or proposed Ramsar sites, and
 - Sites identified, or required, as compensatory measures for adverse effects on European sites, pSPAs, pSACs and listed or proposed Ramsar sites.
- 9.2.8 The NPSNN also states in Paragraph 5.33 that: *“Development proposals may provide many opportunities for building in beneficial biodiversity or geological features as part of good design.”* The NEWP (2014) identifies opportunities for transport to contribute to the creation of coherent and resilient ecological networks. Highways England's Biodiversity Plan also champions this approach. The NPSNN states that; *“When considering proposals the SoS should consider whether the applicant has maximised such opportunities in and around developments. The SoS may use requirements or planning obligations where appropriate in order to ensure that such beneficial features are delivered.”*
- 9.2.9 The NPSNN provides further guidance regarding the likely mitigation requirements. Paragraph 5.36 states that: *“Applicants should include appropriate mitigation measures as an integral part of their proposed development, including identifying where and how these will be secured. In particular, the applicant should demonstrate that:*
- *During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works;*
 - *During construction and operation, best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised (including as a consequence of transport access arrangements);*

- *Habitats will, where practicable, be restored after construction works have finished;*
- *Developments will be designed and landscaped to provide green corridors and minimise habitat fragmentation where reasonable;*
- *Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals, for example through techniques such as the 'greening' of existing network crossing points, the use of green bridges and the habitat improvement of the network verge."*

9.2.10 In the earlier sections of the NPSNN, Section 4 Assessment Principles, Environmental Impact Assessment, Paragraph 4.15 identifies that applications accompanied by an ES must identify, describe and assess the likely significant effects of the Project on fauna and flora. This is to include both direct and indirect effects, including secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative.

9.2.11 Applications should identify the measures envisaged for avoiding or mitigating significant adverse effects and also provide evidence that they have considered reasonable opportunities to deliver environmental benefits as part of schemes, as required under Schedule 4 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009.

9.2.12 The NPSNN also confirms that where potential impacts on European Sites are identified, a Habitat Regulations Assessment is required. Applicants must provide sufficient information to allow an appropriate assessment to be undertaken (if required) as stipulated in The Conservation of Habitats and Species Regulations, (2010) and (where applicable) the Offshore Marine Conservation (Natural Habitats &c) Regulations (2007) (as amended).

9.3 Consultations Undertaken and Proposed

9.3.1 Consultation has been undertaken with the following Statutory Environmental Bodies (SEBs) and key stakeholders during the development of the options:

- Natural England (NE);
- Environment Agency (EA);
- Royal Society for the Protection of Birds (RSPB);
- Marine Management Organisation (MMO); and
- Port of London Authority (PLA).

9.3.2 Following the 2016 public consultation, bilateral meetings were also held with the following conservation organisations;

- Buglife;
- The Woodland Trust;

- Essex Wildlife Trust; and
- Kent Wildlife Trust.

9.3.3 Engagement with key Local Authorities (LAs) has also taken place to review the scope of the proposed Ecology surveys as part of a wider review of the proposed approach to EIA for LTC. Meetings have been held with the following LAs:

- Kent County Council;
- Thurrock Borough Council;
- Gravesham Borough Council;
- London Borough of Havering; and
- Essex County Council.

9.3.4 Engagement with the Borough of Brentwood, and Medway Council is also proposed and mutually agreeable dates for a meeting are currently being sought.

9.3.5 Appendix A presents a summary of the consultation that has occurred.

9.3.6 Comments that have been received from SEBs and key stakeholders have also informed the proposed ecological survey methodology, survey areas and assessment methodology for the Project. Engagement with SEBs and key stakeholders has provided data which has been included in the initial (desk-based) assessment of the baseline ecology information for the Project.

9.3.7 For the EIA, consultation will continue with the SEBs and key stakeholders listed above. During the assessment phase, requests will be made to obtain additional desk study data to further inform our understanding of the baseline conditions and to inform them of the scope and preliminary results of the ecological surveys to ensure that, in particular, statutory consultees are in agreement with the approach that has been adopted for ecological appraisal for the Project.

9.4 Baseline Information Obtained/Surveys Undertaken

Terrestrial Ecology

9.4.1 A high-level preliminary desk study was undertaken in 2016 to inform the initial baseline for the Project which will be utilised as part of the EIA.

9.4.2 As part of these initial assessments, a HRA Screening Report was produced and a desk based Appropriate Assessment Part 1 Report was compiled to undertake an initial assessment (in the absence of survey data) of potential likely significant effects (LSE) for the Project.

International and European designated sites

9.4.3 The preliminary desk study involved a search for all designated sites potentially affected by the Project. This extended to a search of all European sites within a 30km radius of Locations A and C for the options development (refer to Chapter 3: The Alternatives Considered) to identify

the presence of any SACs designated for bats, as recommended in the DMRB Volume 11 Section 4. No bat SACs were identified, but this search also informed the initial assessment of which European sites to screen in for further assessment (as required for HRA), i.e. all European sites on or within 2km of the development boundary. Discussions were held with Natural England to confirm the approach adopted for the HRA screening and the following sites were subsequently screened in for further assessment south of the River Thames:

- North Downs Woodlands SAC,

and associated with the River Thames crossing:

- Thames Estuary and Marshes SPA;
- Thames Estuary and Marshes Ramsar site; and
- Holehaven Creek pSPA (currently designated as a SSSI).

9.4.4 These sites are also of principal importance when undertaking assessment to inform the EIA for the Project as they support s41 habitats and species (these are former UK Biodiversity Action Plan (BAP) habitats and species).

Nationally and locally important designated sites, habitats and species

9.4.5 In addition to the European designated sites search, the preliminary desk study was also used to identify the wider range of ecological features of local and national importance within the main study area for the Project. This data was obtained from the following sources:

- Defra's Multi-Agency Geographic Information for the Countryside website (MAGIC) website: <http://www.magic.gov.uk/>;
- Local Biodiversity Action Plans and Biodiversity Audits (e.g. The Thames Estuary Partnership Habitat Action Plan and Thurrock Council Biodiversity Audit) were reviewed to identify local wildlife sites and locally important sites (Local Nature Reserves) for rare species and habitats;
- Natural England's ancient woodland inventory (via the MAGIC website) and the Woodland Trust's ancient tree hunt (<http://www.ancient-tree-hunt.org.uk/discoveries/interactivemap/>) was used to identify areas of ancient woodland and individual veteran and ancient trees within the Project survey area, respectively; and
- Map data was also received from the RSPB which identified all their reserves within the Thames Estuary area.

9.4.6 This data has been used to produce Figure 9.1, within Appendix F, which identifies all the designated sites that may be impacted by the Project and any areas of functionally linked land associated with the Thames Estuary and Marshes SPA and Ramsar site, both south and north of the river crossing. This has been used to inform the scope of likely ecological surveys to inform the EIA.

9.4.7 Publicly available records of species from the National Biodiversity Network (NBN) (<https://data.nbn.org.uk/>) identified the likely presence of protected species within the Project survey area and helped to refine the likely survey requirements.

Bird species associated with international and European sites

9.4.8 To better understand the importance of the Thames Estuary for over wintering and on passage wetland bird species a number of key data sources have been consulted including:

- Natural England publications relating to the Thames Estuary and Marshes SPA and Ramsar sites, including the SPA and SAC Natura 2000 forms, Ramsar site Data Sheet, Natural England's conservation objectives for the Thames Estuary and Marshes SPA, the current condition status of the South Thames Marshes SSSI (which is encompassed by the SPA and Ramsar site designations) and a review entitled '*What do we know about the birds and habitats of the North Kent Marshes*' (Liley 2011); and
- WeBS annual core count data and estuary wide low tide dot density maps for SPA bird species provided by the British Trust for Ornithology (BTO) for the Thames Estuary.

9.4.9 The geographical coverage of the annual core count WeBS data that has been obtained is presented in Figure 9.2, within Appendix F. This covered all sites along the Thames where recent (typically within the last five years) core counts had been completed. Core count data prior to 2008 have not been included in the review. Data up to the 2013/14 winter are currently held and will be updated with the 2014/15 core count data, which is now available.

9.4.10 A detailed literature review of disturbance impacts on qualifying bird species and their habitats (e.g. noise, lighting, barrier effects, air pollution) as well as identifying their key habitat requirements (feeding /roosting preferences) and information on main dietary requirements was also undertaken to inform assessment of the potential impacts of the Project on these important ecological features.

Important habitats not covered by statutory designations

9.4.11 Following consultation with Buglife, RSPB and NE a review of other important, but undesignated, habitats was also compiled. This review identified the likely distribution of Thames terrace grassland habitats, which are unique to the Thames Estuary area and are considered to support habitats of floristic and invertebrate diversity; and areas of floodplain and grazing marsh, which may represent important supporting habitat for SPA and Ramsar site bird species.

9.4.12 Data was collated for UK BAP priority habitats using the MAGIC website and the following reports: Thames Terrace Invertebrates: A Masterplan for Landscape-scale Conservation in the Greater Thames Marshes (Essex County Council, BugLife, University of East London and Natural England 2013) and a report published by Historic England entitled Essex Historic Grazing Marsh Project (Adrian Gascoyne and Maria Medlycott

2014). Due to their importance, the UK BAP priority habitats and approximate distribution of Thames terrace grassland have been mapped to inform the survey scope and assessment for the Project, refer to Figure 9.3, within Appendix F.

- 9.4.13 Details of the proposed scope and areas to be surveyed are provided in paragraph 9.6.

Marine Ecology

- 9.4.14 In addition to terrestrial ecology (above), an assessment of marine ecology was carried as part of the long and short list options appraisals, HRA Screening Report, and the desk-based Appropriate Assessment Part 1 Report.

- 9.4.15 Desk study data to inform these initial assessments of the short list of options was obtained from the following sources:

- Thames Estuary 2100 flood risk plan (TE2100) and supporting documents provided by the EA;
- Baseline hydrodynamic modelling for the Project provided by Hyder-Halcrow Joint Venture (HHJV) which was produced to assess potential in-river impacts associated with bridge or immersed tube river crossings for the various short list options;
- Initial geomorphology assessment for the Project provided by HHJV for the Thames Estuary;
- JNCC and Natural England advice on the recommended Marine Conservation Zone (rMCZ) for the Thames Estuary;
- The Thames Estuary Partnership Biodiversity Action Group's Tidal Thames Habitat Action Plan;
- UK BAP priority habitats (from the Defra MAGIC website: <http://magic.defra.gov.uk/>);
- Fisheries sensitivity map of British waters main spawning and nursery grounds (Coull *et al.* 1998);
- Spawning and nursery grounds of selected fish species in UK waters (Ellis *et al.* 2012);
- Benthic ecology of the Thames Estuary, trawl data from Port of London Authority 2002-2005 (ABP Mer 2007a); and
- Thames Estuary Marine Mammal signings survey Zoological Society of London (ZSL) (ZSL 2015a).

- 9.4.16 It is currently uncertain what, if any, impacts to the marine environment within the Thames Estuary may occur as a result of the Project. The reliance on the Thames Estuary's intertidal habitats by the qualifying bird species associated with the SPA and Ramsar sites, the importance of these intertidal habitats and the species which they support, and the fact that the Thames Estuary is a recommended Marine Conservation Zone (MCZ), requires that the marine ecology interests are assessed as part

of the EIA until such a time they are able to be ruled out of further assessment.

- 9.4.17 The requirement for surveys to assess the marine ecology interests has yet to be confirmed as part of the emerging design (e.g. the potential requirement for a project-specific jetty to be constructed and/or the use of existing neighbouring facilities). This will also be further informed by the results of additional desk study data. Where sufficiently recent and up to date data is available to assess certain elements (e.g. fisheries data from the Environment Agency, marine mammal data from Zoological Society of London) it may be possible to rule out the requirement for additional survey work. Current proposals for further survey work, based on initial discussions with Natural England, are included in paragraph 9.6.

Initial survey work completed to date

- 9.4.18 Bird survey work to support the HRA commenced on 10 April 2017. This involves twice monthly 6hr vantage point surveys (VPs) overlooking the estuary north and south of the proposed crossing location plus a 500m buffer. In addition, twice monthly walked transects are taking place within an area of Ramsar site and SSSI to the south of the crossing, and to the north of the crossing areas of potential functional habitat are assessed, including East and West Tilbury Marshes Tilbury Marshes (Bretts Farm) and Biggin Marsh Farm. Surveys in these areas are used to establish if these areas are used by birds associated with the Thames Estuary and Marshes Ramsar site and SPA. These monthly and twice monthly surveys are due to continue through to the end of March 2019 to provide two years of detailed assessment in addition to BTO WeBS data for the Thames Estuary. See details of the survey approach in Table 9.1 and Appendix C.
- 9.4.19 The first year of breeding bird surveys of four SSSIs (Shorne and Ashenbank Woods, Cobham Woods, Great Crabbles Wood and Hangmans Wood and Deneholes) and the European sites/areas of functional habitat (identified above) to inform the EIA have been completed (24 April – 26 July 2017) and will be repeated between April and July during 2018. Details of the survey methodology is included in Table 9.1 and Appendix C.
- 9.4.20 The Phase I survey of the route alignment + 50m buffer has also commenced, with surveys starting on 17 July 2017. Details of the survey methodology is included in Table 9.1 and Appendix C.
- 9.4.21 Reptile surveys – These surveys commenced on 4 September and will continue through to early October 2017 (weather conditions permitting). Surveys will recommence in 2018 to ensure all areas identified as having potential to support reptiles have been assessed. Details of the survey methodology is included in Table 9.1 and Appendix C.
- 9.4.22 Water vole and otter surveys commenced in Shorne and Filborough Marshes on 21 August 2017 to take advantage of site access restrictions associated with the Metropolitan Police use of the Milton Firing Range (Eastcourt Marshes and associated exclusion zone within Shorne

Marshes). Surveys for water voles elsewhere along the route alignment are due to start in September 2017. Details of the survey methodology is included in Table 9.1 and Appendix C.

- 9.4.23 Initial badger surveys commenced on 2 October within the 500m buffer for the Project alignment. Further surveys will be carried out in 2018 (including bait-marking for setts directly impacted by the Project). Details of the survey methodology is included in Table 9.1 and Appendix C.
- 9.4.24 Dormice nut searches commenced on 9 October. Further surveys will be carried out in 2019 (dormouse nest tubes will be deployed in areas of suitable habitat where dormice are confirmed through desk study or nut searches or where presence could not be ruled out from nut searches). Details of the survey methodology is included in Table 9.1 and Appendix C.

9.5 Other Baseline Information To Be Obtained

- 9.5.1 A detailed desk study will be undertaken to inform the assessment of both the terrestrial and marine environments affected by the Project. Additional data will be requested from the following sources:

- Natural England;
- RSPB;
- BTO;
- Buglife;
- Plantlife International;
- Essex Wildlife Trust/ Essex Field Club;
- Kent and Medway Biological Records Centre;
- Kent Downs AONB;
- MMO;
- EA;
- West Kent Badger Group;
- Essex Badger Protection Group;
- Kent ornithological Society;
- Essex Birdwatching Society;
- Woodland Trust;
- Centre for Ecology and Hydrology (CEH);
- Botanical Society of Britain and Ireland (BSBI);
- Port of London Authority;
- The Zoological Society of London (ZSL);
- Tilbury 2 Development (public domain documents);

- Ferrovia Agroman UK Ltd. & Laing O'Rourke Construction Joint Venture (public domain documents); and
- London Resort Company Holdings Limited (public domain documents).

9.5.2 Details of the data that is proposed to be obtained from each source is provided in Table 9B-1 in Appendix B.

9.5.3 In addition to a detailed desk study, an extended Phase 1 habitat survey within the application boundary of the Project (with appropriate buffers ranging from 20m – 2km to accommodate more wide-ranging species and designated sites) is proposed for the 2017 field season. The extended Phase 1 habitat survey will follow best practice guidelines (JNCC 2010).

9.5.4 Based on current knowledge, and in the absence of survey data and further engagement with stakeholders, Tables 9-1 and 9-2 outline the surveys that may be required and the methods that may typically be applied. More detail about potential methods for these surveys and references to the survey guidelines is set out in Appendix C.

Table 9-1: Proposed Terrestrial Ecology Surveys For EIA And HRA

Survey	Area requiring survey (application boundary or application boundary + additional)	Survey window	Survey frequency / duration
EIA			
Extended Phase 1	Application boundary + 50m buffer	Apr - Oct	Once, year 1 (2017)
NVC – phase 2 botanical surveys	Application boundary	May - Sep	Once per site, year 2 (2018)
Trees	Application boundary + a minimum 20m buffer (dependent on site specific conditions)	No restriction	Once per survey area, commencing year 1 (2017-2018)
Water vole <i>Arvicola amphibius</i>	Application boundary + 50-500m (depending length of watercourse affected by the Project).	Mid-Apr-Sep	Two surveys, at least two months apart, per watercourse. (2017-2018) Survey effort may be reduced if presence confirmed on first survey visit.

Survey	Area requiring survey (application boundary or application boundary + additional)	Survey window	Survey frequency / duration
Otter <i>Lutra lutra</i>	Application boundary + 1km	Anytime, Spring preferred	Four surveys at three monthly intervals over a 12 month period, per watercourse. (2017-2018)
Great crested newt <i>Triturus cristatus</i> Habitat Suitability Index survey	Application boundary + 500m	Mar - Jun	Once per pond, year 1 (2017) - as part of the Extended Phase 1 survey
Great crested newt <i>Triturus cristatus</i> population surveys	Application boundary + 500m	Mid-Mar – mid-Jun	Between four and six visits per pond undertaken in one season, year 2 (2018)
Bats (building and tree inspections)	Application boundary + 100m for trees/structures directly or indirectly impacted by construction and operation	May - Sep	Initially, as part of Phase I survey to identify trees & structures suitable for use by roosting bats, Year 1 (2017) internal inspection, Year 2 (2018)
Bats (emergence and activity surveys)	Application boundary + 500m, but extending up to 5km buffer where significant roosts are identified from DS that may be impacted by proposals. If any protected sites designated for bats are identified within 10km these sites would also require assessment.	May - Sep	Multiple return visits (up to three emergence surveys per tree / structure, monthly activity surveys may be required to assess commuting routes) within survey window, year 2 (2018)

Survey	Area requiring survey (application boundary or application boundary + additional)	Survey window	Survey frequency / duration
Dormice <i>Muscardinus avellanarius</i> (nest tubes and nut search)	Application boundary + 500m (for nest tubes to be spaced at 20m intervals along hedgerows or into woodland either side of redline)	Apr – Oct (nest tubes); Sep – Dec (nut search)	Nest tubes installed (April) and then checked once per month March- October for one year, year 2 (2018). Nut search will occur once, year 1 (2017).
White-clawed crayfish <i>Austropotam obius pallipes</i>	Application boundary + 50-500m (depending length of watercourse affected by the Project)	Mid-Jul – mid-Sep	Once, year 2 (2018) assuming Desk Study records confirm presence in local watercourses in south Essex /north Kent
Badger <i>Meles meles</i>	Application boundary + 500m, extending up to 1km where setts are identified which require closure	Nov- Feb	Once, end of year 1/early year 2 (2017-2018)
Badger bait marking	Application boundary + 1km	Late Feb – early Apr, and early Sep – mid Oct.	Three weeks in one year (if required) per affected sett (i.e. to determine if suitable alternative shelter for badgers is available), year 2 (2018).
Reptiles	Application boundary	Apr – May and Sep	Seven visits within one year, per site, year 2 (2018)
Invertebrates (Thames Terrace Grassland)	Application boundary + 200m (impacts from air pollution)	May - Sep	Two surveys within one year, per site, year 2 (2018)

Survey	Area requiring survey (application boundary or application boundary + additional)	Survey window	Survey frequency / duration
sites /Ancient woodland)			
Breeding birds (EIA)	Application boundary + 200m	Apr - Jul	Monthly surveys, year 1 (2017) and year 2 (2018)
Winter and migration birds (EIA)	Application boundary + 200m	Sep - Mar	Monthly surveys, year 1 (Sep 2017 – Mar 2018)
Noise (for breeding and wintering/migratory birds)	Application boundary + 200m	Mar, May, Sep, and Nov	Once per quarter for one year, year 2 (2018)
HRA			
Ramsar site NVC – phase 2 botany surveys	Application boundary + up to 3km (theoretical worst case scenario for potential extent of hydrological changes in absence of mitigation)	Jun - Oct	Two survey visits in one year, year 2 (2018)
Ramsar site invertebrates	Application boundary + up to 3km (theoretical worst case scenario for potential extent of hydrological changes in absence of mitigation)	May - Sep	Two survey visits in one year, year 2 (2018)
Birds spring/ autumn/winter (SPA/Ramsar sites/potential functional habitat)	Application boundary + 500m for vantage point surveys, Application boundary +1km for assessment of functional habitat	Apr - Jun (spring) Jul - Oct (autumn) Nov - Mar (winter)	Twice monthly surveys for two years, year 1 & 2 (2017/18 & 2018/19)
Nocturnal birds winter (SPA/Ramsar site/potential functional habitat)	Application boundary + 500m and 1km inland from SPA boundary to assess use of functional habitat.	Nov - Mar (winter)	Once a month for two years, year 1 & 2 (2017/18 & 2018/19)

Survey	Area requiring survey (application boundary or application boundary + additional)	Survey window	Survey frequency / duration
Noise (for birds associated with SPA/Ramsar sites)	Application boundary + 500m	Mar, May, Sep, Nov	Surveys once a quarter to establish a representative sample of baseline conditions for one year, year 2 (2018)
Air quality (designated sites)	Application boundary + 200m	Full 12 months	Diffusion tubes changed monthly, deployed for one year, commencing year 1 (2017-18)

Table 9-2: Potential Marine Ecology Surveys For EIA And HRA (If Required)

Survey	Area requiring survey (Application boundary or Application boundary + additional)	Survey window	Survey frequency / duration
Intertidal ecology survey: Phase I GIS Mapping of Marine Biotopes	Application boundary of potential jetty location	Between April and October, at least two hours before spring tide low water (daylight permitting)	Once, year 2 (2018) Only once need for in-river works and location are confirmed
Collection and analysis of sediments and contaminant samples	Application boundary of potential jetty location	During low flow in summer or autumn	Once, year 2 (2018) Only once need for in-river works

Survey	Area requiring survey (Application boundary or Application boundary + additional)	Survey window	Survey frequency / duration
			and location are confirmed
Subtidal ecology surveys /Benthic substrate and invertebrate surveys	Application boundary + buffer of 1km upstream and 0.3km down stream of potential jetty location	Early autumn	Once year 2 (2018). Assumption of potential jetty location will need to inform approximate Application boundary to enable survey to be completed
Hydrodynamic and sedimentological modelling to identify impact pathways (if any) from dredging on marine environment/species	Modelling to be based on potential jetty location	N/A	N/A laboratory and computer based assessment of impacts from piling or dredging required as part of in-river works
Underwater noise survey and modelling to assess impacts on fish and marine mammals	Survey and modelling to be based on potential jetty location	2 wks survey (timing To Be Confirmed with MMO,PLA, EA)	Once, Year 2 (2018)

9.5.5 In addition, the impacts of night time working on fish and marine mammals will be considered as part of the EIA, should the construction and operation of a jetty be required for the Project.

9.5.6 Upon completion of the detailed desk study, and once the extended Phase I survey is largely completed, detailed follow-up surveys identified in Tables 9-1 and 9-2 (if required) for protected species will commence. This is to ensure completion of the necessary surveys as required to

inform the EclA in support of the DCO application in 2019. These surveys will follow best practice guidelines for individual species and habitat types and will comply with the survey guidelines recommended in DMRB Volume 10, Section 4, Parts 2 to 7.

9.6 Key Environmental Receptors And Their Value

9.6.1 It is acknowledged that there has been an update to the Chartered Institute for Ecology and Environmental Management (CIEEM) EIA Guidelines (2016). This states that the term ‘key environmental receptors’ has been replaced with ‘Important Ecological Features’. The latter term is used hereinafter throughout this chapter.

Terrestrial Ecology

9.6.2 The criteria for determining the significance of ecological impacts differ from most other environmental disciplines within EIA. This is because significance is assessed with regard to the long-term viability or integrity of species populations or habitats, and impacts are considered to be either significant or not significant. Gradation in the severity of the significant effect is provided by the geographic scale at which the ecological receptor has been assessed as being of importance.

9.6.3 Within the EIA requirements for road schemes, a number of Important Ecological Features were identified in the HRA Screening Report, the initial phases of Appropriate Assessment and as part of the Highways England appraisal of the short list options. Of particular importance are the qualifying features associated with the internationally important sites that have been scoped in for further assessment, as detailed in 9-3.

Table 9-3: Important Ecological Features Of International Value

Designated site	Important Ecological Feature (qualifying feature of designated site)
South of the River Thames	
North Downs Woodlands SAC habitats	<i>Taxus baccata</i> woods of the British Isles (Yew-dominated woodland; an Annex I priority habitat); <i>Asperulo-Fagetum</i> beech forests (Beech forests on neutral to rich soils)
	Semi-natural dry grasslands and scrubland facies: on calcareous substrates <i>Festuco-Brometalia</i> (dry grasslands and scrublands on chalk or limestone)
River Thames crossing	
Thames Estuary and Marshes SPA	Intertidal habitats
	Saltmarsh
	Coastal grazing marsh
	Saline lagoons

	Chalk pits
	Over winter: Hen harrier <i>Circus cyaneus</i> , avocet <i>Recurirostra avosetta</i> , dunlin <i>Calidris alpine</i> , red knot, <i>Calidris canuta</i> , black-tailed godwit <i>Limosa limosa</i> , grey plover <i>Pluvialis squatarola</i> , redshank <i>Tringa tonus</i> ;
	On passage: ringed plover <i>Charadrius hiaticula</i>
	75019 waterfowl over winter, including avocet, grey plover, red knot, dunlin, black-tailed godwit, redshank
Thames Estuary and Marshes Ramsar site	Saltmarsh
	Grazing marsh
	Intertidal mudflats
	Floodplain grazing marsh and ditches
	Saline lagoons
	One endangered plant species; 14 nationally scarce wetland plant species
	20 Red Data Book invertebrates
	Over winter: Dunlin, red knot, grey plover, redshank
	On passage: ringed plover and black-tailed godwit
	45118 waterfowl over winter
Holehaven Creek pSPA (based on current SSSI designation)	Intertidal mudflats
	Saltmarsh
	Black-tailed godwit over winter
	8,000 waterfowl during the winter, including curlew <i>Numenius arquata</i> and dunlin

9.6.4 Important Ecological Features detailed as qualifying features of SSSIs and National Nature Reserves (NNRs) would be assessed as having national importance. The qualifying features associated with the nationally important sites that have been scoped in for further assessment, are detailed in Table 9-4.

Table 9-4: Nationally Important Ecological Features

Designated site / ancient woodland	Important Ecological Feature (qualifying feature of designated site)
South of the River Thames	
Wouldham to Detling Escarpment SSSI	Representative examples of woodland, scrub and unimproved grassland habitats on chalk,

Designated site / ancient woodland	Important Ecological Feature (qualifying feature of designated site)
	which support a number of nationally rare and scarce species of plants and invertebrates.
Cobham Woods SSSI	Ancient woodland and parkland supporting rare plant species and breeding birds.
Shorne and Ashenbank Woods SSSI	Ancient woodland and diverse invertebrate fauna.
Great Crabbles Wood SSSI	Ancient woodland; a number of scarce plants occur, including lady orchid <i>Orchis purpurea</i> and man orchid <i>Aceras anthropophorum</i> .
Claylane Wood	Area of ancient woodland known locally as Claylane Wood.
Court Wood LWS	Ancient and ancient replanted woodland incorporating Court Wood and Starmore Wood.
River Thames crossing	
South Thames Estuary and Marshes SSSI	Waterfowl (redshank, knot, dunlin, avocet, ringed plover, European white-fronted goose <i>Anas strepera</i> , teal <i>Anas crecca</i> , pintail <i>Anas acuta</i> , shoveler <i>Anas clypeata</i> , grey plover, curlew, black-tailed godwit and greenshank <i>Tringa nebularia</i>) Breeding bird community (garganey <i>Anas querquedula</i> , pintail, avocet and bearded tit <i>Panurus birmicus</i>). Specially protected birds (hen harrier, short-eared owl <i>Asio flammeus</i> , ruff <i>Philomachus pugnax</i> , common tern <i>Sterna hirundo</i> , avocet and golden plover <i>Pluvialis apricaria</i>) Habitats: Grazing marsh, dykes and fleets with the grazing marsh, saltmarsh, mudflats, freshwater pools, shingle and woodland habitats.
Mucking Flats and Marshes SSSI	Mudflats, saltmarsh and grassland. Wintering wildfowl and waders
North of the River Thames	
Hangman's Wood & Deneholes SSSI	Ancient and semi-natural woodland; medieval chalk mines which provide the most important underground hibernation site for bats in Essex. Species recorded include: brown long-eared bat <i>Plecotus auritus</i> , Natterer's bat <i>Myotis nattereri</i> and Daubenton's bat <i>Myotis daubentonii</i>
Broom Hill LWS	Ancient acid grassland flora and diverse invertebrate community.
Terrels Heath LWS	Ancient woodland known locally as Chadwell Wood.
Rainbow Shaw LWS	Small ancient woodland fragment.

Designated site / ancient woodland	Important Ecological Feature (qualifying feature of designated site)
Clay Tye Wood	Possible ancient woodland, only natural habitat within London that supports nesting rooks.
Franks Wood	Ancient and semi-natural woodland dominated by hornbeam coppice.
Hobbs Hole Wood LWS	Ancient woodland, lowland mixed deciduous woodland.
Codham Hall Wood LWS	Ancient woodland, lowland deciduous woodland dominated by Hornbeam coppice, including Penduculate Oak, Sweet Chestnut, Sycamore and Silver Birch
Coombegreen Wood AW (Foxburrow Wood & Coombe Wood)	Ancient and semi-natural woodland, lowland mixed deciduous woodland on non-ancient sites

9.6.5 Species that have limited range within the south east will be considered as regionally Important Ecological Features, whilst habitats and species associated with local wildlife sites and local nature reserves are considered to have local importance. Table 9-5 identifies the local sites that may potentially be impacted by the Project.

Table 9-5: Locally Important Ecological Features

Local Wildlife Site/ Local Nature reserves	Important Ecological Feature (qualifying feature of designated site)
South of the River Thames	
Canal and Grazing Marsh, Higham LWS	The site includes Eastcourt Marshes and a long stretch of the Higham Canal which has recently been restored to open water, with common reed <i>Phragmites australis</i> on some of the banks.
River Thames crossing	
Goshems Farm LWS	Old landfill area supports two important species populations: the nationally rare Red Data Book plant Stinking Goosefoot <i>Chenopodium vulvaria</i> and the hornet robberfly <i>Asilus crabroniformis</i> .
Tilbury Centre LWS	Mosaic of grassland, ditches, a reed bed and a pond. A colony of Stonewort <i>Chara sp.</i> and the nationally rare great silver beetle <i>Hydrophilus piceus</i> as well as other rare invertebrates.
Tilbury Marshes LWS	Relic grazing marsh, saltmarsh, brackish ditches and the grassland of Tilbury Fort. As well as a saltmarsh habitat and invertebrate assemblage.

Local Wildlife Site/ Local Nature reserves	Important Ecological Feature (qualifying feature of designated site)
North of the River Thames	
Lytag brownfield LWS	Four reptile species (adder <i>Vipera berus</i> , grass snake <i>Natrix natrix</i> , common lizard <i>Zootoca vivipara</i> and slow worm <i>Anguis fragilis</i>) a developing acid grassland and an important invertebrate community.
Low Street Pit LWS	Thames terrace gravels and the national BAP species, the hornet robberfly.
West Tilbury Church LWS	Ancient grassland and botanical interest.
West Tilbury Hall LWS	River terrace with acidic grassland and a diverse invertebrate fauna.
Linford Pit LWS	Brownfield sit supporting important invertebrate fauna.
Mucking heath LWS	Ancient heathlands and acid grassland.
Blackshots Nature Area LWS	Rough grassland supporting an important invertebrate population and nesting habitat for ground nesting birds such as Skylark.
Cranham Marsh LNR	Marshland, Sedge Fen and ancient woodland.
Cranham Brickfields LNR	Former brickfield with large areas of grassland and scrub supporting rare plants (Dyer's greenweed, pepper saxifrage), reptiles (slow worm, common lizard), invertebrates (stag beetle, butterflies) and great crested newts.

9.6.6 In addition to features present within designated sites listed above, the following are deemed likely to be potentially Important Ecological Features which have been scoped in for further assessment:

- Irreplaceable habitats, such as ancient woodland and veteran or ancient trees not protected by site designations (e.g. Claylane Wood);
- Protected species of conservation concern:
 - Bats and bat roosts;
 - Dormice;
 - Water voles;
 - Otter;
 - Badger;

- White-clawed crayfish;
 - Terrestrial invertebrates;
 - Aquatic invertebrates;
 - Breeding and wintering birds (including schedule 1 species);
 - Reptiles;
 - Amphibians; and
 - Schedule 8 plants.
- Invasive non-native plant species detailed on schedule 9 of the Wildlife and Countryside Act.
 - Section 41 species (where confirmed by desk study results):
 - Invertebrates;
 - Vascular plants;
 - Mammals (e.g. harvest mouse *Micromys minutus*, brown hare *Lepus europaeus* and hedgehog *Erinaceus europaeus*); and
 - Lower plants (fungi bryophytes and lichens).

9.6.7 The presence/absence of these Important Ecological Features will be assessed through the proposed suite of ecological surveys required to inform the assessment phase for the Project (refer to Appendix C for survey methodologies). These survey requirements have been determined on the basis of the current understanding of the ecological baseline. If further survey requirements are identified, following the completion of the detailed desk study, the survey methodologies will be updated accordingly.

Marine Ecology

9.6.8 Important ecological features included in the Advice to Defra on recommended MCZ (Natural England and Defra 2012) listing for the Thames Estuary are detailed below:

- Sheltered muddy gravels;
- Intertidal and muddy sand;
- Intertidal mixed sediments;
- Subtidal coarse sediments;
- Subtidal sand;
- Tentacled lagoon worm *Alkmaria romijni*;
- European Eel *Anguilla anguilla*; and
- Smelt *Osmerus eperlanus*.

9.6.9 The Thames Estuary rMCZ contains the second highest density of eels in all EA surveyed estuaries, The European Eel *Anguilla anguilla* and Marine Conservation Zones (Environment Agency 2010). The rMCZ

protects the whole extent of the seasonal seaward migration of smelt and eel. The combinations of habitats, particularly towards the estuary mouth, are considered important for ecosystem services, specifically fisheries Balanced Seas Marine Conservation Zone Project: Final Recommendations (Balanced Seas 2011).

- 9.6.10 These features are likely to be classed as nationally important, as the MCZ, if established, would be classed as a nationally designated site.

9.7 Methodology

Guidance

- 9.7.1 The following guidance will be used when undertaking the Ecological Impact Assessment:
- The Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 4 (1993)
 - IAN 130/10) (2010) Highways England's Interim Advice Note which updates the DMRB criteria for the assessment of Ecology and Nature Conservation
 - IAN 141/11 (2011) which provides updated guidance for the Assessment of Implications on European Sites and the Planning Act 2008
 - The Chartered Institute for Ecology and Environmental Management (CIEEM) Guidelines for ecological impact assessment in the UK and Ireland, terrestrial, freshwater and coastal (EcIA) (2016).
- 9.7.2 Following these guidance documents will ensure the assessment complies with the requirements of the NPSNN. It will also allow the determination of any potentially significant impacts on important ecological features within the zone of influence of the Project and identify whether there is a risk of the Project failing to meet requirements set out in the NPSNN, as well as national and international legislative requirements in relation to protected areas, habitats or species (so called 'Important Ecological Features').
- 9.7.3 In accordance with the CIEEM Guidelines, Important Ecological Features are defined as:
- *Ecological features that are of local or greater importance for biodiversity; and/or*
 - *Ecological features that should be considered due to their legal status.*
- 9.7.4 For example, while badgers are not considered to be of importance for biodiversity, they are included as an Important Ecological Feature due to the protection they receive under the Protection of Badgers Act (1992). Likewise, invasive non-native plant species that are listed under Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) (for which it is an offence to plant or otherwise cause to grow in the wild), are also included as Important Ecological Features for consideration in this assessment.

9.7.5 The importance of ecological features present within the Zol of the Project is assessed on the basis of a combination of their rarity, status and distribution. The CIEEM guidelines indicate a geographical frame of reference presented in or determining the level of importance of Important Ecological Features. The CIEEM approach to the valuation of Important Ecological Features has been compared with the approach adopted by WebTAG and Highways England's IAN 130/10 in Table 9-6 below.

Table 9-6: Geographical Scale Of Important Ecological Features

Geographical scale (CIEEM)	Definition	WebTAG categorisation of value for biodiversity feature	IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment resource valuation	Examples
International	Importance above the UK level, typically at European level	Very high High importance and rarity, international scale and limited potential for substitution	International or European value	Internationally important statutory designated sites for nature conservation or candidate sites (SACs, SPAs, Ramsar sites) and their qualifying features, such as internationally important populations of wintering birds.
National	England	High High importance and rarity, national scale, or regional scale with limited potential for substitution	UK or national value	Nationally important statutory designated sites for nature conservation (SSSIs, NNRs) and their qualifying features.
Regional	South East	Medium High or medium importance and rarity, local or regional scale, and limited potential for substitution	Regional value	A species that is present with the South East in low numbers, but is present in other areas of the UK e.g. at the edge of its range
County	Kent and Essex		County or unitary authority value	Local Nature Reserved (LNRs), County Wildlife Sites (CWS), Biological Heritage Sites (BHSs), ancient woodland, habitats or species of importance for Kent and Essex including LBAP priority habitats and species
Local	Importance at the level of unitary authorities, cities or boroughs.	Low Low or medium importance and rarity, local scale	Local value	Habitats/species that are listed as being of Principal Importance under Schedule 41 of the Natural Environment and Rural Communities (NERC) Act 2006, e.g. species-rich hedgerows.

- 9.7.6 Features that are considered to be of local importance for biodiversity or greater, which could be affected by the Project will be identified as Important Ecological Features. Effects on features of lower than local importance (i.e. application site importance) will not be assessed within the EIA, with the exception of those that warrant mitigation to ensure legislative requirements are adhered to (as detailed above).

Study Area for the EIA

- 9.7.7 The indicative extent of the Project is presented on Figure 2.1, within Appendix F. At present, the exact location and configuration of construction compounds and storage areas for excavated material are uncertain.
- 9.7.8 The ecological study area includes the development footprint plus an appropriate ecological buffer that varies according to the spatial distribution of the important ecological features (species and habitats) potentially impacted by the Project. For example, the extended Phase 1 survey covers the application boundary plus a 500m buffer, but where bat roosts are identified as a result of the desk study, this buffer could extend to 2km -5km (possibly as far as 10km) from the application boundary at specific locations. Figure 9.4, within Appendix F, identifies the likely ecology buffers that would be applied for the proposed survey work.
- 9.7.9 Specific survey locations for bird surveys of the River Thames Crossing; to inform both the EIA and the HRA have been identified. These include vantage point locations south and north of the river and transect routes to assess the use of habitat that may act as functionally linked land adjacent to the estuary (closely associated with historic distribution of coastal floodplain and grazing marsh). The survey areas are shown on Figure 9.3, within Appendix F.
- 9.7.10 Assessment of noise impacts on SPA and Ramsar site qualifying bird species are also proposed. Pre-construction surveys aim to establish a robust 'baseline' of existing conditions to understand what noise levels the birds are habituated to from normal daily activity on and alongside the Thames Estuary at this location. The locations of these monitors and the methodology for the monitoring will be discussed with the noise team and with Natural England.
- 9.7.11 Assessment of current levels of air pollution will be measured to understand the current baseline conditions and to inform future projections for traffic-related air pollution and its likely impacts on sensitive habitats and species they support. Locations for air quality monitoring will be agreed with the Air Quality Team following analysis of the updated traffic survey and associated modelling and in consultation with Natural England and Local Authorities (as required).

Assessment Periods/Scenarios

Pre-construction assessment

- 9.7.12 To establish ecological baseline information in relation to the pre-construction assessment, ecological survey data will need to be gathered. Based on the survey programme outline above in paragraph 9.5, this will require a minimum of two years pre-construction survey, specifically in relation to SPA bird species for the HRA, and one year's survey of other protected species and habitats to inform the baseline assessment and mitigation and/or compensation requirements.

Construction

- 9.7.13 The construction period is likely to be a six year program and will comprise the main period when the most significant impacts on terrestrial and marine ecology are most likely to occur. Construction impacts will be identified during the pre-construction assessment and, where required, ecological mitigation measures will be put in place prior to construction commencing. Due to the length of the construction period, ongoing monitoring will be carried out throughout the construction footprint to make sure that no new ecological constraints arise during this time, for example newly excavated badger setts.

Operation

- 9.7.14 Post construction monitoring is also likely to be required, however this is dependent on the Important Ecological Features present and the mitigation and/or compensation that will be required for the Project. Details of the post-construction monitoring requirements will therefore be confirmed during the EIA, but are likely to be tied to licensing requirements for protected species and the proposed mitigation strategies and compensation and enhancement measures for the Project that will be agreed with statutory consultees.

Future Baseline

- 9.7.15 To account for changes in the future baseline, it is common that a future 'do nothing' scenario (also referred to as the Do-Minimum scenario) be considered for the ES. This will provide a forecast of what the future baseline conditions will be accounting for all factors, but without the particular development under consideration. To enable direct comparison between this and the 'post development' impact predictions made during the EIA, this future scenario will often be set at the opening year of the proposed development. For the Project, this would comprise the opening year 2026.
- 9.7.16 The majority of the Project crosses green belt, which is currently used for agricultural (largely arable with some areas of grazing) and recreational purposes. In the absence of the Project, it is anticipated that the management of the land will remain unchanged.
- 9.7.17 In the absence of the Project, the only foreseeable changes that could affect these habitats would be in relation to changes air quality and noise resulting from changes in traffic use of the existing road infrastructure. Whilst there are no obvious impacts from changes in air quality to the

South Thames Estuary and Marshes SSSI, the Thames Estuary and Marshes SPA or Ramsar site adjacent to the Thames Estuary, as these designated sites are currently more than 200m from the existing road network (and therefore are exposed to existing low background levels of air pollution). Traffic related air quality impacts may still affect the North Downs Woodlands SAC and Wouldham to Detling Escarpment SSSI; both these sites lie south of the river outside of the application boundary, in relation to future traffic volumes on the A229. At this location, habitats associated with the SAC and SSSI are both less than 100m from the roadside and therefore lie within the zone of impact from air pollutants from traffic (NO_x and particulates). Currently, the ancient woodland habitats associated with the SAC are experiencing exceedances in their critical loads for these pollutants, which can affect plant health and result in changes to the structure of the vegetation on the site. The grassland habitats associated with the SSSI may become similarly affected if traffic volumes increase in the future.

- 9.7.18 Acoustic changes from the existing road network have the potential to affect species supported by habitats throughout the survey area for the Project, particularly in more open rural environments. For a future baseline, information provided by traffic modelling and extrapolated air quality and acoustic predictions for year of opening (2026) would need to be assessed to see if impacts from traffic would be significant.

Significance Criteria

- 9.7.19 For the purpose of the EIA the potential for significant effects of the Project on the identified Important Ecological Features will be assessed primarily using the CIEEM guidelines, (CIEEM 2016).
- 9.7.20 The CIEEM Guidelines define a significant effect as *'an effect that either supports or undermines biodiversity conservation objectives for 'important ecological features' or for biodiversity in general'*.
- 9.7.21 Potential effects will be characterised and described using the following parameters set out in the CIEEM guidelines:
- Positive or negative;
 - Magnitude (size or amount of an effect);
 - Extent (the area over which the effect occurs);
 - Duration (the time the effect is expected to last prior to recovery or replacement of the resource or feature);
 - Reversibility (permanent or temporary); and
 - Timing and frequency (some changes may only cause an impact if they coincide with critical life-stage or seasons (e.g. bird nesting season)).
- 9.7.22 Where a significant effect is identified, the importance of the ecological feature is used to help determine the geographical scale at which the effect is significant.

9.7.23 If significant adverse effects are considered likely, the assessment will present mitigation measures that may be required to avoid or minimise a significant adverse effect. The detail of such mitigation would be informed by additional survey data and in agreement with statutory consultees. If after implementation of mitigation measures, a residual effect is anticipated, potential compensation measures may be required. The approach to determining the importance of ecological features and the significance of effects described above is in accordance with the CIEEM Guidelines. Table 9-7 provides a comparison of the approach for ecology with that of other disciplines when defining significance of impacts on Important Ecological Features:

Table 9-7: CIEEM Guidelines Significance, Compared To IAN 130/10 (HE 2010)

Significance Following CIEEM Guidance	IAN 130/10 (HE 2010) Significance category
Significant at the international level	Very large
Significant at the national level	
Significant at the regional level	Large
Significant at the county level	Moderate
Significant at the local level	Slight
Not significant	Neutral

9.7.24 The EIA will consider the inter-relationship of effects from the Project that could occur throughout more than one phase (e.g. construction and operation) and the potential for such effects to interact, potentially to create a greater effect on an ecological feature than if just assessed in isolation in these three key phases. It will also consider the inter-relationship effects between different aspects of the environment. For example, there may be an inter-relationship between planting proposed to mitigate for landscape and visual effects and terrestrial/avian ecology. The EIA will draw upon outputs of other topics of the EIA to determine the nature and extent of such effects.

9.7.25 Cumulative effects will be assessed and the scope of this assessment is set out in Chapter 16.

9.8 Description of Possible Significant Effects on Receptors

Terrestrial Ecology

Construction

9.8.1 The construction of highways can affect site-specific features (habitats or wild flora) and mobile features (populations of wildlife). Impacts can occur through several mechanisms, including:

- Indirect harm through construction disturbance, air quality, vibration, noise or hydrological effects;
- Temporary and direct loss of habitat that has currently been identified as potentially functionally linked land associated with designated sites (to be confirmed through ongoing ornithological surveys);
- Direct loss of wildlife habitats through land-take;
- Severance, by dividing habitats or wildlife corridors;
- Direct mortality through construction activities; and
- Disruption of local watercourses and drainage patterns.

9.8.2 Each of these potential construction impacts is discussed in relation to the potentially Important Ecological Features outlined in paragraph 9.6 and the likelihood of such impacts is detailed in Table 9-8.

Table 9-8: Potential Construction Effects On Potential Important Terrestrial Ecological Features

Important Ecological Feature	Indirect effects	Loss of functionally linked land associated with designated site	Direct habitat loss	Severance	Direct mortality	Disruption of local water courses
South of the River Thames						
North Downs Woodlands SAC habitats	Y	N	N	Y	N	N
Woudham to Detling Escarpment SSSI	Y	N	N	N	N	N
Cobham Woods SSSI	Y	N	N	N	N	N
Shorne and Ashenbank Woods SSSI	Y	N	Y	N	N	Y
Claylane Wood	Y	N/A	Y	Y	Y	Y
Great Crabbles Wood SSSI	Y	N	N	N	N	N
Court Wood LWS	Y	N/A	N	N	N	N
River Thames crossing						
Thames Estuary and Marshes SPA	Y	Y	N	N	N	Y

Important Ecological Feature	Indirect effects	Loss of functionally linked land associated with designated site	Direct habitat loss	Severance	Direct mortality	Disruption of local water courses
Thames Estuary and Marshes Ramsar site	Y	Y	N	N	N	Y
Holehaven Creek pSPA	Y	Y	N	N	N	Y
South Thames Estuary and Marshes SSSI	Y	Y	N	Y	N	Y
Mucking Flats and Marshes SSSI	Y	Y	N	N	N	N
Tilbury Marshes LWS	Y	N/A	N	N	N	Y
Goshems Farm LWS	Y	N/A	Y	Y	N	Y
Tilbury Centre LWS	Y	N/A	N	N	N	Y
North of the River Thames						
Lytag brownfield LWS	Y	N/A	N	N	N	Y
Low Street Pit LWS	Y	N/A	Y	Y	Y	Y

Important Ecological Feature	Indirect effects	Loss of functionally linked land associated with designated site	Direct habitat loss	Severance	Direct mortality	Disruption of local water courses
West Tilbury Church LWS	Y	N/A	N	N	N	Y
West Tilbury Hall LWS	Y	N/A	N	N	N	Y
Broom Hill LWS	Y	N/A	N	N	N	Y
Hangman's Wood & Deneholes SSSI	N	Y	N	Y	N	N
Terrels Heath LWS	Y	N/A	N	N	N	N
Rainbow Shaw LWS	Y	N/A	N	N	N	Y
Linford Pit LWS	Y		N	N	N	Y
Mucking heath LWS	Y	N/A	Y	Y	N	Y
Blackshots nature Area LWS	Y	N/A	Y	Y	N	N
Cranham Marsh LNR	Y	N/A	N	N	N	N
Clay Tye Wood	Y	N/A	N	N	N	N

Important Ecological Feature	Indirect effects	Loss of functionally linked land associated with designated site	Direct habitat loss	Severance	Direct mortality	Disruption of local water courses
Franks Wood	Y	N/A	N	N	N	N
Cranham Brickfields LNR	Y	N/A	N	N	N	N
Hobbs Hole Wood LWS	Y	N/A	N	N	N	N
Codham Hall Wood LWS	Y	N/A	N	N	N	N
Coombegreen Wood (Foxburrow Wood & Coombe Wood)	Y	N/A	N	N	N	N
Throughout the Project application boundary						
Bats and bat roosts	Y	N/A	Y	Y	Y	Y
Dormice	Y		Y	Y	Y	N/A
Water voles	Y		Y	Y	Y	Y
Otter	Y		Y	Y	Y	Y
Badger	N		Y	Y	Y	N/A
Terrestrial invertebrates	Y		Y	Y	Y	N/A

Important Ecological Feature	Indirect effects	Loss of functionally linked land associated with designated site	Direct habitat loss	Severance	Direct mortality	Disruption of local water courses
Aquatic invertebrates	Y		Y	Y	Y	Y
Breeding and wintering birds	Y		Y	Y	Y	Y
Reptiles	N		Y	Y	Y	Y
Amphibians	Y		Y	Y	Y	Y
Schedule 8 plants	Y		Y	Y	Y	Y
Section 41 species	Y		Y	Y	Y	Y

Indirect effects through construction disturbance, air quality, vibration, noise or hydrological effects

- 9.8.3 These effects are likely to be the most common and wide ranging associated with the Project.
- 9.8.4 Disturbance resulting from construction may lead to significant effects on sensitive species. This could lead to abandonment of young, increased competition, predation risk, use of critical energy reserves, etc.
- 9.8.5 This category also includes disturbance by noise, light, vibration, air quality and hydrological effects outside designated sites.
- 9.8.6 Impacts can occasionally be wide ranging and are discussed within the other chapters of this report. The CEMP would identify parts of the application site where pollution may occur, or features that are particularly sensitive.

Loss of functionally linked land associated with designated sites

- 9.8.7 Habitats used by features of a designated site are not always within the boundaries of the application site particularly for mobile species, such as birds. Land in the vicinity may provide additional foraging habitat, for example. This land may be lost or disturbed as part of the Project, with a resultant effect on the species associated with a designated site.

Direct loss of wildlife habitat through land-take

- 9.8.8 Inevitably, loss of habitat leads to loss of resources that may be critical at a single stage or several stages of a given species' life cycle. The offline sections of the Project, such as compounds and spoil storage may be areas where these effects are most significant, as here the land-take is greatest.

Severance, by dividing habitats or wildlife corridors

- 9.8.9 Given the predominantly arable landscape, the severance (including temporary severance during construction) of existing wildlife corridors along the Project (such as watercourses, field margins, hedgerows and tree lines) could have significant effects on species in the area. Severance caused by construction of new highway may be a key potential impact of the Project and would therefore be a focus for the mitigation strategy.
- 9.8.10 Severance leads to isolation both within and between populations and from specific resources separated spatially and temporally. The effects of this could include reduced foraging success, increased competition, genetic isolation and inbreeding.
- 9.8.11 Severance would begin during the application site clearance and the effects may continue during operation, as in the absence of mitigation the road may act as a barrier across the landscape to a range of species.

Direct mortality through construction activities

- 9.8.12 Less mobile species, or animals that are young or hibernating, are likely to be those that may be most vulnerable to direct mortality during construction. The effects of individual mortality erode the population,

which can lead to local extinctions once the population falls beneath a critical threshold. These population-level effects of direct mortality can take considerable time to become apparent. Often it is the longer-lived species, with greater parental investment and low annual recruitment, which struggle to recover from the loss of individuals resulting from construction activities.

Disruption of local water courses

- 9.8.13 This covers effects from pollution, increased silt levels through to culverting or diverting a water course.
- 9.8.14 Aquatic species are the most vulnerable to these effects, however, species such as bats can be affected by this impact as they often follow water courses when they forage.

Operation

- 9.8.15 Following the completion of construction, the Project has the potential to affect both application site-specific and mobile receptors in the following ways:
- Changes in air quality;
 - Disturbance or hydrological effects on designated sites or qualifying features of the designated sites;
 - Direct mortality through traffic collisions;
 - Polluted road runoff affecting the water environment;
 - Impacts on vegetation from polluted spray from road traffic;
 - Impacts on species through road lighting; or
 - Barrier effect on movement of animals caused by the new road which broadly bisects the existing habitat on a north south axis (thereby restricting movement east west and vice versa).
- 9.8.16 Each of these possible operational impacts is discussed in relation to the potentially Important Ecological Features outlined in paragraph 9.6 and the likelihood of such impacts is detailed in Table 9-9.

Table 9-9: Potential Operational Effects On Potentially Important Ecological Features

Potential Important Ecological Feature	Air quality	Disturbance or hydrological effect on designated sites, functionally linked land or qualifying features	Traffic collisions	Polluted road run off	Road lighting	Polluted spray impacting verge habitat	Noise disturbance
South of the River Thames							
North Downs Woodlands SAC habitats	Y	N	N/A	N	N	N	N
Woudham to Detling Escarpment SSSI	Y	N	N/A	N	N	N	N
Cobham Woods SSSI	Y	N	N/A	N	N	N	N
Shorne and Ashenbank Woods SSSI	Y	Y	N/A	Y	Y	Y	Y
Claylane Wood	Y	N	N/A	Y	Y	Y	N
Great Crabbles Wood SSSI	Y	N	N/A	N	N	N	N
Court Wood LWS	Y	N	N/A	N	N	N	N
River Thames Crossing							
Thames Estuary and Marshes SPA	Y	Y	N/A	Y	Y	N/A	Y

Potential Important Ecological Feature	Air quality	Disturbance or hydrological effect on designated sites, functionally linked land or qualifying features	Traffic collisions	Polluted road run off	Road lighting	Polluted spray impacting verge habitat	Noise disturbance
Thames Estuary and Marshes Ramsar	Y	Y	N/A	Y	Y	N/A	Y
Holehaven Creek pSPA	N	Y	N/A	N	N	N/A	N
South Thames Estuary and Marshes SSSI	Y	Y	N/A	Y	Y	N	Y
Mucking Flats and Marshes SSSI	Y	Y	N/A	N	N	N	N
Tilbury Marshes LWS	Y	Y	N/A	N	N	N	N
Goshems Farm LWS	Y	Y	N/A	Y	Y	Y	Y
Tilbury Centre LWS	Y	Y	N/A	N	N	N	Y
North of River Thames Crossing							
Lytag brownfield LWS	Y	Y	N/A	N	N	N	N
Low Street Pit LWS	Y	Y	N/A	Y	Y	Y	Y
West Tilbury Church LWS	Y	N	N/A	N	N	N	N
West Tilbury Hall LWS	Y	N	N/A	N	N	N	N
Broom Hill LWS	Y	N	N/A	N	N	N	N

Potential Important Ecological Feature	Air quality	Disturbance or hydrological effect on designated sites, functionally linked land or qualifying features	Traffic collisions	Polluted road run off	Road lighting	Polluted spray impacting verge habitat	Noise disturbance
Hangman's Wood & Deneholes SSSI	N	Y	N/A	N	Y	N	N
Terrels Heath LWS	Y	N	N/A	N	N	N	N
Rainbow Shaw LWS	Y	N	N/A	N	N	N	Y
Linford Pit LWS	Y	N	N/A	N	N	N	N
Mucking heath LWS	Y	Y	N/A	Y	Y	Y	N
Blackshots Nature Area LWS	Y	N	N/A	Y	Y	Y	Y
Cranham Marsh LNR	Y	N	N/A	N	N	N	Y
Clay Tye Wood	Y	N	N/A	N	N	N	N
Franks Wood	N	N	N/A	N	N	N	N
Cranham Brickfields LNR	N	N	N/A	N	N	N	N
Hobbs Hole Wood LWS	Y	N	N/A	N	Y	N	Y
Codham Hall Wood LWS	Y	N	N/A	N	Y	N	Y
Coombegreen Wood (Foxburrow Wood & Coombe Wood)	Y	N	N/A	N	N	N	Y

Potential Important Ecological Feature	Air quality	Disturbance or hydrological effect on designated sites, functionally linked land or qualifying features	Traffic collisions	Polluted road run off	Road lighting	Polluted spray impacting verge habitat	Noise disturbance
Throughout the Project application boundary							
Bats and bat roosts	Y	N/A	Y	Y	Y	N/A	Y
Dormice	N		Y	N	N	Y	N
Water voles	N		Y	N	N	N	N
Otter	N		Y	Y	Y	N	Y
Badger	N		Y	N	N	N	N
Terrestrial invertebrates	Y		Y	Y	Y	Y	N
Aquatic invertebrates	N		N/A	Y	Y	N	N
Breeding and wintering birds	N		Y	Y	N	Y	Y
Reptiles	N		Y	Y	Y	N	N
Amphibians	N		Y	Y	Y	N	N
Schedule 8 plants	Y		N/A	Y	Y	N	N
Section 41 species	N		Y	Y	Y	Y	Y

Changes in air quality

- 9.8.17 The key receptors that may be sensitive to changes in vehicle emissions are the designated sites noted for their botanical value and any species that depends on these. Increased levels of NO_x is generally the main threat to vegetation from vehicle emissions. However, this is usually only within close proximity to the road. The changes in air quality concentrations will be assessed as part of the air quality assessment (see Chapter 6) and the impacts on important ecological features will be reported as part of the Biodiversity chapter.

Disturbance or hydrological effects on designated sites, functionally linked land or qualifying features of designated sites.

- 9.8.18 There is potential for designated sites and functionally linked land associated with designated sites to be negatively affected by the operational Project. Further assessment will be undertaken and mitigation may be required to prevent designated sites falling into unfavourable condition.

Direct mortality through traffic collisions

- 9.8.19 This impact could affect mobile species, specifically mammals as well as birds, amphibians and reptiles. Direct mortality will impact the local population and can trigger local extinctions, once the population falls below a certain threshold. Population level effects can take time to become apparent. Similar to the effects of mortality during construction, this impact often impacts longer-lived species, with greater parental investment and low annual recruitment more severely.

Polluted road runoff affecting the aquatic environment

- 9.8.20 Predominantly this could impact on aquatic species, such as water vole, otter, and aquatic invertebrates. Impacts can be wide ranging and are discussed within the Chapter 14: Road Drainage and Water Environment.

Impacts from road lighting

- 9.8.21 Impacts from lighting are most likely to affect bats along the Project, although birds, invertebrates and some mammals could also be affected. The effect of lighting on bats is complex, but outcomes could include roost disturbance, abandonment and severance, loss of foraging habitat for species that are excessively light shy and an increase in collisions for species that forage in insects attracted to light. For example, south of the River Thames there are records of bats in Shorne and Ashenbank Woods SSSI and road lighting would therefore need to be carefully considered in relation to the new junction with the A2. North of the River Thames, Hangman's Wood and Dene Holes SSSI is the most important hibernation site for bats in Essex. Careful assessment of indirect impacts of lighting on commuting routes used by bats to reach this hibernation site will also require careful consideration.

Impacts on verge vegetation from polluted spray from the road

- 9.8.22 Habitat in the direct vicinity of the Project could be affected by spray from traffic. This will likely lead to a decrease in diversity and a more

halophytic community, due to the treatment of roads with salt during the winter.

Noise disturbance

9.8.23 A number of species are negatively affected by increased noise. Some species avoid noisy areas, as they cannot hear predators or find mates, this means that the noisy habitat becomes useless for such species. This can lead to isolation of populations of the affected species.

Marine Ecology

Construction

9.8.24 The construction phase of the Project could affect marine site-specific features (habitats or wild flora) and mobile features (populations of wildlife such as waders and wetland birds, fish, marine mammals and/or benthic invertebrates). Impacts can occur through several mechanisms, including:

- Indirect harm through construction disturbance; vibration, noise, sediment discharge (e.g. from piling or any dredging associated the construction of a project-specific jetty, if required), increased shipping traffic or hydrological effects.
- Temporary loss of wildlife habitats through land-take (i.e. jetty construction – extent of loss dependent on any jetty proposals, e.g. if a temporary project-specific jetty was required for import of materials and export of tunnel arisings).
- Direct mortality through construction activities.

9.8.25 There are fewer potential impacts on marine ecological features in comparison to terrestrial ones, as the vast majority of the Project is terrestrial, with only the potential construction of a jetty, increased boat traffic and indirect effects (vibrations from drilling, silt disturbance, possible pollution incidents etc.) having potential to impact on the marine environment. Each of these potential effects is discussed in relation to the ecological features outlined in paragraph 9.6 and the likelihood of such impacts is detailed in Table 9-10.

Table 9-10: Potential Construction Effects On Important Marine Ecological Features

Important Ecological Feature	Indirect impacts	Direct habitat loss	Direct mortality
Sheltered muddy gravels	Y	Y	N/A
Intertidal and muddy sand	Y	Y	N/A
Intertidal mixed sediments	Y	Y	N/A

Important Ecological Feature	Indirect impacts	Direct habitat loss	Direct mortality
Subtidal coarse sediments	Y	N	N/A
Subtidal sand	Y	N	N/A
Tentacled lagoon worm	Y	N	Y
European Eel	Y	N	Y
Smelt	Y	N	Y

Indirect impacts

- 9.8.26 These impacts may be most numerous and common during the construction phase of the Project. Indirect impacts can be reduced by mitigation and a CEMP would be used to identify parts of the application site where pollution may occur, or features that are particularly sensitive need to be protected. It would be important to avoid or minimise effects in the habitats detailed in the rMCZ.

Direct habitat loss

- 9.8.27 Direct marine habitat loss is only likely to occur in relation to the construction of a permanent project-specific jetty (if this were required). Mitigation through micro-siting to avoid any important habitat could reduce this impact.

Direct mortality

- 9.8.28 Direct mortality could be caused by the potential jetty construction or as a part of the increased boat traffic.

Operation

- 9.8.29 Unlike the impacts identified for the terrestrial environment, following the completion of construction, the Project has no foreseeable negative operational impacts on the marine environment as the Project footprint would be restricted to the tunnel beneath the estuary. Any jetty installation provided to facilitate the construction of the Project would no longer be in use and the additional boat traffic associated with construction would cease. The tunnel portals and proposed locations for the tunnel would be set well back from the river banks.
- 9.8.30 A positive operational effect could be achieved through the retention of a project-specific jetty to provide a high tide roosting location for birds associated with the Thames Estuary and Marshes SPA and Ramsar site. This benefit would need to be considered against the impact of the permanent loss of an area of intertidal habitat associated with retaining any project-specific jetty on a permanent basis.

9.9 Potential Mitigation Measures

9.9.1 At this phase, it is considered that likely effects can be avoided, mitigated or, if necessary, compensated through the design and that the Project offers good opportunities for biodiversity enhancement within the study area. The potential mitigation for the effects identified above for both the terrestrial and marine environments would be described further in the ES. However, at this phase the following standard mitigation measures are likely to form part of the package:

- Avoiding/minimising illumination of construction area and/ or completed structures at night;
- Implementing adequate pollution control measures during construction and operation with monitoring to ensure their effectiveness;
- Close monitoring of in-channel works (e.g. dredging/piling) to ensure that water quality is maintained and that levels of suspended sediment do not exceed agreed limits;
- Implementation of bunds or other barriers to reduce impacts associated with noise/visual disturbance, with monitoring to ensure their effectiveness;
- Where habitat is temporarily lost to construction, reinstatement works to create a replacement habitat that meets the functional requirements of the species dependent on it, with additional enhancement to improve its suitability, where possible; and
- Provision of alternative habitat (either through enhancement of existing habitat or creation of new habitat) to mitigate for the loss of undesignated habitat associated with the Project.

9.10 Aspects/Impacts Scoped out of the EIA

9.10.1 The CIEEM Guidelines require the assessment to 'scope out' receptors at an early phase to allow the assessment to concentrate on those ecological receptors that are considered to be 'key' (i.e. those ecological resources that are considered could experience significant effects – that is, those that could adversely affect the integrity of the habitat or the favourable conservation status of a species' local population) and which are identified as being of sufficient value to be material to decision-making (District/Borough level or above)). This process would be fully documented in the ES.

9.10.2 Currently no topics have been scoped out of the EIA assessment. Any future decision to scope out items following the completion of the detailed desk study and survey work would be reviewed following consultations, the receipt of the scoping opinion and as the Project design progresses.

9.11 Any Other Information

9.11.1 At this stage, there is no further information to report.

10 Geology and Soils

10.1 Introduction

10.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on geology and soils during both construction and operational phases.

10.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or survey work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess effects on geology and soils;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

10.1.3 The Geology and Soils Chapter discusses land stability, contaminated land, soils in relation to Agricultural Land Classification (ALC) and agricultural land use.

10.1.4 There may be interrelationships related to the potential effects on geology and soils, and other disciplines comprising:

- Chapter 6 Air Quality
- Chapter 9 Nature Conservation
- Chapter 13 People and Communities
- Chapter 14 Road Drainage and the Water Environment

10.1.5 Evidence of the competence of the experts involved in the preparation of this topic assessment will be provided within the ES.

10.2 NPSNN Requirements

10.2.1 The NPSNN sets out the need for and the Government's policies to deliver development of NSIPs on the national road and rail networks in England.

10.2.2 There are limited details relating directly to geology and soils within this document. Geological conservation is covered within the Biodiversity and

- Ecological Conservation chapter and relates to sites that are designated for their geology and / or their geomorphological importance¹.
- 10.2.3 Where projects require EIA, the statement must set out any likely significant effects on soils and on internationally, nationally and locally designated sites of geological conservation importance. The Project should demonstrate how it has taken advantage of opportunities to conserve and enhance geological conservation interests.
- 10.2.4 Development should avoid significant harm to geological conservation interests, including mitigation and consideration of reasonable alternatives. Where significant harm cannot be avoided or mitigated, appropriate compensation measures should be sought, as a last resort.
- 10.2.5 The NPSNN states that “Applicants should identify any effects, and seek to minimise impacts, on soil quality, taking into account any mitigation measures proposed. Where possible, developments should be on previously developed (brownfield) sites provided that this is not of high environmental value. Where developments are on previously developed land, applicants should ensure they have considered the risk posed by land contamination and how it is proposed to address this.”
- 10.2.6 In addition, the NPSNN states that “Applicants should take into account the economic and other benefits of the best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification). Where significant development of agricultural land is demonstrated to be necessary, applicants should seek to use areas of poorer quality land in preference to that of a higher quality.” Specific reference is also made to the protection of soils during construction in line with the Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009).
- 10.2.7 The NPSNN covers land instability in a separate section. This relates to the effects such as landslides, subsidence or ground heave which could cause harm to human health, local property, associated infrastructure and the wider environment if not considered during development.
- 10.2.8 A preliminary assessment of ground instability should be undertaken, including investigation to ascertain that the site is and would remain stable or any issues can be dealt with as part of the development. The site needs to be assessed in context of surrounding areas where subsidence, landslides and land compression could threaten the development during its anticipated lifetime or damage neighbouring land or property.
- 10.2.9 If required, mitigation measures should be put in place such as design of structures to cope with any anticipated movements or hazards such as ground gases or ground improvement techniques involving the removal of poor material and replacement with suitable inert and stable material.
- 10.2.10 Land quality is referred to in the Pollution Control and other environmental protection regimes section. This states that issues relating

¹ The designated sites are listed in the Geological Conservation Review held by the Joint Nature Conservation Committee (JNCC).

to discharges or emissions from a proposed project which affect air quality, water quality, land quality and the marine environment may be subject to separate regulations under the pollution control framework or other consenting and licensing regimes.

- 10.2.11 Where a development is likely to affect any relevant marine areas, the Marine Management Organisation (MMO) should be consulted.

10.3 Consultations Undertaken and Proposed

- 10.3.1 During the options phase, organisations such as local authorities, Natural England and the Environment Agency were consulted regarding the proposed route options. No responses specifically in relation to Geology and Soils were received from the Environment Agency.
- 10.3.2 Natural England highlight the potential for ‘a range of other impacts on the natural environment, including to local wildlife sites, priority habitats and species, protected species, landscapes outside designated sites, soils, geodiversity and access to the natural environment.’
- 10.3.3 They also highlight the importance of soils in relation to Ancient Woodland sites, as well as the potential presence of high grade agricultural land, stating that *“All route options would result in loss of agricultural land and severance of farm holdings. This is particularly notable for Essex routes, where most of the land is provisionally classified as being in Agricultural Land Classification Grades 2 and 3, with some Grade 1 around North and South Ockenden. Soil is a finite resource that fulfils many important functions and services (ecosystem services) and should be protected and used in a sustainable manner.”*
- 10.3.4 An initial review has been undertaken with Natural England on the current understanding of the soils and agriculture baseline, the proposed scope of ALC surveys, soil surveys and landowner interviews and the approach to assessment. Further detail on survey points and extent will be provided for review by Natural England specialists prior to surveys commencing.
- 10.3.5 It is proposed the following stakeholders will be consulted:
- Environment Agency - Groundwater and Contaminated Land officer
 - Contaminated Land Officers of local councils - The London Borough of Havering, Gravesham Borough Council, Thurrock Council, Kent County Council and Essex County Council, Brentwood Borough Council and Medway Council
 - Mineral Value Officer - to understand current potential geological resources in the study area
 - MMO and Port of London Authority in relation to the sediments / surface water quality
 - Natural England and local geological groups – to establish the presence of any sensitive geological features (e.g. Regionally Important Geological Sites (RIGS), Sites of Special Scientific Interest (SSSI))

- Natural England – to finalise the scope of any soil and ALC surveys and the assessment criteria to be used
- Individual land owners / land managers – to obtain baseline information on farm businesses

10.4 Baseline Information Obtained/Surveys Undertaken

- 10.4.1 During options appraisal a Preliminary Sources Study Report (PSSR) (Halcrow Hyder (2016)) was prepared which provided geological and ground condition information across the study area.
- 10.4.2 Relevant information has been taken from this report and detailed below.
- 10.4.3 The PSSR is currently being updated for the specific route and will be consulted in the preparation of the ES chapter.

Geology

- 10.4.4 The generalised geological succession of the area under study is detailed in Table 10-1 below. The distribution of the solid and drift deposits are shown on Figures 10.1 and 10.2 in Appendix F.

Table 10-1: General Geological Succession Across The Area

System / Period	Series	Group	Formation	General Description	Stratigraphical Thickness
Quaternary	Holocene		Alluvium	Marine and Estuarine Alluvium Silt and clay with lenses and beds of peat, and seams of sand and gravel.	1 – 20m
Quaternary	Pleistocene		Head Deposits Terrace Gravels (Taplow Gravel) (Lynch Hill Gravel) (Boyn Hill Gravel) (Black Park Gravel)	Undifferentiated, pebbly sandy clay; some gravel. River Terrace Deposits – Gravel, sandy and clayey in part.	Not confirmed
Palaeogene	Eocene	Thames Group	London Clay Formation Harwich Formation	Dark bluish to brownish grey clay, containing variable amounts of fine-grained sand and silt. Cross-bedded shelly sand (the Oldhaven Beds) with a basal pebble bed.	Up to 150m 0-12m

System / Period	Series	Group	Formation	General Description	Stratigraphical Thickness
Palaeogene	Palaeocene	Lambeth Group	Woolwich Formation Upnor Formation	The upper beds are clay with shells, ferruginous sand, lignitic sand and lignite. The lower beds are coarse sand with pale grey clay partings and coarse gravel of black flint. Greenish to brownish grey silty, fine-grained sand, clayey and more silty in the lower part, with a conglomerate of flint pebbles and nodular flints at the base.	5-20m
			Thanet Formation (Thanet Sand)		Up to 32m
Cretaceous	Upper Cretaceous	White Chalk Subgroup	Seaford Chalk Formation Lewes Nodular Chalk Formation	Fossiliferous nodular chalk with bands of nodular flints, hardgrounds and marl seams. White chalk with hard nodular beds.	Up to 70m 20 – 40m

Notes: Excludes stratigraphical units that are absent from the study area. Stratigraphical thicknesses have been taken from the Geological Maps

10.4.5 The geology of the proposed route is provided in more detail below. It has been divided into the following sections based on topography and geology:

- The A2 to Lower Higham and Gravesend

- River Thames Valley (Lower Higham and Gravesend to Tilbury)
- West Tilbury and the Coalhouse Fort to the A13 (Orsett) which includes the Tilbury Link
- A13 (Orsett) to M25 Junction 29

The A2 to Gravesend and Lower Higham

- 10.4.6 The geology of the majority of this area consists of the White Chalk outcropping at the surface. South of the River Thames the Thanet Sand Formation is indicated to be present above the Chalk.
- 10.4.7 The high ground to the east of the WSL from Cobham through the Shorne Wood Country Park to Higham consists of London Clay Formation and Harwich Formations at the highest parts, unconformably overlying the Lambeth Group and Thanet Formation, which in turn unconformably overlie the White Chalk. The geological maps show that the London Clay Formation has been worked here in the vicinity of Shorne Wood. Head Deposits are also present on the lower parts of the hill sides.
- 10.4.8 The land falls from the A2 road to the River Thames at Gravesend and the Marshes in the east. Lynch Hill River Terrace Deposits of limited extent are encountered directly south of the Marshes overlying the White Chalk. Around the area of Queen's Farm, south of Shorne Marshes, River Terrace Deposits (Taplow Gravel) are encountered overlying the White Chalk and the Thanet Formation. Head Deposits are found in localised outcrops overlying the White Chalk on the lower parts of the hill sides.

River Thames Valley – Lower Higham and Gravesend to Tilbury

- 10.4.9 In the low lying Marshes on either side of the River Thames the geology consists of Alluvium overlying White Chalk, although other Quaternary deposits such as the River Terrace Deposits may intervene in places. In the River Thames channel the Holocene Alluvium is overlain by more recent Intertidal and Marine Deposits of mud, sand and gravel. The White Chalk subcrops below the Alluvium (and possibly other Quaternary deposits) in the River Thames channel.
- 10.4.10 Depths of the Alluvium have been proven in boreholes to generally range from 10 to 20m close to the River Thames and generally thin out to the north and south (BGS (1997)). Within the Alluvium five distinct peat horizons have been identified. The Geology of London Special Memoir notes that the total thicknesses of peat beds exceeds 2m in large areas between the confluence of the rivers Thames and Lea and Tilbury.

West Tilbury and the Coalhouse Fort to the A13 (Orsett)

- 10.4.11 To the east of Southfields the London Clay Formation was exposed in a Gravel Pit, this area is noted as Worked Ground (described as mainly chalk, sand and gravel or clay pits with little or no fill) and Worked Ground Made Ground (described as wholly or partly backfilled pits).

- 10.4.12 Eastwards the land slopes down towards the River Thames Valley and the Mucking Marshes and East Tilbury Marshes. Here Alluvium (ranging from approximately 5 to 11m thick) overlies the Thanet Formation, which unconformably overlies the White Chalk. It would be anticipated to encounter areas of River Terrace Deposits beneath the Alluvium.
- 10.4.13 In this area the geology continues to be topography related, with the Lambeth Group overlain by River Terrace Deposits in many places on the highest ground. Underlying the Lambeth Group is the Thanet Formation and then the White Chalk. The Thanet Formation is generally overlain by River Terrace Deposits and outcrops in places along the lower slopes of the hills. Head Deposits generally occur lower down on the hill sides. The Black Park Gravel Member is located to the south of the A13 around the proposed spur road joining the Project with the A13.

A13 (Orsett) to M25 Junction 29

- 10.4.14 The geology of this area comprises Head Deposits, Alluvium and River Terrace Deposits (Lynch Hill Gravel) overlying the London Clay Formation. The Lynch Hill Gravel is located at the northern extent with the Junction of the M25. Alluvium deposits follow the location of the Mardyke and increase in width moving northwards.
- 10.4.15 In localised areas (which are generally relatively small), no superficial deposits are present and there are outcrops of London Clay. Within the proposed route this occurs near to the junction with the M25.
- 10.4.16 There are many old clay pits in the area with the London Clay Formation noted on the geological maps. These old clay pits are shown as Worked Ground and Made Ground (described as wholly or partly backfilled pits).

Geological Conservation Review

- 10.4.17 The JNCC Geological Conservation Review database has been studied and there are no entries within 500m of the Project. The nearest sites are over 4km from the Project.

Hydrology

- 10.4.18 The main watercourse feature is the River Thames. To the south of the River Thames, the Shorne Marshes are located to the east and this area is drained by a network of channels. The disused Thames and Medway Canal crosses the proposed route to the south of the marsh area.
- 10.4.19 There are no surface water features in the proximity of the WSL.
- 10.4.20 To the north of the River Thames, the other main watercourse is the Mardyke and associated tributaries, which is located to the north of the A13. The West Tilbury watercourse is located approximately 100m to the east of the proposed route and flows into the River Thames. This flows through Goshems Farm which has historically been subject to landfilling activities. It is understood that this area is currently undergoing restoration and remediation.

Hydrogeology

Aquifer Status

- 10.4.21 The EA website and obtained GIS information for the Project shows spatial layout of aquifers, groundwater Source Protection Zones (SPZ) and abstraction licences. These are summarised in Table 10-2 and would be used to assess the impacts from contaminated land to groundwater.

Table 10-2: Aquifer Status

Geological Formation	Aquifer Status
Superficial Aquifers	
Alluvium	Secondary Undifferentiated ²
Head Deposits	Secondary Undifferentiated
River Terrace Gravels	Secondary A ³
Bedrock Aquifers	
London Clay	Unproductive ⁴
Lambeth Group	Secondary A
Thanet Formation	Secondary A
Chalk	Principal ⁵

- 10.4.22 Superficial aquifer groundwater levels are likely to be shallow comprising a perched water body especially when underlain by low permeability bedrock (London Clay Formation or Lambeth Group) such as north of the A13. Hydraulic connection with surface water bodies may also influence superficial groundwater levels especially near Mardyke and locally near flooded former gravel pits. Head deposits comprise a widespread secondary undifferentiated superficial aquifer north of the A13 although their lithology is likely to be of clay and therefore generally not water bearing.
- 10.4.23 The secondary A aquifers (Thanet Formation and Lambeth Group) are the dominant aquifers in vicinity of the A13 and further south to the north of the River Thames valley. Perched water is anticipated in the Lambeth Group due to interlayering but may also be influenced by regional piezometric levels where deeper. A regionally influenced water table is likely in the Thanet Formation. Similar piezometric levels to the

² This classification has been assigned in cases where it has not been possible to attribute either category Secondary A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.

³ Permeable layers capable of supporting water supplies at a local rather than strategic scale and in some cases forming an important source of base flow to rivers.

⁴ These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

⁵ These are rocks of drift deposits that have a high intergranular and /or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale.

underlying Chalk aquifer may occur where the aquifers are in hydraulic continuity.

- 10.4.24 The River Thames valley area hydrogeology is influenced by the River Thames. There is a high probability of hydraulic continuity of river water with the River Terrace Gravels aquifer and the Chalk aquifer, with tidally fluctuating water levels expected in both strata.

SPZ and Abstractions

- 10.4.25 The location of SPZ and abstraction points are detailed on Figure 14-4 in Appendix F.
- 10.4.26 The edge of a SPZ3 crosses the western end of the WSL at the proposed junction with the A2.
- 10.4.27 The proposed route crosses a SPZ 2 (outer) and SPZ 3 (total catchment) to the north of the River Thames in the locality of Linford. The SPZ 1 (inner zone) is located to the east of the proposed route.
- 10.4.28 There are five groundwater abstraction points located adjacent / close proximity to the proposed route on the northern side of the River Thames. Three are located in the SPZ 3 near Linford and the other two are to the north of the A13 near Orsett Fen. A previously unidentified groundwater abstraction well (unlicensed) is also present at Southern Valley Golf Course.
- 10.4.29 Surface water abstraction points and discharge consents are indicated along the proposed route, mainly to the north of the River Thames but three abstractions are located near to the southern foreshore of the River Thames.

Historical Development

South of the River Thames

- 10.4.30 This area is mainly rural in nature and dominated by the urban development of Gravesend in the east. In the 1920s and 1930s major improvements to the A2 between Dartford and Gravesend were made. The A2 was formerly known as Watling Street, a Roman road that is now buried beneath the A2 trunk road. This was upgraded during the 1950s to a dual carriageway.
- 10.4.31 Closer to the Thames, the Thames and Medway canal was constructed between 1804 and 1824 and later, in 1846, the North Kent railway was constructed alongside.
- 10.4.32 Adjacent to the Thames lies the Milton Rifle Range which was constructed in 1860 and is now used by the Metropolitan Police.
- 10.4.33 During the 20th century Gravesend developed significantly, extending eastwards up to Thong Lane and the area known as Chalk.
- 10.4.34 High Speed Rail from London to Folkestone (HS1) was constructed alongside the A2 and M2 in 2002. Following the construction of HS1 the A2 was diverted to run alongside the railway between Ebbsfleet and Cobham.

North of the River Thames

- 10.4.35 Prior to the 1900s the area was very rural. Throughout the area there are a number of historic fortifications and buildings. In 1856 the London Tilbury and Southend railway was constructed. This included a loop line via Tilbury just north of the Thames and the main line running through West Horndon towards the north end of the study area. The Upminster-Grays single line branch, constructed in 1892/ 1893, passes under the M25, through South Ockendon and passes over the A13.
- 10.4.36 During the 20th century the villages of East Tilbury, Chadwell St Mary and the port of Tilbury expanded considerably.
- 10.4.37 During WWII two groups of anti-aircraft gun emplacements with connecting roads were constructed and were in use up to the 1950's near East Tilbury. It is also reported there were anti-glider trenches and gun emplacements located in Tilbury Marshes.
- 10.4.38 During the 1980s new roads namely the A13 and A1089 (Tilbury port access road) were constructed amongst many other local road upgrades. In 1947 Tilbury power station (A) situated alongside the Thames at the western edge of the study area was constructed with Tilbury B, later, in 1969. Adjacent land to the east was used to dispose of the ash (Pulverised Fuel Ash - PFA) generated. Between the River Thames and the A13, extraction of sand and gravel took place extensively during the latter half of the 20th century.
- 10.4.39 At the same time, in the vicinity of South Ockendon, numerous clay pits were excavated to support the nearby cement industry.

Potential Contaminative Uses

- 10.4.40 A review of the historical development around the Project has been carried out utilising GIS datasets obtained from Landmark Envirocheck during the PSSR preparation, who created the datasets in collaboration with Ordnance Survey via a review of available historical maps.
- 10.4.41 The datasets are titled HLU (Historical Land Use Data) and HTEF (Historical Tanks and Energy Facilities). Figure 10-3 in Appendix F illustrates the locations of the industrial uses and contaminative land uses. These include the following;
- The Project crosses three railway lines, one adjacent to the disused canal to the south of the River Thames and two to the north.
 - There are several areas of previous quarry which generally relate to areas which historically or are currently being used as landfill sites.
 - Seven industrial areas are indicated along the Project; four to the south of the River Thames and three to the north.
 - The locations of seven historical tanks are shown adjacent to the Project. These are mainly around the proposed junction with the A13 and A2 to the south.
- 10.4.42 A Conceptual Site Model (CSM) report has been prepared for the project which highlights areas of potential contamination and associated

potential contaminant linkages. This report will be reviewed during the preparation of the ES chapter.

Landfills

- 10.4.43 No landfills have been identified to the south of the river within proximity to the WSL. The WSL has three known decommissioned quarries along the route that may have been infilled and could present a settlement risk. The quarries may contain contaminative materials.
- 10.4.44 A small historic landfill site (Filborough Farm) is located to the north of Lower Higham Road which received inert and commercial waste until the end of 1991.
- 10.4.45 A number of landfills, both historic and active, are present along the proposed route, north of the River Thames. These are illustrated on Figure 10-3 in Appendix F. The landfill figure has been developed through collation of information from the various sources such as Environment Agency records, Veolia Environmental Services, Landmark Envirocheck Database, Thurrock Council, Kent County Council and British Geological Survey.
- 10.4.46 The main area of focus, is the area of landfilling situated at the proposed location of the tunnel portal on the northern side of the Thames. This landfill (Goshems Farm) is known to be historic and may date back to Victorian times and it is understood that the landfill ceased accepting waste in 1958, although is currently undergoing permitted capping/land raise operations. Available information indicates household and refuse ash are some of the potential contents deposited which could be between 6 and 8 m deep.
- 10.4.47 Immediately north of the Victorian landfill, PFA originating from Tilbury Power Station is known to have been tipped across the surface to an estimated depth of in excess of 3m. From the northern bank of the Thames mapping indicates the ash to extend up to 1.45km north along the current alignments and in excess of 1.4km in width (east-west), although not centrally to the alignments. The area of PFA tipping holds the Thurrock Council ID THU011.
- 10.4.48 Historically re-excavated PFA has been found to contain additional contaminative contents illegally tipped within it, such as asbestos. This should be considered should any works take place in this area.
- 10.4.49 Adjacent to Goshems Farm is East Tilbury landfill site was active from 1932 to 1991. This landfill site accepted domestic, industrial, commercial and liquid waste.
- 10.4.50 Table 10-3 and Table 10-4 below provide details of the majority of the landfill sites (both historic/closed landfill sites and authorised landfill sites) within 500m of the Project. The reference numbers are marked on Figure 10.3, within Appendix F, where they intersect the Project.
- 10.4.51 An authorised landfill site is a landfill site which has been permitted by the Environment Agency or Local Authority, however it may not be currently active.

10.4.52 The landfill status will be reviewed during the further work and assessment which will form the ES chapter.

Table 10-3: Historic / Closed Landfill sites

Landfill Site	Ref	Year Open	Year Close	Yrs in Operation	Waste Type	Estimated Location wrt* to route
Goshems Farm	THU 048	Not known	1958	-	Household	On route
Wm Cory & Sons / East Tilbury Marshes	THU 017	1932 (lic in 1979)	1991	59	Household, Hazardous, Solids, Liquids	320m east (haulage road crosses this area)
Tilbury B Power Station	THU 011	Not known	Not known	Not known	Fly Ash / PFA	On route
Low Street Brickworks	THU 062	1956	1977	21	Industrial	100m east
Low Street	THU 061	1969	1976	7	Non Hazardous Industrial Commercial	Boundary of landfill is on route
Millers Sand and Gravel Pits / Mobb Farm	THU 058 THU 073	1948	1965	17	Household Commercial	Partially on route
Ockendon Grays Area No 3	THU 091	Not known	Not known	Not known	Not known	Boundary of landfill is adjacent to route
Groves Farm / Hall Farm, Ockendon Road	THU 045	1959	1978	19	Inert, Commercial and Household	320m north east
Groves Farm	THU 007	1972	1978	6	Inert, Industrial	315m north

Landfill Site	Ref	Year Open	Year Close	Yrs in Operation	Waste Type	Estimated Location wrt* to route
					and Commercial	
Stubbers Outdoor Pursuits Centre	HAV 22	1979	1989	10	Inert and Industrial	430m west
Grange Farm	THU 006	1974	1990	16	Inert, Commercial and Household	300m south – now part of Veolia CLE005
Linford Quarry	THU 086 THU 026 THU 027	1984	1993	9	Inert and Industrial	400m north east

*wrt = with respect to

Table 10-4: Authorised Landfill Sites

Landfill Site	Reference/ License Status	Year Opened	Years in Operation	Waste Type	Location wrt to route
RWE nPower plc, Fort Road Tilbury	Area B NAT 002 / Expired	1978	38	Industrial Waste (Factory Curtilage)	Within application boundary
RWE nPower plc, Fort Road Tilbury	Area A1, A2 & C NAT001 / Expired	1991	25	Industrial Waste (Factory Curtilage)	On route and within application boundary (850m west of route)
RWE nPower plc, Fort Road, Tilbury	Area A3 INT004 / Expired	2001	15	Industrial Waste (Factory Curtilage)	Within application boundary

Landfill Site	Reference/ License Status	Year Opened	Years in Operation	Waste Type	Location wrt to route
RWE nPower plc, Fort Road Tilbury	INN002 / Expired	2001	15	Industrial Waste (Factory Curtilage)	On route
Veolia ES Cleanaway (UK) Ltd, Medebridge Road (East)	CLE005 / FP3236LV / Issued	1990	26	Co-Disposal (licence expired – planned reopen in next 5 yrs)	<50m south east
Veolia ES Cleanaway (UK) Ltd, Medebridge Road (East)	CLE002 / BW0410IH / Expired (planned reopen in next 5 yrs)	1997	19	Co-Disposal (licence expired – planned reopen in next 5 yrs)	On route
Clearserve Ltd / Rainbow Shaw Quarry	CLE003 / XP3430LS / Issued	1999	16	Landfill taking non-biodegradable waste	430m north east
Linford Quarry	THU 026 / TAR130 / Transferred	Unknown	Unknown	Inert Factory	350m north east

Man Made Mining and Natural Cavities / Mining

- 10.4.53 Data on natural and manmade cavities have been obtained for the PSSR via the Peter Brett Associates and Ove Arup & Partners databases through the Landmark Envirocheck database, (version 2005). Figure 10-3 in Appendix F shows the locations currently known.
- 10.4.54 There are several manmade mining cavities shown by the WSL and Junction with A2. In this area, there are also two natural cavities at the southern end of the WSL with the proposed junction with the A2. These are likely to be associated with the chalk outcrops in this area.
- 10.4.55 The historical mineral planning permission figure (Figure 10.4 in Appendix F) has been developed from a GIS dataset obtained through BGS which entails planning permission granted historically for mineral abstraction. There are several BRITPITS (British Pits) along the proposed route. These indicate surface or underground mineral workings in the area. The main area of valid permission is to the north of the

proposed route which relates to the location of a current landfill site (Veolia - CLE005 / FP3236LV – see landfill section).

- 10.4.56 Quarrying of sand and gravel for building materials and the excavation of chalk and clay for the manufacture of cement was extensive either side of the River Thames, the majority of which has now ceased. The chalk quarries, of which there are many between the A13 in the north and the A2 in the south, were up to 25m deep or more. Since the cease of manufacture of cement the quarries have either been backfilled with waste, left as water-filled lakes or been redeveloped for industrial, retail and residential development.
- 10.4.57 Other areas of chalk, sand and gravel extraction have occurred near the A2 at Shorne, the surrounding land between East Tilbury and Chadwell St Mary and along the A13. The majority of these have been backfilled with landfill material.
- 10.4.58 Small scale lignite mining took place in 1947 when a seam up to 4m thick was found south of the A2 near Cobham Hall. The drift mine produced around 80 tonnes per week. There were plans proposed for expansion but these were abandoned due to difficulties encountered, included flooding which was controlled by pumping. The mine was closed in 1953. During the site investigation and construction of HS1 the adits and lignite were encountered.

Land Stability Hazards

- 10.4.59 A GIS mapping dataset developed by BGS for the PSSR has been utilised to create figures highlighting potential hazard areas from movement or subsidence, which are attached (Figures 10.5 to 10.8 in Appendix F). This dataset covers the main spectrum of geotechnical / land stability problems that may be encountered from the naturally varying geology by identifying formations that have encountered such issues in the past allowing problems to be pre-empted during design.
- 10.4.60 The main hazards and where they are present on the proposed route are detailed in Table 10-5.

Table 10-5: Land Stability Hazards

Hazard	Description of Hazard	Presence of Hazard on Proposed Route
Compressible Ground (Figure 10.5 in Appendix F)	Highlights areas of cohesive deposits with the potential for Peat or soft Clay to be present. These deposits are likely to compress when loaded or soften if the groundwater migration alters resulting in differential settlement.	To the south of the River Thames the WSL is in an area where compressible strata are not thought to occur. To the north of the River Thames, the majority of the route is in area where compressible strata are not thought to occur. The route crosses an area where compressibility and

Hazard	Description of Hazard	Presence of Hazard on Proposed Route
		uneven settlement hazards are probably present to the north of the A13. This also applies for the River Thames and the land either side.
Landslides (slope instability) (Figure 10.6 in Appendix F)	Slope failures generally occur due to the nature of the geology present, some being more susceptible than others. Failures can be due to external factors such as the weather which can be exacerbated by inadequate drainage or the general gradient of the land or even loading from a structure without adequate consideration as to the effects of the load transfer. This can apply to cohesive and non-cohesive strata.	For the majority of the route, slope instability problems may be present or anticipated. There is an area south of the River Thames around the A226 where instability problems are indicated not likely to occur.
Running Sand	Running sand mainly affects granular geological formations where the sands are naturally loose. If combined with water this can cause the sand to become fluidised which can be to run removing the underlying support from foundations.	For the majority of the proposed route, running sands are considered unlikely. To the south of the river, initially running sands are not thought or are unlikely to be present, however at the southern extent of the WSL near the A2 junction, running sand conditions are probably present. In these areas constraints may apply to land uses involving excavation or the addition or removal of water. There are also small areas around West Tilbury and either side of the river, where running

Hazard	Description of Hazard	Presence of Hazard on Proposed Route
		sands are probably present.
Shrink-Swell (Figure 10.7 in Appendix F)	Due to the presence of certain minerals within some clay formations, they have the potential to swell when water adsorption is allowed to occur on a microscopic level. Adversely when this water is allowed to drain from loading or evaporated from heat the clay can shrink. Where these clays are supporting foundations this can lead to differential settlement or structural failure as well as issues with pipes or services.	To the south of the River Thames the area associated with alluvial deposits is considered to be medium plasticity. The WSL is in a non-plastic area associated with the chalk outcrop.
Soluble Rocks (Figure 10.8 in Appendix F)	Ground dissolution occurs when certain rocks dissolve or have soluble constituents. This can occur beneath the ground creating cavities with no surface indication which can be highly hazardous when loaded likely leading to collapse	To the south of the River Thames soluble rocks and dissolution features (some to many) are present. In areas on the WSL there is the potential for difficult ground conditions are at a level where they should be considered. Potential for subsidence is at a level where it may need to be considered. For the majority of the proposed route north of the River Thames, soluble rocks are not thought to be present, however there is a band to the north of Tilbury where soluble rocks are present and few dissolution features are likely to be present.

Unexploded Ordnance (UXO)

- 10.4.61 A UXO desk study has been undertaken by Zetica for the proposed route. A number of potential sources of UXO hazard have been identified relating World War II bombing, including Milton Range and the River Thames.
- 10.4.62 The Plate below (Plate 10-1) is an extract from the report which shows the UXO hazard along the Scheme and associated risk rating.

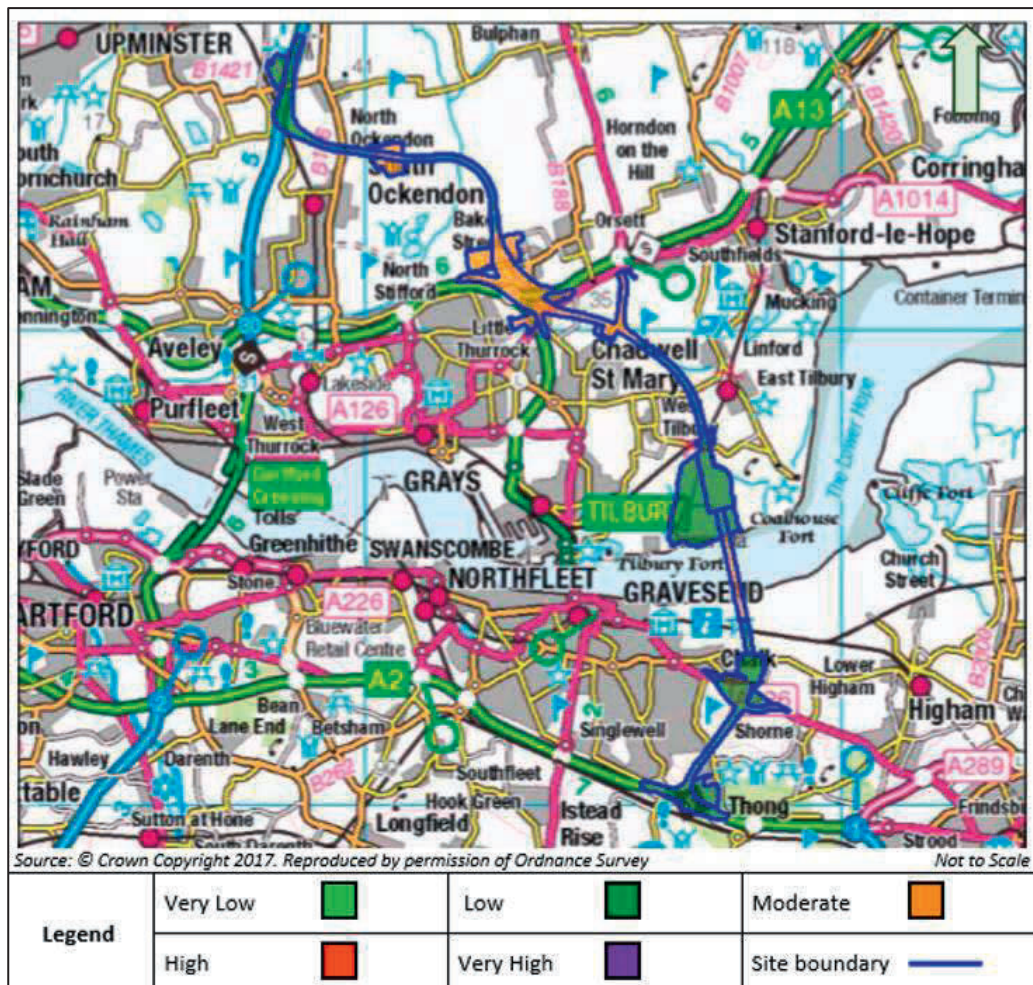


Plate 10-1: UXO Hazard Plan Of The Site

- 10.4.63 The UXO report will be reviewed in more detail during the preparation of the ES chapter.

Soils

- 10.4.64 Some information on the soils and land quality is available from published sources.
- 10.4.65 Published soil mapping is shown in Figure 10.12 in Appendix F. Soils adjacent to the River Thames are described as loamy and clayey floodplain soils with naturally high groundwater. To the south of the River Thames the floodplain soils give way to freely draining slightly acid but base-rich soils and then freely draining lime-rich soils as the underlying chalk geology becomes exposed from the overlying alluvium.

- 10.4.66 To the north of the River Thames the floodplain soils give way to freely draining slightly acid loamy soils and then slowly permeable seasonally wet slightly acid but base-rich loamy and clayey soils, with floodplain soils again present where the solid geology is overlain with tidal flat deposits.
- 10.4.67 Overall, the underlying solid and drift geology are key drivers in terms of the nature of the soils present. These characteristics will also influence the land grades present.

Agricultural Land Classification

- 10.4.68 Agricultural land in England and Wales is graded between 1 and 5, depending on the extent to which physical or chemical characteristics impose long-term limitations on agricultural use. Grade 1 land is excellent quality agricultural land with very minor or no limitations to agricultural use, and Grade 5 is very poor quality land, with severe limitations due to adverse soil characteristics, relief, climate or a combination of these. Grade 3 land is subdivided into Subgrade 3a (good quality land) and Subgrade 3b (moderate quality land).
- 10.4.69 Grades 1, 2 and 3a are defined as the best and most versatile land (BMV).
- 10.4.70 Soil wetness is one characteristic which can limit the productivity of land; it is therefore expected that the provisional ALC mapping (Figure 10.10 in Appendix F) shows lower grades adjacent to the estuary to the south of the River Thames. The land adjacent to the northern bank is mapped, at this scale, as non-agricultural, possibly reflecting the extent of land taken up by Tilbury Power Station. The ALC mapping suggests that the higher land grades are associated with the freely draining, base-rich soils, and again this would be expected. It should be noted that the ALC mapping at this scale will provide overall context and an indication of likely grade, but is not suitable for detailed land grade assessments.
- 10.4.71 Some areas of land within or adjacent to the application site have been mapped in detail, as shown in Figure 10.11A in Appendix F. At the southern end of the application site land at grades 2, 3a and 3b have been mapped. Adjacent to the northern end land of grades 2 and 3a have been mapped. The data behind this mapping would be sought and reviewed to confirm if the methodology used conforms to the ALC assessment guidelines (MAFF, 1988).
- 10.4.72 The soils support valuable habitats, in particular Ancient Woodlands. Soils associated with Ancient Woodlands form a critical component of the overall biodiversity value of these sites and so would need to be considered in detail should any Ancient Woodland sites be affected.

Agricultural Land Use

- 10.4.73 As noted above, there are a range of potential land grades present and this will influence the land use pattern. At the southern limit of the application boundary, between the A2 and Chalk, the land appears to be under arable production. North of Lower Higham Road the land appears to be predominantly under pasture with an extensive ditch network visible, likely to be floodplain grazing marsh. It is assumed the ditch

network is used to manage water levels across the area adjacent to the River Thames.

- 10.4.74 Immediately north of the River Thames there is an area of man-made ground associated with Tilbury Power Station which gives way to predominantly arable land. The application boundary also includes other land uses such as golf courses and a firing range, along with small pockets of non-agricultural land.

10.5 Other Baseline Information to be Obtained

- 10.5.1 Historical mapping would be reviewed to understand historic land uses that could have resulted in ground contamination that may be mobilised by the Project. Mapping would indicate areas of infilling across the Project.
- 10.5.2 An extensive Ground Investigation would be undertaken to inform the Project design. The results of this investigation would be reviewed to inform the likelihood for disturbance of contaminated materials as well as details about the geology encountered, soil and groundwater quality and groundwater depths. Land stability would be assessed based on the results of the ground investigation.
- 10.5.3 UXO mitigation would be undertaken during the Ground Investigation based on the findings of the Zetica desk study. Any findings would be documented.
- 10.5.4 Information from Consultees regarding land quality, ground conditions and geological features would be reviewed to gain further understanding about these elements across the Project.
- 10.5.5 Historical aerial photograph will be interpreted to assess historical activities within the Scheme.
- 10.5.6 Reports prepared by other workstreams such as updated PSSR, desk study or CSM reports will be reviewed during the preparation of the ES chapter.
- 10.5.7 Additional baseline soils information would be obtained through a Soils Site Report (obtained from the National Soil Resources Institute). Following consultation with Natural England soil and ALC surveys would be undertaken to determine the characteristics of the soils present and the land grades (with soil surveys being undertaken across non-agricultural where the soils are important in the land use supported). The ALC surveys would follow published guidelines (MAFF, 1988).
- 10.5.8 Land owner / land manager interviews would be conducted to gain a full understanding of the nature and functioning of the agricultural businesses affected.
- 10.5.9 Further information would be obtained from the design team regarding the construction of the road e.g. the use of embankments, requirements for ground improvements and likely composition of the waste materials to be generated by the Tunnel Boring Machine (TBM) and its likely treatment, storage and disposal.

10.6 Key Environmental Receptors and their Value

10.6.1 Based on the current understanding of the Project and study area, the key environmental receptors are;

- Geological and soil resources (and the land grade these soils support) in and around the Project.
- The type of farm enterprises and farming/land management practices present, including any agri-environment schemes.
- The possible presence of crop/soil/animal diseases or noxious weeds, and the risk of spreading such disease/weeds.
- Controlled Waters (surface and groundwater) in relation to contaminated land
- Human Health receptors (e.g. residents, recreational users) in relation to contaminated land
- Building environment (e.g. underground structures / building foundations / roads) which could be affected by settlement / land instability

10.6.2 Construction workers are not considered to be receptors as they are governed by H&S legislation.

10.7 Methodology

Guidance

10.7.1 There is currently no defined methodology for assessing the value of geology receptors, so assessment of significance would be undertaken using professional judgement.

10.7.2 However, in relation to contaminated land, a source, pathway receptor approach in accordance with Environment Agency CLR11 Model Practices (EA, 2004) would be adopted for assessing risks from contaminated soils / groundwater. Soil contaminant concentrations when available would be screened against appropriate screening values such as the Suitable 4 Use Levels (S4ULs) (LQM / CIEH, 2015). Water concentrations would be screened against appropriate Water Quality Standards (WQS), including Drinking Water Standards and Environmental Quality Standards. Assessment of significance of the risks would be undertaken using professional judgement with guidance based on CIRIA C552.

10.7.3 In addition, apart from the EIA Regulations there are no legislative requirements governing the assessment of agricultural matters, and the framework of any assessment is derived from a combination of EU and national agricultural and land use policies and measures. The key elements of these can be summarised as:

- the conservation of the best and most versatile resources of agricultural land;
- retention of a competitive and sustainable agricultural industry;

- the diversification of individual farm businesses into supplementary non-agricultural activities; and
- the more positive engagement of individual farm businesses with the delivery of environmental benefits.

Study Area for the EIA

- 10.7.4 For the geological environment, the study area would be defined to include the area within the application boundary, plus a buffer zone of 250m. The application boundary would include all the temporary laydown / construction areas and permanent land take required for the Project.
- 10.7.5 The study area would also be defined to reflect the surrounding geological and environmental (e.g. landfill sites) features and the distance over which significant effects can reasonably be thought to have the potential to occur.
- 10.7.6 In relation to soils, the study area would comprise the application site. In relation to the agricultural enterprises, the study area would be extended to assess the effects of the Project in relation to each farm enterprise affected (i.e. to understand the proportion and significance of any one enterprise affected).

Assessment Periods/Scenarios

- 10.7.7 The assessment would consider the impacts during the construction and operational phase. Consideration would be given to the length of the construction phase and the impact this would have on receptors, e.g. exposure of soils in construction areas to contaminative material such as fuels.
- 10.7.8 The operational period would be assessed, but the road itself would form a degree of mitigation and the impacts are likely to be less significant than during the construction phase.

Future Baseline

- 10.7.9 Future baseline would be assessed by considering the existing site conditions at the time of the start of construction. If any significant changes in ground conditions has occurred since the ground investigation has taken place for example, potential contaminative uses on or near to the route, landslides / stability issues, then additional investigation would be undertaken to confirm the current conditions.
- 10.7.10 The baseline conditions with regards to geology and soils are not anticipated to alter significantly prior to commencement of the construction of the Project as the majority of the soil and groundwater contamination is historical.

Significance Criteria

- 10.7.11 Significance criteria for the assessment of effects on the geological resource, would be developed using guidance from CLR11, CIRIA C552 and professional judgement.

10.7.12 The value of the identified receptors / resources would be assessed against the criteria shown in Table 10-6. This has been based on the guidance provided in DMRB Volume 11 (Highways Agency, 2009).

Table 10-6: Criteria for Determining Value (sensitivity) of the Geology

Sensitivity/Value	Description of resource (receptor)
Very High	<ul style="list-style-type: none"> • Very rare and/or of very high national and regional geological/geomorphological importance with no potential for replacement • Principal groundwater aquifers (Source Protection Zone 1) or contaminated land with highly mobile contaminants) • EC Designated Salmonid/Cyprinid Fishery, WFD Class 'High, designated sites such as SAC, SPA, SSSI, WPZ, Ramsar site, salmonid water • Human Health* – Future users of residential properties with private gardens
High	<ul style="list-style-type: none"> • Medium national and/or high regional geological/geomorphological importance with limited potential for replacement • Principal groundwater aquifers (Source Protection Zone 2) or contaminated land with mobile contaminants) • WFD Class 'Good', Major Cyprinid Fishery, Species protected under EC or UK habitat legislation. • Human Health* – Future users of allotments / / nearby residents
Medium	<ul style="list-style-type: none"> • Low regional and/or high local geological/geomorphological importance with some potential for replacement • Secondary groundwater aquifers (Source Protection Zone 3) or contaminated land with contaminants of low mobility) • WFD Class 'Moderate'. • Human Health* – Future users of residential properties without private gardens
Low	<ul style="list-style-type: none"> • Local geological/geomorphological importance with potential for replacement

Sensitivity/Value	Description of resource (receptor)
	<ul style="list-style-type: none"> • Secondary groundwater aquifers or contaminated land with immobile contaminants • WFD Class 'Poor' • Human Health* – Future users of the completed highway and associated public open space
Negligible	<ul style="list-style-type: none"> • Little local geological/geomorphological interest • Non-aquifers and brownfield land with negligible contamination • WFD Class 'Poor'. • Human Health* – Future users of commercial / industrial properties

* Duration of exposure to contamination and number of pathways of exposure to contamination increases from commercial/industrial (minimum) to residential with private garden (maximum) land uses. Therefore, future users of industrial sites are considered to be of negligible importance as they would have minimal contact with underlying soils, whilst residential ends users are likely to be in contact with underlying soils on a more regular basis and are therefore of very high value.

10.7.13 The magnitude of impacts on geology resources would be described using the criteria outlined in Table 10-7 below.

Table 10-7: Criteria For Determining The Magnitude (Scale) Of Impact On The Geology

Magnitude of impact	Definition
Major adverse	<ul style="list-style-type: none"> • The Project is very damaging to the geological environment/soils resource of the study area; may result in loss of or damage to areas designated as being of regional or national geodiversity value; and the effects cannot be mitigated. • Significant harm to a designated receptor (e.g. human health) is likely to arise from an identified hazard at the site without appropriate remedial action. • Loss or extensive change to a fishery, Loss or extensive change to a designated Nature Conservation Site

Magnitude of impact	Definition
	<ul style="list-style-type: none"> • Loss of, or extensive change to an aquifer used for potable supply, potential high risk of pollution of groundwater.
Moderate adverse	<ul style="list-style-type: none"> • The Project may result in the loss of or damage to areas designated as being of national and/or regional geodiversity value within the study area. Some mitigation may be possible but would not prevent damage to the geological environment, as some features of interest would be lost or partly destroyed. • It is possible that without appropriate remedial action, significant harm to a designated receptor (e.g. human health) could arise to a designated receptor but it is relatively unlikely that any such harm would be severe and if any harm were to occur, it is likely that such harm would be relatively mild. • Partial loss in productivity of a fishery • Partial loss or change to an aquifer, potential medium risk of groundwater pollution. Partial loss of the integrity of groundwater supported designated wetlands.
Minor adverse	<ul style="list-style-type: none"> • The Project would not affect areas with regional or national geodiversity value but may result in the loss of or damage to areas of local geodiversity value. The effects cannot be completely mitigated but opportunities exist for local enhancement of geodiversity value. • It is possible that harm could arise to a designated receptor (e.g. human health) from an identified hazard but it is likely that at worst this harm if realised would normally be mild. • No significant change to an aquifer, potential low risk of pollution to groundwater. Minor effects on groundwater supported wetlands • Slight decrease in water quality
Negligible adverse	<ul style="list-style-type: none"> • The Project would result in very minor loss of geodiversity value of local areas of geological interest/soils resource such that mitigation is not considered practical.

Magnitude of impact	Definition
	<ul style="list-style-type: none"> • There is a low possibility that harm could arise to a designated receptor. In the event of such harm being realised, it is likely to be mild or minor. • The Project is unlikely to affect the integrity of the water environment. • Negligible decrease in water quality
No change	<ul style="list-style-type: none"> • No observable effect either adversely or beneficially.
Negligible beneficial	<ul style="list-style-type: none"> • The Project would be of minor benefit to geodiversity value by potentially providing greater exposure and/or protection. • The Project may resolve slight impact from existing land or water contamination.
Minor beneficial	<ul style="list-style-type: none"> • The Project may result in the exposure of geological formations that may become of significant local interest. The Scheme may resolve minor impact from existing land or water contamination.
Moderate beneficial	<ul style="list-style-type: none"> • There is benefit to the geodiversity value of the geological/soils resource of the area as a result of the Project. • The Project may result in the exposure of geological formations that may become of significant regional interest. • The scheme may resolve moderate impact arising from existing land or water contamination
Major beneficial	<ul style="list-style-type: none"> • The Project is very beneficial to the geodiversity value of the geological/soils resource of the area. • The Project may result in the exposure of geological formations that may become of significant regional and/or national interest. • The Project may resolve major impact arising from existing land or water contamination.

10.7.14 The determination of significance of the impact is a factor of the value/sensitivity of the feature/resource (receptor) and the magnitude of the impact (change) as described above. Table 10-8 shows how the significance of effect is derived.

Table 10-8: Determination Of The Significance Of Impacts

Magnitude of Impact (Change)	Value/sensitivity of Receptor / Resource				
	Very high	High	Medium	Low	Negligible
Major	Very large	Large / very large	Moderate / large	Moderate	Slight
Moderate	Large / very large	Moderate / large	Moderate	Slight	Neutral
Minor	Moderate / large	Moderate	Slight	Neutral	Neutral
Negligible	Slight	Slight	Neutral	Neutral	Neutral
No change	Neutral	Neutral	Neutral	Neutral	Neutral

Source: DMRB Volume 11, Section 2, Part 5 HA 205/08 'Assessment and Management of Environmental Effects'

10.7.15 In relation to soils and agriculture, the criteria for determining the value (sensitivity) of the resource is set out in Table 10-9. This is based on DMRB Volume 11 and expert judgement. There is a proposal to develop, through IEMA, a standard set of assessment criteria in relation to agricultural land; this will be referenced in the assessment if published.

Table 10-9: Criteria For Determining Value (Sensitivity) Of The Soil And Agricultural Resources

Sensitivity/Value	Description of resource (receptor)
High	<ul style="list-style-type: none"> • Grade 1 land agricultural land. • Irrigated agriculture. • Higher level agri-environment schemes. • Soils with a high susceptibility to structural damage and soil erosion throughout the year, including heavily textured, poorly structured soils. • Pastoral farms.
Medium	<ul style="list-style-type: none"> • Grade 2 and 3a agricultural land. • Entry level agri-environment schemes. • Soils with some seasonal susceptibility to structural damage and soil erosion. • Mixed farms.
Low	<ul style="list-style-type: none"> • Grade 3b agricultural land. • Arable or grassland areas.

Sensitivity/Value	Description of resource (receptor)
	<ul style="list-style-type: none"> • Soils with medium to coarse textures and some resistance to structural damage for most of the year. • Organic arable farms
Very Low	<ul style="list-style-type: none"> • Grade 4 and 5 agricultural land. • Course textured and stony soils with little potential for structural damage. • Non-organic arable farms

10.7.16 The magnitude of impacts on soil and agricultural resources would be described using the criteria outlined in Table 10-10 below.

Table 10-10: Criteria For Determining The Magnitude (Scale) Of Impact On The Soil And Agricultural Resources

Magnitude of impact	Definition
High	<ul style="list-style-type: none"> • Permanent loss or degradation of over 20ha of best and most versatile land (BMVL), or entire regional resource of BMVL (ALC Grades 1, 2, 3a). • Existing land-use would not be able to continue (i.e. permanent and full displacement of intended land use / current farm practice is seriously affected leading to viability issues).
Medium	<ul style="list-style-type: none"> • Permanent loss or degradation of 5-20ha of BMVL, or large proportion of regional resource of BMVL. • Existing land-use would be able to continue but with major changes such as loss of yield, additional land management or increased use of fertilisers and herbicides.
Low	<ul style="list-style-type: none"> • Permanent loss or degradation of <5ha of BMVL, or small proportion of regional resource of BMVL. • Existing land-use would be able to continue but with some changes such as loss of yield, additional land management or increased use of fertilisers and herbicides.
Very Low	<ul style="list-style-type: none"> • Permanent loss or degradation of non-BMVL BMVL. • Short-term impacts to receptors with no impact on integrity. No material change to existing land-use.
No change	No observable effect either adversely or beneficially.

10.7.17 The determination of significance of the impact is a factor of the value/sensitivity of the feature/resource (receptor) and the magnitude of the impact (change) as described above. Table 10-11 shows how the significance of effect is derived.

Table 10-11: Determination Of The Significance Of Impacts

Magnitude of Impact (Change)	Value/sensitivity of Receptor / Resource			
	High	Medium	Low	Negligible
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Minor
Low	Moderate	Minor	Minor	Negligible
Very Low	Minor	Negligible	Negligible	Negligible

10.8 Description of Possible Significant Effects on Receptors

Construction

- 10.8.1 There is the potential for loss of geological resources. Mining / mineral extraction has taken place across the area in the past. The construction of the Project could have an impact on this being possible in the future and would be assessed. Conversely it may provide opportunity for mineral resources (eg River Terrace Deposits) of appropriate value to be used within the Scheme.
- 10.8.2 There is the potential for disturbance of potentially contaminated land such as landfills, industrial sites and areas of Made Ground. There are historic landfill sites located on route and in particular the location of the proposed tunnel portal on the northern side of the River Thames.
- 10.8.3 Construction / lay down areas would be required during the construction of the Project. Contamination could occur in these areas due to the storage / spillages of fuels / chemicals and construction materials.
- 10.8.4 Due to the proposed route crossing through or in close proximity to a number of landfill sites, there is the potential for migration of ground gases from such features into construction areas / confined spaces. This could impact human health receptors / structures during the construction phase.
- 10.8.5 During construction there is also the potential that the works may give rise to the following effects:
- Mobilising contaminants in the soil that would otherwise be immobile.
 - Creation of new pollutant pathways, for example via the use of band drains or piling techniques during the construction of the road which would allow pathways for contamination to reach groundwater and surface water resources.
 - Creation of contaminated run-off that could affect geology / soils as well as surface and groundwater resources in the locality.
 - Contamination of adjacent soils and land as a result of the storage and movement of the waste generated by the TBM.

- Exposure to human health receptors (nearby residents) to contaminants in soils / dust and shallow groundwater via ingestion and inhalation.
- 10.8.6 During the construction phase, the earthworks would involve boring the tunnel beneath the River Thames, and excavation works to create cuttings or creation of embankments on either side of the river to the road infrastructure. Deep excavations would occur at the tunnel portals which would involve the disturbance of soils. Dewatering may be required, which could allow contaminants to flow into the area via groundwater. This would be considered in depth in the Water Environment assessment but, where relevant in relation to contaminated land, reference would be made in the Geology and Soils chapter.
- 10.8.7 UXOs may be present along the proposed route which if disturbed could explode posing a significant risk to receptors.
- 10.8.8 Due to the construction of the Project, settlement of existing and the new structures may occur due to the changes in ground conditions / ground movement. This would depend on the sensitivity of the building or structure. This would have an effect on the built environment around the Project.
- 10.8.9 Potential effects during construction on soils and agricultural businesses include:
- Permanent loss of agricultural land through land take, in particular the loss of BMVL;
 - Degradation of agricultural land used temporarily for construction, for example due to:
 - d) Soil handling methods and storage arrangements;
 - e) Impairment of crops/land close to the construction site, for example due to airborne dust emissions or silt-laden runoff;
 - f) Indirect effects on surrounding agricultural land caused by changes in site hydrology or hydrogeology, for example through disruption to land drainage;
 - g) Spreading of noxious weeds caused by soil/land management arrangements.
 - Risk of spreading disease through uncontrolled disturbance of any potential animal burial pits;
 - Severance of access to individual fields or fixed farm infrastructure resulting from both temporary and permanent land take; and
 - Increased nuisance to farm enterprise operations, for example increased traffic, increased footpath use, fly tipping etc.

Operation

- 10.8.10 During the operational phase, the risk to the underlying geology is mainly mitigated by the Project itself as it forms a barrier to soils preventing significant contamination. However, if a major accident occurs resulting

in a large fuel spill, an impact to surrounding geology / soils and water environment could occur.

- 10.8.11 As detailed above, due to the proposed route crossing through or in close proximity to a number of landfills sites, there is the potential for migration of ground gases from such features into service ducts / man holes, structures and other confined spaces. This could impact human health receptors / structures during the operational phase. Leachate produced by the decomposition of materials in the landfill sites, have the potential to migrate towards the Project which could impact the underground structures / water environment.
- 10.8.12 Settlement due to ground movement can occur after the construction phase has been completed and the Project is in operation. Long term (post construction) settlement could affect the built environment of the Project itself and in close proximity.

10.9 Potential Mitigation Measures

- 10.9.1 A ground investigation would be undertaken along the Project to establish the ground conditions and determine if significant contamination is present. If required, mitigation measures would be implemented to ensure that contaminants are not mobilised during the excavation process.
- 10.9.2 Land stability concerns would be investigated and assessed during the ground investigation. If required, mitigation measures would be incorporated into the design of the Project to reduce the impact on receptors.
- 10.9.3 The construction compounds / laydown areas would be established to ensure appropriate storage of waste materials, drip trays on vehicles / machinery, availability of oil spillage kits, bunded fuel tanks and designated areas for refuelling and storage of vehicles / machinery. All of these measures to reduce pollution would be documented in the CEMP and performance against the CEMP regularly audited. Good construction practice and pollution prevention measures would be adopted during the construction phase.
- 10.9.4 A land quality baseline survey would be undertaken prior to use as a compound area and a repeat survey would be undertaken on decommissioning. Any contamination created by the construction works would be appropriately remediated.
- 10.9.5 Soils excavated during the construction would be stored in accordance with good practice to ensure they are suitable for re-use when required. It may also be possible for these materials to be re-used in other projects. At the end of the construction phase the soils for re-use would be re-instated and, therefore, the effect would be temporary and reversible.
- 10.9.6 Where soils are not suitable for re-use, they will be removed off site to a suitably licensed landfill facility.
- 10.9.7 The sustainable re-use of the soil resource would be undertaken in line with the Construction Code of Practice for the Sustainable Use of Soil on

Construction Sites (Defra, 2009). This would be achieved by identifying the soils present, proposed storage locations and handling methods and locations for re-use where possible. Measures which would be implemented include (but are not limited to):

- Completion of a Soil Resources Survey;
- Ensuring soils are stripped and handled in dry conditions;
- Confinement of vehicle movements to defined haul routes until all the soil resource has been stripped;
- Protection of stockpiles from erosion and tracking over; and
- Ensuring the physical condition of the entire replaced soil profile is sufficient for the post-construction use.

- 10.9.8 A considerate construction approach would be used to minimise potential impacts on the agricultural enterprises during the construction phase. This would include the development of access arrangements to ensure continued operation of farm businesses and minimising severance where feasible. Toolbox Talks would be provided by the Environmental Coordinator or their recognised deputy to all staff.
- 10.9.9 All fencing around the Project would be sufficient to resist damage by livestock, and would be regularly checked and maintained in a suitable condition.
- 10.9.10 UXO mitigation would be undertaken during the intrusive investigation based on the findings of the Zetica desk study report.
- 10.9.11 Gas monitoring would be undertaken as part of the investigation works, which would inform the design of the Project and appropriate mitigation measures can be incorporated into the design to reduce the impact to receptors.
- 10.9.12 A Materials Management Plan (MMP) would be prepared in line with the CL:AIRE Development of Waste : Code of Practice for the Scheme to keep excavated soils outside waste legislation and allow re-use of suitable materials within the Scheme.

10.10 Aspects/Impacts Scoped out of the EIA

- 10.10.1 Both the construction and operational impacts of the Project would be assessed therefore no aspect would be scoped out of the assessment.

10.11 Any Other Information

- 10.11.1 At this stage, there is no further information to report.

11 Materials

11.1 Introduction

- 11.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on materials during both construction and operational phases.
- 11.1.2 The aims of this chapter are to:
- Detail the requirements of the NPSNN for the assessment
 - Present the consultations undertaken and proposed
 - Explore the baseline information that has been collected to date
 - Provide information on what would be collated through further desk study or surveys work
 - Identify the key receptors that would be considered in the EIA
 - Detail the methodology that would be used to assess effects on materials
 - Outline the potential significant effects that would occur
 - Describe the potential mitigation measures
 - Identify (and justify) any aspects/impacts scoped out of the assessment
- 11.1.3 Note that this chapter does not make reference to impacts associated with the offsite manufacture of products or the off-site extraction of primary materials. These stages of the products' or material resources' life-cycles are outside the scope of this assessment due to the range of unknown variables associated with the extraction and manufacturing processes.
- 11.1.4 The term 'materials' was introduced within the DMRB Volume 11 (Department for Transport, 2009) in August 2009 and embraces the main material resources required to construct the Project and construction-related wastes.
- 11.1.5 This chapter outlines the potential effects resulting from the use of material resources associated with the works and waste management in the construction, demolition and excavation (CD&E) phases of the Project. It also assesses potential embodied carbon impacts associated with material resources to be used and the management of waste.
- 11.1.6 There may be interrelationships related to the potential effects on material resources, and other disciplines.
- 11.1.7 Therefore, please refer to the following chapters:
- Chapter 12 Geology and Soils
 - Chapter 14 Road Drainage and the Water Environment
 - Chapter 15 Climate Change

11.2 NPSNN Requirements

- 11.2.1 The NPSNN sets out the need for and the Government's policies to deliver, development of NSIPs on the national road and rail networks in England. The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications. The materials aspects of the NPSNN are presented from paragraphs 5.39 through to paragraph 5.45.
- 11.2.2 The NPSNN provides information regarding what should be included in the applicant's assessment in paragraph 5.42, which states that:
- 11.2.3 *"The applicant should set out the arrangements that are proposed for managing any waste produced. The arrangements described should include information on the proposed waste recovery and disposal system for all waste generated by the development. The applicant should seek to minimise the volume of waste produced and the volume of waste sent for disposal unless it can be demonstrated that the alternative is the best overall environmental outcome".*
- 11.2.4 In relation to decision making paragraphs 5.43, 5.44 and 5.45 provide advice to the decision maker (the SoS) which should be used when determining whether a scheme should receive consent;
- 5.43 The Secretary of State should consider the extent to which the applicant has proposed an effective process that will be followed to ensure effective management of hazardous and non-hazardous waste arising from the construction and operation of the proposed development. The Secretary of State should be satisfied that the process sets out:*
- any such waste will be properly managed, both on-site and off-site;*
 - the waste from the proposed facility can be dealt with appropriately by the waste infrastructure which is, or is likely to be, available. Such waste arisings should not have an adverse effect on the capacity of existing waste management facilities to deal with other waste arisings in the area; and*
 - adequate steps have been taken to minimise the volume of waste arisings, and of the volume of waste arisings sent to disposal, except where an alternative is the most sustainable outcome overall.*
- 5.44 Where necessary, the Secretary of State should use requirements or planning obligations to ensure that appropriate measures for waste management are applied.*
- 5.45 Where the project will be subject to the Environment Agency's environmental permitting regime, waste management arrangements during operations will be covered by the permit and the considerations set out in paragraphs 4.48 to 4.56 will apply.*
- 11.2.5 This chapter would present a forecast of the waste likely to arise from the Project and assesses the quantity of waste likely to arise from the Project against the capacity of the study area's waste management

facilities. Chapter 15 Climate Change would also present an assessment of embodied carbon for materials to be used in the Project.

11.2.6 The delivery of the mitigation measures set out in this chapter of the EIA Scoping Report will support adherence to the requirements of the NPSNN by minimising the volume of waste produced and the volume of waste sent for disposal.

11.2.7 In accordance with the requirements of the NPSNN, all material resources used and waste arisings from the Project would be managed onsite and offsite in accordance the CEMP and a Site Waste Management Strategy. The intention would be that the contractors would be required to produce a Site Waste Management Plan (SWMP), Materials Management Plan (MMP) and Construction Traffic Management Plan (CTMP).

11.3 Consultations Undertaken and Proposed

11.3.1 During the options phase, organisations such as local authorities, Natural England and the EA were consulted regarding the proposed route options. No responses specifically in relation to materials were received.

11.3.2 During the preparation of the ES it is proposed the following stakeholders will be consulted:

- EA Waste officer.
- Waste Officers of Kent County Council, Medway Council, Thurrock Council and Essex County Council.
- Relevant landfill and waste transfer station operators and sites that could potentially take materials from the Project (e.g. excavated materials).

11.3.3 The consultation will aim to:

- Define the targets of Kent County Council, Medway Council, Thurrock Council and Essex County Council waste policies.
- Discuss waste management aspirations for the application site and set targets.
- Understand the capacity of waste sites in vicinity of the Project and set out the strategy for waste management.
- Understand proposals for any future waste facilities within the study area and implications on waste management at the application site.

11.4 Baseline Information Obtained/Surveys Undertaken

Material Resources

11.4.1 Primary aggregate “*is the term used for aggregate produced from naturally occurring mineral deposits and used for the first time*” (British Geological Society, 2014).

- 11.4.2 Secondary aggregates as defined by Aggregain (a free Sustainable Aggregates information service provided by the WRAP Aggregates Programme) are derived from a very wide range of materials that may be used as aggregates. Many arisings of secondary materials have a strong regional character. For example, china clay sand in South West England, slate waste in North Wales, and metallurgical slag in South Wales, Yorkshire and Humberside.
- 11.4.3 Recycled aggregates, as defined by Aggregain, can be sourced from a variety of materials arising from construction and demolition (concrete, bricks, and tiles), highway maintenance (asphalt planings), excavation and utility operations.
- 11.4.4 Baseline conditions for material resources (including construction materials) have been established through desktop research. As a specific study area has not been set for material resources as data for all material resources to be used is not available for the waste study area (Kent and Greater Essex). The quantitative assessment has been based on available material resources data for the UK.
- 11.4.5 Table 11-1 provides a breakdown of the annual UK demand of key material resources expected to be used by the Project based on data from the Mineral Products Association, 2016 and the International Steel Statistics Bureau, 2016.

Table 11-1: Annual UK Demand Of Key Material Resources (2015)

Material Resources	Quantities (tonnes)
Aggregates	225,000,000
Pavement	24,000,000
Concrete	81,000,000
Steel	10,400,000

Current Local Aggregates Reserves

- 11.4.6 The Kent Minerals and Waste Local Plan (Kent County Council, 2016), the Medway Authority Monitoring Report (Medway Council, 2016) and the Local Aggregate Assessment for Greater Essex (Essex County Council, Southend-on-Sea Borough Council and Thurrock Council, 2016) identify the tonnage of aggregate reserves (including sand and gravel, land and marine won, crushed rock and recycled aggregates).
- 11.4.7 Permitted reserves of land won aggregates remaining unworked in Kent in 2016 were 75,680,000 tonnes (excluding hard rock due to confidentiality). Crushed rock in terms of permitted reserves was abundant in Kent in 2016, approaching 50,000,000 in total.
- 11.4.8 Appendix D includes the most up to date list of aggregate quarries in Kent which has been extracted from the 2016 Kent Minerals and Waste Local Plan. It is currently uncertain whether they would be appropriate for use in construction of the Project.
- 11.4.9 The consented secondary and recycled aggregates processing capacity within Kent currently exceeds 2,700,000 tonnes per annum, 630,000

tonnes per annum of which is identified as temporary capacity. Inert CD&E waste is the main source of recycled aggregate and arisings of this waste in Kent are estimated to be 2,600,000 tonnes per annum which indicates that some capacity may be utilised for imported materials.

- 11.4.10 The Medway Council Local Plan Consultation Document (Medway Council 2016) indicates that the total proven aggregate mineral resources in the Medway area are calculated to be 1,640,000 tonnes. The total potential river terrace sand and gravel reserves in the unconstrained areas of the Hoo Peninsula may range from 3,345,326 tonnes to 4,547,940 tonnes.
- 11.4.11 The Medway Authority Monitoring Report (Medway Council, 2016) shows that the permitted reserve of sand and gravel reported by Medway in 2016 is 1,300,000 tonnes. The 10-year average of sales from quarries in Medway is 9,147 tonnes per annum. The 3-year average of sales is 3.333 tonnes per annum. Therefore, overall the demand appears to be very low for land won resources in Medway.
- 11.4.12 The Local Aggregate Assessment for Greater Essex identifies the tonnage of aggregates (including sand and gravel, land and marine won, crushed rock and recycled aggregates); the sites are summarised in Table 11-2.

Table 11-2: Aggregates Produced Within Greater Essex, 2015

Site Name	Operator	Cessation Date for Planning Permission
Operational Sand and Gravel Quarries with Permitted Reserves		
Bradwell Quarry, Silver End	Blackwater Aggregates	2022
Widdington Pit, Widdington	Carr and Bircher	2025
Martells Quarry, Ardleigh	Aggregate Industries	2026

- 11.4.13 As of December 2015, there were 25 sand and gravel quarries (21 operational) across Greater Essex, of which one also produced silica sand, as well as two brick clay sites and a single chalk site. Out of necessity, Greater Essex is an importer of crushed rock, importing 1,525,000 tonnes of this mineral annually. Appendix D presents the permitted sand and gravel reserves in Greater Essex.
- 11.4.14 Appendix D also presents all the operational and non-operational primary mineral sites with planning permission within Greater Essex.

Waste

- 11.4.15 Baseline conditions to support the quantitative assessment of waste arisings have been established through desktop research, including the review of key data sources: EA 2015 Waste Data Tables (Environment Agency, 2016) and EA Environmental Permitting Regulations (EPR)

database (Environment Agency, 2016) and Kent County Council , Medway Council, Thurrock Council and Essex County Council websites.

- 11.4.16 The Waste Framework Directive has targeted recovery of at least 70% of all CD&E waste by 2020. Table 11-3 outlines the volume of CD&E waste produced in the UK during 2008, 2010, 2012 and 214.

Table 11-3: Current CD&E Waste Arisings In The UK

Years	CD&E Waste (tonnes)
2008	100,999,493
2010	102,231,321
2012	108,800,000
2014	120,400,000

Current Local Waste Arisings

- 11.4.17 The total CD&E waste arisings in Kent and Greater Essex for 2005 is estimated to be 6,951,533 tonnes per year. Of this total:
- 52% was recycled to produce graded and ungraded aggregates and soil (excluding topsoil).
 - 31% was deposited in licensed landfill sites, of which 35% are used for engineering and capping and 65% are waste.
 - 17% was used on exempt sites (sites whereby a waste permit is not required, e.g. where wastes are used for land reclamation or improvement, composting etc)
- 11.4.18 Data since 2005 has been reclassified into categories used under the Pollution Prevention and Control (PPC) permitting of landfills and because of the ban on the co-disposal of waste in landfills in July 2004.
- 11.4.19 Whilst figures for the study area arisings are reasonably robust for all years, for years prior to 2010, there were some significant methodological differences compared to later years. Therefore, data from 2005 should not be compared directly with the latest data from 2016.
- 11.4.20 Most recent data from Office for National Statistics (2016) shows that the total waste arisings (including municipal, commercial and CD&E waste) in Kent and Greater Essex is estimated to be 5,350,000 tonnes per year (Table 11-3)

11.4.21 Of this total, 98% is non-hazardous waste comprising:

- Some stable non-reactive hazardous wastes (SNRHW) being sent to a dedicated cell⁶ within a suitable landfill (13.39%).
- 75.07% inert waste
- 9.13% other non-hazardous waste.

Table 11-4: Annual Waste Arisings Within The Study Area (Data From 2015)

Waste arisings	Area		Total	% Total
	Essex	Kent		
Hazardous Merchant	0	13,538	13,538	0.25%
Hazardous Restricted	0	21,222	21,222	0.40%
Non-hazardous with SNRHW cell	0	195,006	195,006	3.65%
Non-hazardous	2,859,895	133,300	2,993,195	55.95%
Hazardous*	0	0		0%
Inert	1,033,677	1,093,055	2,126,732	39.75%
TOTAL	3,893,572	1,456,121	5,349,693	100%

* Hazardous waste data has not been presented at this level of detail within the waste management 2016 data from National Statistics.

Potential Local Hazardous Waste Arisings

11.4.22 A review of the historical development around the preferred route has been carried out utilising GIS datasets obtained from Landmark Envirocheck, who created the datasets in collaboration with Ordnance Survey via a review of available historical maps.

11.4.23 Figure 10-3 in Appendix F illustrates the locations of the industrial uses and contaminative land uses. A list of the locations that could potentially be contaminated are presented in Chapter 10: Geology and Soils

Waste Capacity

11.4.24 The capacity of waste infrastructure sites that could potentially receive CD&E waste arisings from the Project has been assessed using data gained from the EA EPR database. The total capacity of landfills within 20km of the Project is around 115,600,000 tonnes per year and of waste transfer stations is around 19,800,000 tonnes per year.

11.4.25 Appendix D details the annual waste infrastructure capacities from landfills and active waste management facilities taking CD&E waste

⁶ This is the area in a landfill that has been constructed and approved for disposal of waste. The cells range in size depending upon total tonnes of waste received each day at the landfill.

within 20 km of the Project which can accept over 100,000 tonnes per annum.

- 11.4.26 The capacity of waste stream specific infrastructure sites that could potentially receive waste arisings from the Project has also been assessed using data gained from the Waste Management 2016 in Kent and Greater Essex Data Tables. Table 11-5 details the annual waste infrastructure capacities (landfills) for waste likely to arise from all activities (including CD&E, commercial and industrial, etc.) within the study area.

Table 11-5: Annual Waste Capacity (Including CD&E) Within The Study Area

Waste Capacity (landfill and metal treatment facilities)	Area	
	Essex	Kent
Hazardous Merchant	0	550,000
Hazardous Restricted	0	10,175
Non-hazardous with SNRHW cell	0	2,441,731
Non-hazardous	12,709,139	136,788
Hazardous*	484,092	0
Inert	4,485,109	5,792,862
TOTAL	17,678,340	8,931,556

11.5 Other Baseline Information to be Obtained

- 11.5.1 Relevant local authorities and the Environment Agency would be consulted to obtain future baseline data and to further review the list of potential receptor sites for waste arisings from the Project (landfills, waste management facilities and other projects).
- 11.5.2 The capacities of soil treatment facilities that could potentially receive and process contaminated soil waste arisings from the Project would be obtained.
- 11.5.3 Further information would be obtained from the design team regarding the construction of the tunnel and road e.g. quantities of material resources to be used, the use of embankments and likely composition of the waste materials, details of dredged materials associated with a potential jetty for use during construction, spoil to be generated by the Tunnel Boring Machine (TBM) and its likely treatment, storage and disposal.

11.6 Key Environmental Receptors and their Value

- 11.6.1 There are no obvious environmental receptors for material resources in the same way that there are for other topic areas. However, it will be possible to quantify the use of typical key material resources required for

the Project in absolute terms, for example, tonnes of primary aggregate, concrete and steel.

- 11.6.2 The primary receptor for waste is the available waste management infrastructure within reasonable proximity of the Project and the impacts on the capacity of these facilities. The production of large quantities of waste within a short period of time, for example, the production of a large volume of waste concrete could have adverse effects on waste infrastructure by reducing the capacity to manage other waste streams. For some types of waste management infrastructure, such as disposal facilities, this impact can be permanent via a permanent reduction in void capacity. For other types of infrastructure, such as waste transfer stations, material recovery facilities or recycling sites, the impacts would be temporary. Identifying recycling options for wastes produced by the Project will be considered to have a lower environmental impact than disposing of waste.
- 11.6.3 There are no accepted criteria for determining the value (sensitivity) of material resources and waste (including waste infrastructure). In the absence of such guidance, the materials assessment will be undertaken using professional judgement of material resources and waste specialists. Sensitivity of material resources used will be based on the availability of the material resource and whether its use in the Project could result in significant depletion. Full details are contained in Table 11-6.
- 11.6.4 For example, a rare material resource that is not available locally or only available locally in very limited amounts may be assessed as high sensitivity. The scarcity of the required material resource could therefore lead to it being significantly depleted. Conversely, a material resource that is very common locally or that primarily comprises reused, recycled or recovered material resources such that its use would contribute to meeting waste reduction targets and the avoidance of the use of primary material resources, may be considered to have a low sensitivity.

Table 11-6: Determining The Value / Sensitivity Of Resource

Value/ sensitivity of receptor	Criteria
Very High	<ul style="list-style-type: none"> • There is no available waste management infrastructure capacity within the study area for any waste arisings from the Project. • Very high importance and rarity of resource on a national scale. Very limited materials reuse, recycling and or recovery. • No capacity of existing highways network, rail or river to accommodate any increases in lorry, train and barge and/or ship movements resulting from the flow

Value/ sensitivity of receptor	Criteria
	of material resources and wastes to and from the Project.
High	<ul style="list-style-type: none"> • There is limited waste management infrastructure capacity within the study area in relation to the forecast waste arisings from the Project. • High importance and rarity of resource on a regional scale. Limited materials reuse, recycling and or recovery. • Low capacity of existing highways network, rail or river to accommodate any increases in lorry, train and barge and/or ship movements resulting from the flow of material resources and wastes to and from the Project.
Medium	<ul style="list-style-type: none"> • There is adequate waste management infrastructure capacity within the study area for the majority of waste arisings from the Project. • High or medium importance and rarity of resource on a regional scale. Moderate materials reuse, recycling and or recovery. • Medium capacity of existing highways network, rail or river to accommodate any increases in lorry, train and barge and/or ship movements resulting from the flow of material resources and wastes to and from the Project.
Low	<ul style="list-style-type: none"> • There is adequate available waste management infrastructure capacity within the study area for all waste arising from the Project. • Low or medium importance and rarity of resource on a local scale. High materials reuse, recycling and or recovery. • High capacity of existing highways network, rail or river to accommodate any increases in lorry, train and barge and/or ship movements resulting from the flow of material resources and wastes to and from the Project.
Negligible	<ul style="list-style-type: none"> • Negligible scarcity of required material resource. • There is waste management infrastructure capacity within the study area for all waste arisings from the Project.

Value/ sensitivity of receptor	Criteria
	<ul style="list-style-type: none"> • Negligible importance and rarity of resource on a local scale. Very high materials reuse, recycling and or recovery. • Very high capacity of existing highways network, rail or river to accommodate any increases in lorry, train and barge and/or ship movements resulting from the flow of material resources and wastes to and from the Project.

11.7 Methodology

Guidance

11.7.1 There is currently no defined methodology for assessing the value of material receptors, so assessment of significance would be undertaken using professional judgement and presented within the ES.

Study Area for the EIA

11.7.2 In respect of the assessment in relation to material resources, a specific study area has not been identified due to the whole market approach that will be used to procure material resources required for the Project.

11.7.3 For the waste assessment, the study area comprises the area within the application boundary and also Kent and Greater Essex for CD&E waste and for waste arisings presented by waste stream.

11.7.4 In the absence of hazardous waste arisings data within the study area, hazardous waste arisings for the South-East will be used to inform the assessment.

11.7.5 The waste infrastructure sites (landfills and waste management facilities) that may potentially accept waste arisings from the CD&E phases of the Project within the described study area will be included in the assessment. Non-exhaustive list of these landfills and waste management facilities, including postcodes, are included in Appendix D.

Assessment Periods/Scenarios

11.7.6 The assessment would consider the impacts during the construction and operational phases. Consideration would be given to the length of the construction phase and the impact this would have on receptors, e.g. waste management facility capacity.

11.7.7 The operational phase would be assessed, but the road and tunnel would not require large amount of material resources or produce significant quantities of waste during the operational phase.

Future Baseline

Material Resources

- 11.7.8 The Kent Materials and Waste Local Plan indicates that there will be 10,080,000 tonnes of sharp sand and gravel (including 3,610,000 tonnes of currently permitted reserves up to 2030, and a landbank of at least 5,460,000 tonnes in 2030). The 10,640,000 tonnes of soft sand, at existing permitted sites and new allocations, will provide at least 4,960,000 tonnes making a total provision of 15,600,000 tonnes. This will be sufficient to provide 11,050,000 tonnes up to 2030 plus a landbank of 4,550,000 in 2030. The 50,000,000 tonnes of crushed rock at existing permitted sites will be sufficient to provide 13,260,000 tonnes up to 2030 plus a landbank of 7,280,000 tonnes in 2030 without the need for any new allocation.
- 11.7.9 Medway Council has analysed several external sources to project any trends that may be emerging that would influence demand. The population of Medway is predicted to increase by 22% to 2037 and house builders are reporting increased workloads and planning permissions granted nationally indicating a potential increase in demand over the coming years, but this appears not yet to have significantly affected the market.
- 11.7.10 As of 31 December 2011, the combined Thurrock and Essex updated landbank for sand and gravel was 8.3 years. Planning permissions secured on the preferred sites identified in the Essex Minerals Local Plan (Essex County Council, 2014) will increase the permitted landbank which otherwise decreases through sales of the aggregates.

Waste

- 11.7.11 The Kent Waste Needs Assessment Study (Jacobs, 2010) has based its forecast for future waste provision on the National Study on Inert CD&E Waste Arisings Study (DCLG, 2005) and does not use any factor for growth for Kent and Medway. The National Planning Practice Guidance for Waste (DCLG, 2014) also advises that Waste Planning Authorities should start from the basis that net arisings will remain constant over time. Therefore, the forecast used in the Kent Minerals and Waste Local Plan 2013-30 assumes no growth in this waste stream.
- 11.7.12 The projected waste arisings (including C&D waste) for Thurrock are presented in Table 11-13. The proportional split has been revised in the Thurrock 2010 study to take account of higher recycling targets and less generous exemptions under the environmental permitting regulations during the plan period.

Table 11-7: Estimated Requirements For Management For C&D Waste In Thurrock

Year	2009/10	2020/21	2025/26
Recycled aggregate and soil	169,334	300,802	325,615
Disposed at landfill	100,218		132,997

Year	2009/10	2020/21	2025/26
Used at exempt sites	76,028	None	None

- 11.7.13 Policy CSTP31 (Provision of Minerals) sets out the Council's position on encouraging greater recycling and re-use of C&D waste. Therefore, recycling rates are expected to increase over the Plan period. This will be considered in the approach for additional C&D recycling capacity and the need for sites in the Minerals and Waste Development Plan Document.
- 11.7.14 The revised 2010 Thurrock Study on waste arisings and capacity estimates, has taken into account the principle of increasing the amount of recycled aggregates and soil to achieve up to 70% recycling by 2021 in accordance with the Waste Framework Directive 2008/98/EC.
- 11.7.15 The Essex County Council Capacity Waste Gap Report shows the forecast CD&E waste arisings for the Plan Area to 2032, based on the construction sector forecasts from the East of England Economic Forecasting Model. By 2032, arisings are forecast to have increased to 3,910,000 tonnes per annum.
- 11.7.16 In line with the predictions of waste management capacity higher up the waste hierarchy, there would be a surplus of non-hazardous landfill capacity at 2031/32, if no further permissions are granted and all permissions that have secured planning permission become operational.

Significance Criteria

- 11.7.17 There is currently no defined methodology for assessing the value of material receptors, so criteria for assessing significance of criteria would be undertaken using professional judgement and presented within the ES.

11.8 Description of Possible Significant Effects on Receptors

Construction

- 11.8.1 For material resources use, the potential environmental effects are the depletion of finite natural resources associated with the extraction and transport of primary raw materials, the manufacture of products and their subsequent transport to and use on construction sites.
- 11.8.2 However, it is outside the scope of the assessment to assess the environmental impacts associated with the extraction of raw material resources and the manufacture of products. Instead, the assessment would cover the impacts of the use of primary, secondary and recycled raw materials and manufactured products in the construction of the Project.
- 11.8.3 For surplus material resources and waste, the potential environmental effects are associated with the production, movement, transport, processing and disposal of waste from the application site. Effects would include the temporary occupation of waste management facility space

(during treatment) and the permanent reduction in landfill capacity (disposal).

11.8.4 By maximising efficiencies, selecting material resources appropriately and managing waste in line with the waste hierarchy, the potential adverse effects of the Project with regard to material resources and waste arisings can be minimised.

11.8.5 The transport of material resources and waste would increase the number of journeys on highways, river and rail networks.

Operation

11.8.6 It is anticipated that, during the lifetime of the Project, limited amounts of material resources would be required and only minor quantities of operational waste would be produced. Therefore, no additional measures are envisaged to be put in place.

11.9 Potential Mitigation Measures

11.9.1 Measures would be implemented to reduce the impacts of material resources use and waste arisings from the Project.

11.9.2 A CEMP would be prepared that would require the contractors to:

- Promote opportunities for the potential reusing and recycling of all material resources and waste.
- Sort and segregate waste into different waste streams (where technically and economically feasible).
- Manage material use to maximise the environmental and Project's benefits from the use of surplus materials.

11.9.3 The CEMP would provide a suite of mitigation measures of particular relevance to materials and waste.

11.9.4 The design would apply the five key principles of waste minimisation (Design for: Reuse and Recovery, Off Site Construction, Materials Optimisation, Waste Efficient Procurement and Deconstruction and Flexibility) in all design phases to support the use of materials in a more efficient manner and to consider how reuse, recycling and recovery of materials can be incorporated into the design and ultimately reduce waste to landfill.

11.9.5 Some of the key aspects of waste minimisation that would be considered during design phases are:

- Design complexity: reduce the complexity of the design to standardise the construction process and reduce the quantity of material resources required.
- Specifications: avoid over specification and minimise variation in material resources, components and joints; evaluate the reuse and recycling opportunities for the specified material resources before specification.

Material Resources

- 11.9.6 The CEMP would contain the measures the contractor would implement during construction. Measures could include those detailed below.
- 11.9.7 Where appropriate, materials would be stored to minimise the potential of damage or wastage. Measures would include off-ground storage e.g. on pallets, remaining in original packaging, protection from rain or collision by plant or vehicles. The materials storage area could be secured during out of hours to prevent unauthorised access.
- 11.9.8 Where possible, consideration would be given to the reuse of material (e.g. uncontaminated soils) back into the Project. However, the proposed Project would require specific material resources to be imported to the application site (e.g. additional bulk fill materials). Some demolition materials would be retained / reused onsite (e.g. elements of the drainage would be retained and utilised within the current design where feasible).

Waste

- 11.9.9 The CEMP would contain the measures the contractor would implement during construction including those detailed below.
- 11.9.10 Excavated material would be targeted for fill and landscaping where this is feasible and the material is suitable. Excavated materials, such as soils, would be carefully stored in segregated piles for subsequent reuse on the application site, where possible. If the material is contaminated then it would be kept separate from clean material and sent for either treatment, recycling or recovery, where appropriate, or disposal at appropriately permitted facilities.
- 11.9.11 Surplus inert excavated materials (e.g. soils, stone, bricks, clay, rubble, rock) may be suitable for use in land reclamation projects. This would require compliance with the criteria and thresholds for an exemption or a permit under the Environmental Permitting Regulations 2010 (as amended) (The Stationery Office, 2010). The CL:AIRE Protocol (CL:AIRE, 2011) may also be applicable for the reuse of this material.
- 11.9.12 As with other similar construction projects, where possible, excavated and tunnel boring materials would be sent for beneficial use at a suitable receptor site. The volume of spoil that could be transported by river would depend on the suitability and condition of the excavated material for transport by river and against any waste acceptance criteria/procedures that may be applicable at the receiving facility.
- 11.9.13 The historical use of the application site has a legacy of contamination of the Made Ground that would possibly necessitate treatment to make the materials suitable for reuse off site. This treatment can be undertaken either onsite, potentially reducing its waste classification (i.e. hazardous to non-hazardous) or removed from site for treatment. The alternative is disposal at a suitable location (i.e. landfill).
- 11.9.14 Materials unsuitable for use onsite (e.g. timber off cuts that cannot be used onsite) would be collected for subsequent separation and considered for recycling at an off-site waste management facility.

- 11.9.15 Waste generated by the clearance of Japanese knotweed, if present in the application site, would be segregated from all other wastes and managed in accordance with the EA's Code of Practice (Environment Agency, 2013).
- 11.9.16 Any material produced by the enabling works (e.g. good quality topsoil) deemed acceptable, would be stored and re-laid within the application site whenever possible.

Hazardous waste

- 11.9.17 Hazardous wastes, including any contaminated soil would be identified, removed and kept separate from other CD&E wastes in order to avoid contaminating 'clean' materials.
- 11.9.18 Historically re-excavated PFA has been found to contain additional contaminative contents illegally tipped within it, such as asbestos. This should be considered should any works take place in this area. Any asbestos encountered on site would be managed by a qualified asbestos removal contractor.

Site practices

- 11.9.19 Waste management compound would be established within the application site to handle incoming waste from construction activities. These would be designed to facilitate the segregation of key waste streams to maximise the opportunity to reuse, recycle and return wastes generated onsite.
- 11.9.20 An area would be established for spoil classification at the application site. Spoil would be inspected, tested (as necessary) and assessed as suitable for removal or remediation prior to removal from the application site. Material in this area would be stockpiled by type and disposal method.
- 11.9.21 C&D work would be carried out closely with the waste management contractors, in order to determine the best techniques for managing waste and ensure a high level of recovery of materials for recycling.
- 11.9.22 For all waste management options on the site compounds, consideration would need to be given for identifying whether waste exemptions or permits are required to enable for the storage and treatment of waste materials.
- 11.9.23 Waste management options would be supported by the identification of appropriately permitted waste management and recycling facilities in close proximity to the site compounds.

Operational material resources and waste

- 11.9.24 It is anticipated that only minor quantities of operational waste would be produced during the lifetime of the Project, therefore no additional measures are envisaged to be put in place.

11.10 Aspects/Impacts Scoped out of the EIA

- 11.10.1 Both the construction and operational impacts of the Project would be assessed therefore no aspect would be scoped out of the assessment.

11.11 Any Other Information

11.11.1 At this stage, there is no further information to report.

12 Noise and Vibration

12.1 Introduction

12.1.1 This chapter outlines the proposed approach to the assessment of the Project and potential effects of noise and vibration during both the construction and operational phases.

12.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or survey work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess effects of noise and vibration;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

12.1.3 Note that the key issues of construction and operational noise will be considered and assessed individually, the relevant methodologies are set out below.

12.1.4 There may be interrelationships between the noise and vibration assessment and other environmental topics comprising:

- Chapter 9 Nature Conservation;
- Chapter 8 Landscape; and,
- Chapter 13 People and Communities.

12.1.5 Appropriate cross-referencing is made to these other environmental topics in this chapter.

12.2 NPSNN Requirements

12.2.1 The NPSNN sets out the Government's policies to deliver NSIPs on the national road and rail networks of England. The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications.

12.2.2 The relevant noise guidance contained within the NPSNN is in paragraphs 5.186 to 5.200. Specifically, paragraph 5.188 sets out factors that will likely determine noise impacts from a Project, including:

- *construction noise and the inherent operational noise from the proposed development and its characteristics;*

- *the proximity of the proposed development to noise sensitive premises (including residential properties, schools and hospitals) and noise sensitive areas (including certain parks and open spaces);*
- *the proximity of the proposed development to quiet places and other areas that are particularly valued for their tranquillity, acoustic environment or landscape quality such as National Parks, the Broads or Areas of Outstanding Natural Beauty; and*
- *the proximity of the proposed development to designated sites where noise may have an adverse impact on the special features of interest, protected species or other wildlife.*

12.2.3 Paragraph 5.189 of the NPSNN quantifies what is required to be considered within any noise assessment of a Project that is subject to EIA and has the potential for significant noise impacts to occur. These considerations should form part of any noise study and ES:

- *“a description of the noise sources including likely usage in terms of number of movements, fleet mix and diurnal pattern. For any associated fixed structures, such as ventilation fans for tunnels, information about the noise sources including the identification of any distinctive tonal, impulsive or low frequency characteristics of the noise.*
- *identification of noise sensitive premises and noise sensitive areas that may be affected.*
- *the characteristics of the existing noise environment.*
- *a prediction on how the noise environment will change with the proposed development:*
 - *In the shorter term such as during the construction period;*
 - *in the longer term during the operating life of the infrastructure;*
 - *at particular times of the day, evening and night as appropriate.*
- *an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas.*
- *measures to be employed in mitigating the effects of noise. Applicants should consider using best available techniques to reduce noise impacts.*
- *the nature and extent of the noise assessment should be proportionate to the likely noise impact.”*

12.2.4 Paragraph 5.190 specifies in addition to the considerations outlined above that:

“The potential noise impact elsewhere that is directly associated with the development, such as changes in road and rail traffic movements

elsewhere on the national networks, should be considered as appropriate.”

- 12.2.5 Section 5.195 sets out the main aims of the NPSNN with regard to Government Policy on sustainable development, and details that the SoS “*should not grant development consent unless satisfied that the proposals will meet, the following aims:*
- *avoid significant adverse impacts on health and quality of life from noise as a result of the new development;*
 - *mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and*
 - *contribute to improvements to health and quality of life through the effective management and control of noise, where possible.”*
- 12.2.6 The NPSNN also considers mitigation stating that it could be necessary during both construction and operational phases, but should be “*proportionate and reasonable*” (Paragraph 5.198). The NPSNN specifically requires consideration of mitigation measures on any identified Defra Noise Important Areas (NIAs) – refer to Figure 12.1, within Appendix F, for the location of NIAs.
- 12.2.7 Additionally, the NPS NN qualifies that where relevant the Noise Insulation Regulations (NIR) will apply to national network projects.

12.3 Consultations Undertaken and Proposed

- 12.3.1 Initial meetings have been held with the affected local authorities listed below, and an outline of the noise and vibration assessment protocol given.
- 12.3.2 As part of the EIA process the Environmental Health Departments at the following local authorities would be contacted where appropriate, and in situations where potential noise and vibration impacts as a result of the Project may be evident within their defined administrative areas:
- London Borough of Havering;
 - Gravesham Borough Council;
 - Dartford Borough Council;
 - Thurrock Council;
 - Brentwood Borough Council; and
 - Medway Borough Council.
- 12.3.3 The consultation would look to agree the specifics of the assessment methodology for construction and operational noise, the details of the baseline noise surveys informing the assessment (locations and durations) and any other local factors which require to be considered within the assessment of noise associated with the Project.

12.4 Baseline Information Obtained/Surveys Undertaken

- 12.4.1 No recent noise surveys have been identified within the area of the Project that could be used within the scope of the EIA.
- 12.4.2 A desktop review of the study area indicates that the dominant source of noise in the area would predominantly be from infrastructure sources.
- 12.4.3 To the south of the River Thames, the dominant noise source is likely to be road traffic noise; originating from the A2/M2.
- 12.4.4 To the north of the River Thames noise from the M25 and A13 is likely to dominate the noise climate.
- 12.4.5 However, on a more local level at individual receptors, the noise climate is likely to be more complex, and include contribution from other more localised sources such as commercial, industrial, leisure and human activity noise sources, and could therefore only be suitably quantified through the baseline noise monitoring surveys supporting the assessment.
- 12.4.6 Defra has produced Noise Action Plans which address the management of noise issues and effects from major roads in England under the terms of the Environmental Noise (England) Regulations 2006. The Action Plans are intended to apply in particular to the most 'important areas' identified by the strategic noise maps. Therefore, a set of NIAs have been identified for each of the Noise Action Plans. The NIAs, with regards to roads, are defined as "an area where the 1% of the population that are affected by the highest noise levels are located". The location of NIAs of relevance to this assessment and the Project are shown on Figure 12.1, within Appendix F.

12.5 Other Baseline Information to be Obtained

- 12.5.1 Baseline surveys would be undertaken at sensitive receptors in the vicinity of the Project which have the potential to be affected by the Project during either the construction or operational phases. Construction and operational receptors may be different as a result of the way in which different elements of the Project need to be assessed and considered.
- 12.5.2 Monitoring locations used in the study must be representative of the following land uses (as defined within the DMRB HD213/11, Annex 1 para A1.13) where they occur within the study area, and would be agreed with the relevant Local Authorities as defined within Section 12.3. However, examples of the types of land uses requiring consideration for baseline surveys would include the following, concentrating on where there are likely to be the largest impacts
- Residential dwellings;
 - Hospitals;
 - Schools;

- Community facilities;
- Designated areas (e.g. AONB, National Parks, Ramsar, Special Areas of Conservation, Special Protection Areas and Sites of Special Scientific Interest Scheduled Monuments); and
- Public Rights of Way.

12.5.3 Monitoring would be undertaken as agreed with the relevant local authorities in order to quantify a representative baseline noise climate of the study area including consideration of diurnal variations, and covering both the daytime and overnight periods during the weekday and weekend. The dataset would be used in both the construction and operational noise assessments.

12.5.4 Figure 12.1 in Appendix F presents 35 indicative locations along the Project where short term and longer term noise monitoring will be considered in consultation with the with the relevant Local Authorities. These locations will be subject to agreement on location and duration with the relevant Local Authority prior to any ambient/ baseline noise surveys being undertaken.

12.6 Key Environmental Receptors and their Value

12.6.1 Sensitive receptors in terms of noise would be defined in accordance with the DMRB. These would include the receptors identified in Section 12.5.

12.6.2 As outlined in Section 12.4 Defra has identified a number of NIAs which are in the vicinity of the Project, including:

- Along the A2 in the vicinity of Thong;
- On sections of the A13 and the A1013 around Orsett, Little Thurrock and Chadwell St Mary; and
- On A127(T) around West Horndon.

12.6.3 However, consultation with the relevant Local Authorities will develop the study area and allow confirmation of which NIAs would be within the Project study area and as such assessed appropriately.

12.6.4 The next round of noise mapping is due to be undertaken under the Environmental Noise Directive (END) in 2017 and as such there is the potential that new NIAs may be identified requiring consideration in the assessment. This will be considered in due course when the information is released.

12.6.5 In terms of noise, a methodology has not yet been developed to assign the value of a receptor, currently this is defined based upon professional judgement and the guidance notes of the NPSE. Therefore, based upon professional judgement the value of a receptor would be defined using the criteria provided in Table 12-1.

Table 12-1: Determining The Importance / Sensitivity Of Resource

Importance/Sensitivity of Receptor	Criteria
High	<ul style="list-style-type: none"> • Residential dwellings • Hospitals • Schools • Community facilities • Designated areas (e.g. AONB, National Park, SAC, SPA, SSSI, Scheduled Monument (SM)) • Places of Worship • Public Rights of Way
Medium	<ul style="list-style-type: none"> • Offices • Bars/cafes/restaurants where external noise may be intrusive
Low	<ul style="list-style-type: none"> • Factories and working environments with existing high noise levels • Night clubs

12.6.6 In addition, a Significant Observed Adverse Effect Level (SOAEL) is a concept defined within the National Noise Policy Statement for England (NPSE), along with Lowest Observed Adverse Effect Level (LOAEL) and No Observed Effect Level (NOEL), which are based upon toxicology and defined as:

- SOAEL – Significant Observed Adverse Effect Level
 - This is the level above which significant adverse effects on health and quality of life occur.
- LOAEL – Lowest Observed Adverse Effect Level
 - This is the level above which adverse effects on health and quality of life can be detected.
- NOEL – No Observed Effect Level
 - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

12.6.7 Specifically, with regard to the definition of SOAEL the NPSE states that *“It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what*

may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.”

12.6.8 Within the scope of the assessment the operational road traffic noise levels of LOAEL and SOAEL, at residential properties, have been based upon the approach used on other large infrastructure projects (A14 Cambridge to Huntingdon Improvement Scheme, A19 / A184 Testos Junction Improvement) and the guidance provided in the Defra commissioned report ‘Possible Options for the Identification of SOAEL and LOAEL in Support of the NPSE’ as presented in Table 12-2.

Table 12-2: Levels of LOAEL and SOAEL Assumed for Operational Road Traffic Noise

Time Period	Adverse effect level	L _{Aeq} noise level (dB)	L _{A10} noise level (dB)
Day	LOAEL	50	60
Day	SOAEL	63	68*
Night	LOAEL	40	n/a
Night	SOAEL	55	n/a
* Aligned with Noise Insulation Regulations			

12.6.9 For construction noise, the approach used on other large infrastructure project assessments such as the Silvertown Tunnel Project, Bank Station Capacity Upgrade Project and HS2 have been considered. The construction noise LOAEL and SOAEL for residential properties is defined within Table 12-3.

Table 12-3: Levels Of LOAEL And SOAEL Assumed For Construction Noise

Time Period	LOAEL L _{Aeq,T} (dB)	SOAEL L _{Aeq,T} (dB)
Daytime <ul style="list-style-type: none"> • 07:00 – 19:00 Monday to Friday. • 07:00 – 13:00 Saturday. 	60	75
Evening and Weekends <ul style="list-style-type: none"> • 19:00 – 23:00 Monday to Friday. • 13:00 – 23:00 Saturday. • 07:00 – 23:00 Sunday. 	55	65
Night	45	55

Time Period	LOAEL L _{Aeq,T} (dB)	SOAEL L _{Aeq,T} (dB)
<ul style="list-style-type: none"> 23:00 – 07:00 Monday to Sunday. 		

12.6.10 These definitions of LOAEL and SOAEL as defined within Tables 12.2 and 12.3 will be used in the assessment and consideration of the Project.

12.6.11 The location of all sensitive receptors would be defined once the detailed study area is defined (in accordance with DMRB for operational noise and BS5228 for construction noise) as the two are intrinsically linked.

Future Baseline Receptors

12.6.12 The predicted future road traffic noise baseline scenario will take account of potential road traffic noise changes in the detailed study area associated with planning determinations for developments as incorporated within the traffic data. In terms of the impact of the Project, assessment of effects will be based upon the likelihood of the development being occupied by the opening year, and where appropriate the receptor(s) will be included in the noise and vibration assessment.

12.6.13 Identified parcels of land which may be earmarked for future development will be considered separately by the comparison of future noise levels in the design year both with and without the Project.

12.7 Methodology

12.7.1 Separate assessment methodologies apply to both the construction and operational phases of the Project. These assessment methodologies are presented and discussed further below.

12.7.2 Noise and vibration health impacts will be assessed with reference to the levels of LOAEL and SOAEL presented in section 12.6, and will be reported within the noise and vibration assessment for both construction and operational phases of the Project.

Study Areas for the EIA

12.7.3 Study areas for the different facets of the noise assessment would be defined in accordance with appropriate guidance as detailed below:

Construction Noise and Vibration Study Area:

12.7.4 The study area for the construction noise assessment will comprise an area up to 300m from the Project boundary. This is determined in accordance with relevant guidance and using professional judgement. At distances over 300m noise predictions have to be treated with caution because of the increasing importance of meteorological effects. The predicted noise levels when calculated in accordance with British Standard 5228:2009+A1:2014 ‘Code of Practice for Noise and Vibration Control on Construction and Open Sites’ Parts 1 (BS5228) may be unreliable at distance greater than 300m.

- 12.7.5 Specific sensitive receptors would be identified in association with the Local Authorities within this study area, and would be considered specifically relating to construction noise impacts.
- 12.7.6 The study area for the rail movements associated with the construction phase of the Project will consider sensitive receptors within 300m of any loading facilities and sidings that will be used during the construction phase. The distance of 300m is based upon the limitation of the Calculation of Rail Noise (CRN) prediction methodology (DfT, 1995).
- 12.7.7 Noise impacts from the barge loading associated with the construction phase of the Project will be considered at selected worst case sensitive receptors agreed with the local authorities which are within close proximity to the loading facility/Jetty during the construction phase.
- 12.7.8 The study area for the construction vehicle assessment will consider road traffic noise changes any road/route identified as experiencing an increase in noise of greater than 1dB as a result of the Project during the construction phase.

Operational Road Traffic Noise and Vibration Study Area

- 12.7.9 The operational road traffic noise study area will be derived in accordance with the requirements of DMRB Volume 11 Section 3 Part 7 HD213/11 'Noise and Vibration' Detailed Assessment Methodology (HD213/11).
- 12.7.10 Outside of the detailed DMRB defined study area, consideration of noise changes along major traffic routes within the Lower Thames Crossing version 3 traffic model would be undertaken on the basis of the comparison of CRTN defined Basic Noise Level (BNL) values.
- 12.7.11 Defra defined NIAs within the DMRB defined study area would also be assessed.
- 12.7.12 Airborne traffic induced vibration will be assessed at all residential receptors within 40m of the Project as specified within the methodology presented in the DMRB.

Static Plant (Tunnel Ventilation) Study Area

- 12.7.13 Noise impacts from the operation of the tunnel ventilation systems and other static plant/equipment will be considered at selected worst case sensitive receptors agreed with the relevant local authorities which are within close proximity to the operational plant.
- 12.7.14 Outside of this immediate area ventilation plant noise is not anticipated to have any significant impacts.

Construction Noise and Vibration Assessment

- 12.7.15 Construction noise and vibration will be assessed using the guidance set out in British Standard (BS) 5228-1:2009+A1:2014 '*Code of practice for noise and vibration control on construction and open sites. Noise*' (BS5228-1) and also BS 5228-2:2009+A1:2014 '*Code of practice for noise and vibration control on construction and open sites. Vibration*' (BS5228-2).

- 12.7.16 Part 1 of BS 5228 provides guidance on predicting and measuring construction noise and assessing its impact on the environment.
- 12.7.17 Part 2 of BS 5228 provides recommendations for basic methods of vibration control and methods of assessing its effects on the environment relating to construction where work activities/operations generate significant vibration levels.
- 12.7.18 The following assessment methodologies will be used:
- Noise: In line with precedents set on other NSIP applications, the BS5228-1: 2009 +A1: 2014 “ABC Method” will be used within the scope of the Project assessment in order to establish construction noise limits for the purposes of EIA; and
 - Vibration: BS5228-2: 2009 +A1: 2014 Annex B provides guidance on human response to vibration in buildings in terms of peak particle velocity (PPV). This will be used as the methodology for the assessment and consideration of construction generated ground borne vibration.
- 12.7.19 Rail noise associated with train movements along any new rail sidings created/adapted for the construction phase will be calculated in accordance with CRN and considered accordingly. This is the recognised prediction methodology for rail noise in the UK.
- 12.7.20 With regard to Tunnel Boring Machine operations as there is no UK defined criteria for when ground borne noise becomes significant, impacts will be considered based upon criteria used on other major tunnelling projects including Crossrail, Silvertown Tunnel and Thames Tideway Tunnels.

Operational Road Traffic Noise Assessment

- 12.7.21 Road traffic noise calculations for specific receptors will be carried out under the guidance set out in the ‘Calculation of Road Traffic Noise’ (CRTN: 1988) as required under the appropriate parts of the DMRB HD213/11. Prediction of road traffic noise effects would be undertaken using a proprietary and appropriately validated 3-dimensional noise mapping software package such as IMMI or SoundPLAN 7.5/8.0.
- 12.7.22 As a result of the size and nature of the Project it is anticipated that a DMRB ‘detailed’ level assessment would be necessary for the Project. In accordance with this level of assessment, as defined within the DMRB, the following comparisons will be made for road traffic noise levels to consider the impacts of the Project in both the short and longer terms:
- Do-Minimum scenario in the baseline year against Do-Minimum scenario in the future assessment year (long term);
 - Do-Minimum scenario in the baseline year against Do-Something scenario in the baseline year (short term); and
 - Do-Minimum scenario in the baseline year against Do-Something scenario in the future assessment year (long term).
- 12.7.23 For night-time noise impacts, in accordance with DMRB, only comparisons in the long term will be considered for receptors predicted

to exceed an L_{night} outside of 55 dB(A) or greater. The calculation of permanent traffic noise nuisance impacts will be undertaken for the following comparisons:

- Do-Minimum scenario in the baseline year against Do-Minimum scenario in the future assessment year (long term); and
- Do-Minimum scenario in the baseline year against Do-Something scenario in the future assessment year (long term).

12.7.24 All predictions and comparisons will be presented in the reporting tables as specified in DMRB HD213/11, and assessed accordingly.

Operational Static Plant Noise Assessment

12.7.25 Static plant noise calculations for specific receptors will be carried out under the guidance set out in the *ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*. Prediction of static plant noise effects would be undertaken using a proprietary and appropriately validated 3-dimensional noise mapping software package such as IMMI or SoundPLAN 7.5/8.0.

12.7.26 Assessment and consideration of impacts associated with static plant and equipment, such as tunnel ventilation plant, would be undertaken in accordance with the methodology of BS4142: 2014 *Methods for rating and assessing industrial and commercial sound*.

12.8 Description of Possible Significant Effects on Receptors

Construction

12.8.1 There is potential for adverse noise and vibration effects during the Project construction phase. It is anticipated that construction noise effects could occur due to the following –

- Noise from the operation of construction plant;
- Noise from HGV movements to and from the site, for example site deliveries and the removal of spoil;
- Noise from the operation of the TBM;
- Increase in noise levels in the vicinity of rail lines should spoil be removed via this mode of transport; and
- Increase in noise level from barge loading for the removal of spoil.

12.8.2 It is anticipated that construction vibration effects could occur due to the following construction activities –

- Percussive piling activities;
- Vibratory piling activities; and
- TBM generated vibration.

12.8.3 Rotary bored piling operations are considered to have inherently low vibration levels, even at close proximity and it is not anticipated that any

significant ground borne vibration effects from this type of piling activity would occur.

12.8.4 The time of day that construction activities occur will also be considered to have the potential to create a significant noise and vibration effect. Issues which would be considered specifically include:

- Tunnelling projects are typically required to operate on a 24 hour, 7 day basis due to the nature of the TBM process; and
- The removal of spoil by barge would be tide dependent.

Operation

12.8.5 The Project has the potential to affect existing noise levels following opening in the following ways:

- Changes (positive or negative) in road traffic noise levels at sensitive receptors within close proximity to the Project alignment;
- Noise could be affected (positively or negatively) by changes in vehicle flow, speed and composition on the existing road network as a result of the Project; and
- Noise impacts from the tunnel ventilation system could also generate an adverse significant effect for sensitive receptors within close proximity to the tunnel portal/ventilation buildings.

12.8.6 The operation of the Project would occur 24 hours a day, seven days a week following commissioning and therefore there is potential for operation of the Project to affect (adversely or beneficially) both existing daytime and night time noise levels.

12.9 Potential Mitigation Measures

12.9.1 Specific mitigation measures will be considered and recommended where required and practicable based upon the findings of the noise assessment.

12.9.2 However, where necessary the following generic noise mitigation measures will be considered within the scope of the noise study to control noise impacts in accordance with the requirements of the NPSNN aims.

Construction

12.9.3 Measures to minimise noise and vibration impacts from the construction phase would involve adopting Best Practicable Means' (BPM) (as outlined in Section 72 of the Control of Pollution Act 1974) and the recommendations of good practice presented in BS 5228-1:2009+A1:2014.

12.9.4 These methods would be implemented through a CEMP and secured within the DCO.

Operational

12.9.5 The following measures would be considered where appropriate within the operational noise assessment with regard to road traffic noise:

- Low-noise surfacing can be considered where the average speed of the traffic is above 75 kmph. Below this speed there is a reduced benefit from these surface systems due to increased prominence of vehicle engine noise contributing to the overall noise level.
- The use of noise barriers can reduce the road traffic noise levels attributable to the Project at dwellings by interrupting sound propagation. To be most effective barriers are required to be either very close to the source (the road) or to the receptor (the dwellings). The effectiveness of noise barriers as a mitigation measure will depend on site specific circumstances. Where a noise barrier is located close to the road, the effect on noise propagation is usually effective up to about 300m. It may not always be possible to locate barriers close to the road as they can have adverse effects on pedestrian environment and also on visibility splays for drivers and cyclists in junction situations. Barriers will be included within the Project design where necessary and appropriate associated with both new or altered highways; and
- A reduction in the average speed of vehicles can result in a reduction in traffic noise.

12.10 Aspects/Impacts Scoped out of the EIA

Ground-borne Traffic Vibration

- 12.10.1 Extensive research on a wide range of buildings of various ages and types has been carried out (Watts G.R, 1990), with no evidence found to support the supposition that traffic induced vibrations are a source of significant damage to buildings.
- 12.10.2 DMRB HD 213/11 states “significant ground-borne vibrations may be generated by irregularities in the road surface. Such vibrations are unlikely to be important when considering disturbance from new roads and an assessment will only be necessary in exceptional circumstances”.
- 12.10.3 Given the advice of DMRB HD213/11 that ground borne vibration should only be assessed in exceptional circumstances, the fact that the proposal is for a new road Project where surface irregularities would be minimised, no impacts from ground borne road traffic vibration would be assessed within scope of the noise and vibration chapter.

12.11 Any Other Information

- 12.11.1 At this stage, there is no further information to report.

13 People and Communities

13.1 Introduction

13.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on people and communities during both construction and operational phases.

13.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment
- Present the findings of consultations undertaken and set out those which are proposed
- Explore the baseline information that has been collected to date
- Provide information on further baseline information to be collated through desk study or surveys
- Identify the key receptors that would be considered in the EIA
- Detail the methodology that would be used to assess effects on people and communities
- Outline the potential significant effects that would occur
- Describe potential mitigation measures
- Identify (and justify) any aspects/impacts scoped out of the assessment

13.1.3 Broadly, the people and communities topic considers the impact and effect of the construction and operation of the Project on:

- Community and private assets – private property (including both residential and commercial property), community facilities (as a result of permanent and temporary land-take) and impacts on navigation in the event of marine infrastructure being required.
- Development land (this relates both to sites for which planning applications have been submitted and/or determined as well as to sites that have been allocated in relevant planning policy documents)
- The local and wider economy (for example employment levels)
- Community severance (where access to community facilities may be affected)
- Pedestrians, cyclists and equestrians (referred to as non-motorised users or NMUs), and vehicle travellers, including changes experienced to journey length, amenity, traveller views and driver stress

13.1.4 There are linkages between the assessment of potential effects on People and Communities and other disciplines, notably:

- Chapter 10 Geology and Soils – this chapter considers the potential effects of the Project on agricultural land and viability of farm businesses;
- Chapter 8 Landscape –the assessment of traveller views will draw on findings from the landscape assessment;
- Chapter 6 and 12 - (Air Quality and Noise and Vibration respectively) – findings from these chapters may be referred to specifically in relation to changes in amenity / quality of life for local residents and businesses.

13.2 NPSNN Requirements

13.2.1 The NPSNN sets out the need for, and Government’s policies to deliver, development of NSIPs on the national road and rail network in England. The Secretary of State (SoS) uses the NPSNN as the primary basis for making decisions on DCO applications.

Local and Wider Economy

13.2.2 The Government’s vision and strategic objectives for national networks includes “*supporting a prosperous and competitive economy*” and specifically:

- Networks with the capacity and connectivity to support national and local economic activity and facilitate growth and create jobs
- Networks which join up our communities and link effectively to each other.

13.2.3 Paragraph 2.27 of the NPSNN states that “in some cases...it will not be sufficient to simply expand capacity on the existing network. In those circumstances new road alignments and corresponding links, including alignments which cross a river or estuary, may be needed to support increased capacity and connectivity.”

13.2.4 Paragraph 3.3 requires that “*reasonable opportunities to deliver environmental and social benefits as part of schemes*” should be considered and that environmental and social impacts should be mitigated in line with the principles set out in the NPPF and the Government’s planning guidance.

Community and Private Assets

13.2.5 Paragraph 5.165 states that the ES should identify existing and proposed land uses near the Project, including the effects of replacing an existing development or use, or the effects associated with precluding a new development or use proposed in the development plan.

13.2.6 In relation to open space and recreation, paragraph 5.166 of the NPSNN states that “*existing open space, sports and recreational buildings and land should not be developed unless the land is surplus to requirements or the loss would be replaced by equivalent or better provision in terms of quantity and quality in a suitable location*”.

Accessibility and Severance

- 13.2.7 The NPSNN identifies key considerations and requirements in relation to accessibility, severance and non-motorised users, requiring projects to minimise adverse impacts.
- 13.2.8 The NPSNN expects applicants to improve access on and around the national networks by designing and delivering schemes that take account of the accessibility requirements of everyone who uses, or are affected by the network. It advises all reasonable opportunities to deliver improvements in accessibility on and to the existing network should also be taken. Applicants are advised to seek to deliver improvements that reduce community severance and improve accessibility.
- 13.2.9 The NPSNN recognises the importance of Public Rights of Way (PRoW), National Trails and other rights of access to land for walkers, cyclists and equestrians. Where severance occurs, mitigation measures are required to address adverse effects. Where possible access should be improved. The character, use and attractiveness of the area need to be taken into consideration.
- 13.2.10 The NPSNN identifies there is a direct role for the national road network to play in helping pedestrians and cyclists. It states “*the Government expects applicants to use reasonable endeavours to address the needs of cyclists and pedestrians in the design of new schemes.*” In particular in relation to accessibility, safety and severance.
- 13.2.11 As part of this, the NPSNN states that evidence is required to show that projects have used reasonable endeavours to address any existing severance issues that act as a barrier to non-motorised users. It also requires applicants to identify opportunities to invest in infrastructure where the national road network severs communities and acts as a barrier to cycling and walking “*by correcting historic problems, retrofitting the latest solutions and ensuring that it is easy and safe for cyclists to use junctions.*”
- 13.2.12 The NPSNN sets out the duty of applicants to promote equality and to consider the needs of disabled people, and the requirement to comply with any obligations under the Equalities Act 2010.

Health and Well-being

- 13.2.13 The NPSNN also sets out requirements in relation to the impacts of projects on health, in particular if they affect access to key public services, local transport, opportunities for cycling and walking or the use of open space for recreation and physical activity.
- 13.2.14 Where the Project has likely significant environmental impacts that would have an effect on human beings, ESs are required to identify and set out the assessment of any likely significant adverse health impacts.

Changes to Amenity

- 13.2.15 Paragraph 5.89 of the NPSNN discusses what considerations may need to be given to a scheme of management and mitigation to reduce any loss to amenity as a result of emissions of odour, dust, steam, smoke or artificial light from the Scheme.

Travellers Views

- 13.2.16 There is also reference in the NPSNN to considering the visual appearance in the design of new infrastructure projects. Adverse visual impacts should be minimised and mitigated. This is of relevance to the People and Communities assessment of the view from the road.

13.3 Consultations Undertaken and Proposed

- 13.3.1 Stakeholder and public consultation was carried out for the short-listed route options between January and March 2016.
- 13.3.2 To inform the preparation of the People and Communities assessment specific interest groups will be engaged. Initial consultations have been undertaken to date with Kent County Council, Essex County Council and Thurrock Council. In addition, it is proposed that consultation will include:
- Gravesham Borough Council, the London Borough of Havering, Brentwood Borough Council and Medway Council. These may include consultations with planning officers, members of the PRow teams, local highways officers
 - South East Local Enterprise Partnership
 - Owners and managers of commercial and community enterprises that may be affected by land-take, identified facilities such as Southern Valley Golf Course (relevant organisations here including Kent Country Parks Team and the Woodland Trust)
 - Local Access Forums including Thurrock, Essex and Kent
 - Port of London Authority
 - Sustrans, the Cycle Touring Club, the Ramblers Association, British Horse Society, Essex and Kent Bridleway Associations
 - Representatives of public transport organisations such as Bus Users UK

13.4 Baseline Information Obtained/Surveys Undertaken

- 13.4.1 This section sets out baseline information obtained in relation to each of the sub-topic areas.

Community and Private Assets

- 13.4.2 This section provides an overview of the Project in relation to surrounding land-uses and activities, from the junction with the A2 to the south of the River Thames through to the junction with the M25 to the north of the river. Settlements referred to in the text are identified on Figure 13.1 in Appendix F, with features to the north of the River Thames identified on Figures 13.3 and 13.4, within Appendix F, and to the south of the River Thames identified on Figure 13.1.
- 13.4.3 South of the River Thames, the Project passes through Gravesham Borough Council. From its junction with the A2, the route heads north primarily through open countryside. Settlements in the vicinity of the

route include the villages of Thong and Shorne. The current alignment for the Project passes within close proximity to the Church of St Mary in Chalk, the Riverview Park housing estate to the west of Thong Lane and Hartshill Nursery. Recreational facilities in the immediate vicinity of the proposed route corridor to the south of the River Thames include the Cascades Leisure Centre & Legends Sports Club, the Southern Valley Golf Club and various areas of woodland which are shown on figure 13.1, within Appendix F.

- 13.4.4 The suburb of Chalk, found on the eastern fringes of Gravesend and with a population of just over 1,200, is within 0.5km of the proposed route corridor. Other settlements to the south of the River Thames include Gravesend to the west and Rochester to the east.
- 13.4.5 Immediately to the south of the River Thames lies the Shorne Marshes nature reserve run by the Royal Society for the Protection of Birds (RSPB); although the site can be accessed from nearby foot and cycle paths, it is not capable of accommodating large numbers of visitors.
- 13.4.6 Infrastructure crossed by the proposed route corridor to the south of the River Thames includes the north Kent railway line (connecting London with the towns of Dover and Hastings) and the Thames Medway Canal (also known as the Gravesend and Rochester Canal (now disused)), which both run in an east-westerly direction.
- 13.4.7 Other land uses in the vicinity of the proposed route corridor to the south of the River Thames include the Metropolitan Police Specialist Training Centre and rifle range.
- 13.4.8 The Thames Estuary is a major shipping route along the east coast of the UK, handling thousands of movements each year, including large oil tankers, container ships, bulk carriers and roll-on/roll-off ferries. The area is also popular for recreational boating, with sailing clubs at Gravesend, Grays (Thurrock Yacht Club) and Cliffe (Blue Circle Sailing Club).
- 13.4.9 The England Coast Path is a new National Trail proposed to be complete in 2020; the Grain to Gravesend section in Kent and Gravesend to Southend section in Essex are both at an early stage of development.
- 13.4.10 The majority of the proposed route to the north of the River Thames then falls within the unitary authority of Thurrock Council. Industrial uses to the north of the River Thames in the vicinity of the Project include Readmans Industrial Estate, which comprises a number of industrial, warehouse and office units, and Tilbury Docks.
- 13.4.11 The growth of Tilbury owes much to its location and the presence of a deep-water port. The Port of Tilbury covers over 850 acres and includes over thirty operational berths. The Port is well positioned via road and rail connections to provide distribution services to the south-east of the UK and beyond.
- 13.4.12 Land uses along the northern bank of the River Thames in this area include Tilbury Power Station, Tilbury Sewage Treatment Works and Tilbury Fort. The latter is a site managed by English Heritage and attracts just over 16,000 visitors per annum. A small area of open access

land (land allocated under the Countryside and Rights of Way Act (CRoW) 2000 giving a public right of access) can be found to the north of Tilbury Fort.

- 13.4.13 The landscape along the proposed route corridor to the north of the River Thames is characterised by agricultural land, isolated farm buildings and small settlements including the villages of Orsett, Chadwell St Mary, Linford and East and West Tilbury. Commercial and community facilities in this area include Orsett Golf Course. The proposed route corridor passes between the villages of Orsett and Chadwell St Mary; in this area there are a number of residential properties that may be affected by the Project.
- 13.4.14 The proposed route corridor crosses infrastructure including the A13 trunk road and the Tilbury loop line (which forms part of the wider London, Tilbury and Southend railway line connecting Fenchurch Street Station in Central London) with destinations in east London and Essex, including Grays and Tilbury.
- 13.4.15 The River Thames is subject to thousands of journeys a year, with passenger vessels on scheduled and charter services, fast ferries, tugs and tows (water transfer of barges delivering aggregates) service vehicles (for example emergency services, Environment Agency services) and recreational vessels such as dragon boats, kayaks and dinghies. In addition, there are multiple annual events on the River Thames, including, for example, the Transport on the Water (TOW) Barge Race and the Great River Race, held in July and September respectively, the Tall ships event in August and the Totally Thames festival held during September.
- 13.4.16 There is marine infrastructure within the immediate vicinity of the scheme in an area that is known as Gravesend Reach. This includes wharfs, jetties and ferry terminals, and spans from Coalhouse Point in the east to Tilbury Docks in the west.
- 13.4.17 Within Gravesend Reach on the southern banks of the River Thames, the following marine assets are found:
- Port Control Centre, which is managed by the Port of London Authority and provides a crossing to the north banks of the River Thames;
 - Gravesend Embankment Marina & Sailing Club, which has serviced pontoon berths, lock access to the Thames and an established, community of residential and leisure berth holders;
 - Royal National Lifeboat Association – Gravesend Lifeboat Station, which is one of the RNLI's newest lifeboat station and one of four lifeboat stations operating on the River Thames; and
 - Denton Wharf, which is managed by the Port of London Authority and provides a purpose-built facility to undertake a wide range of marine operations
- 13.4.18 Within Gravesend Reach on the northern banks of the River Thames, the following marine assets are found:

- Port of Tilbury – The Port of Tilbury is London’s major port, providing fast, modern distribution services for the benefit of the south east of England and beyond;
- London Cruise Terminal, which is London’s only deep water purpose-built cruise facility. Over the years, the terminal has become increasingly popular as a turnaround port for Baltic and Northern European destinations but is also well placed for transit calls to visit England’s capital city, Kent and the south east.

Human Health and Well-Being

13.4.19 Using Census data and a number of other cited data sources at borough and regional levels, data has been collected on the health status and well-being of residents living in Kent, Essex and Havering and compared against national data as applicable. The information presented provides a brief overview of health status, followed by a focus around those health factors relevant to the Project and transport projects.

13.4.20 Table 13.1 shows that Thurrock, as a percentage of people, has the best self-reported health status, with 48.2% of residents stating they had a “very good health” status. Gravesham, Havering’s and England’s reported health status is lower, with 46.5% and 46.0% respectively reporting “very good health”. However, a higher proportion of residents reported their health as “good” and “fair” in Gravesham (48.4%), Havering (48.9%) and England (47.3%) compared to Thurrock (47.0%). The proportion of residents reporting “bad health” and “very bad health” is lowest in Thurrock (4.7%) and highest in Havering (5.2%), and 5.1% for Gravesham. However, each of the areas report lower proportions of “bad health” and “very bad” health, than England as a whole (5.4%).

Table 13-1: Health Status Of Residents Living In Gravesham, Thurrock, Havering And England

	Gravesham	Thurrock	Havering	England
Very Good Health	46.5%	48.2%	46.0%	47.2%
Good Health	35.0%	34.7%	35.6%	34.2%
Fair Health	13.4%	12.3%	13.3%	13.1%
Bad Health	4.0%	3.7%	4.0%	4.2%
Very Bad Health	1.1%	1.0%	1.2%	1.2%

Source: Census, 2011

13.4.21 Life expectancy at birth (shown in Table 13.2) has nationally risen due to improvements in public health. For males, Havering has the highest life expectancy at birth (80.2), followed by Gravesham (79.4) and Thurrock

(78.9). By means of comparison, in England life expectancy at birth for males is 79.5. For females, Havering has the highest life expectancy at birth (84.4), followed by Gravesham (83.2) and Thurrock (82.6). For England, life expectancy at birth for women is 83.1.

Table 13-2: Life Expectancy Of Residents Living In Gravesham, Thurrock And Havering

	Gravesham		Thurrock		Havering		England	
	Male	Female	Male	Female	Male	Female	Male	Female
Life Expectancy at Birth	79.4	83.2	78.9	82.6	80.2	84.1	79.5	83.1

Source: Public Health England, 2017, 2013 - 2015

13.4.22 Heart disease and respiratory disease are major causes of death in each of the areas, however there are some differences in rates between the three. For mortality due to cardiovascular deaths, Thurrock is significantly worse than the England average, Gravesham is not significantly different from the England average and Havering is significantly better than the England average. For mortality due to cancer, Thurrock is again significantly worse than the England average, and both Havering and Gravesham are not significantly different from the England average.

Development Land

13.4.23 A review of planning applications has been undertaken to identify those applications deemed ‘major’. These are defined by using professional judgement and are: applications for developments comprising more than 10,000m² of gross development floor area or more than 100 units; minerals and waste developments; and Nationally Significant Infrastructure Projects.

13.4.24 Sites allocated for residential and employment uses in the relevant local authority development plans have also been identified.

Pedestrian, Cycle and Equestrian Routes

13.4.25 Data has been gathered in relation to PRoW that are likely to be severed by the Project. The location of PRoW, cycle and equestrian routes is shown on Figure 13.1, within Appendix F.

Local and Wider Economy

13.4.26 Baseline information relating to the labour force and employment (for example economic activity, employment by sector, unemployment, skills and qualifications) has been collated from a variety of sources including:

- 2011 Census
- Mid-year population projections (2015)
- Nomis official labour market statistics
- Office for National Statistics (ONS)
- Business Register and Employment Survey (BRES).

- 13.4.27 The Project is located in one of the UK's most economically active regions, and an area experiencing high population growth. However, there are socio-economic differences within the region. Whilst the counties of Kent and Essex as a whole may broadly be in line with national averages in terms of various socio-economic indicators, at the more local level (such as the unitary authority of Thurrock), there are clear differences. For example, unemployment in Thurrock is higher than the national average and appears to still be increasing; education levels are lower than average; and there are pockets of significant deprivation (with areas amongst some of the most deprived in the UK). Future challenges for economic policy in the Thurrock area are likely to focus on skills shortages and poor access to the labour market. Clusters of economic activity include the transport, distribution and logistics sectors (focused around Tilbury Docks for example) as well as retail (the Lakeside Shopping Centre is a major source of employment). Thurrock also forms part of the wider Thames Gateway South Essex development area.
- 13.4.28 The borough of Gravesham exhibits similar characteristics, experiencing greater economic challenges than neighbouring areas such as the impact of economic restructuring and concentrations of deprivation. As with Thurrock, Gravesham has seen generally lower skills levels in the local workforce, but also a slower rate of economic growth. Sector specialisms in Gravesham include manufacturing, transport and logistics; future opportunities include proposals for a major leisure destination at Paramount Park near Gravesend.
- 13.4.29 Further information in relation to the local and wider economy will be drawn together through desk-top research.

13.5 Other Baseline Information to be Obtained

- 13.5.1 Other sources of data to be explored as part of the People and Communities assessment would include:
- Relevant policies/data contained within the South-East Local Enterprise Partnership Strategic Plan and local economic assessments produced for individual local authorities;
 - Data relating to Travel to Work Areas (ONS) and commuting patterns for the main settlements in the area;
 - Data relating to usage of the River Thames, including port activity at Tilbury and recreational use of the Thames Estuary;
 - Identification of community infrastructure, residential and commercial assets along the Project and within the study area;
 - Data relating to the condition of PRow that may be affected by the Project, including identification of wider linkages of individual PRow with the wider network;
 - Data relating to NMU usage;
 - Consultation results from targeted consultation; and

- Results from V3 traffic model on peak traffic flow and speed.

13.5.2 This information would be drawn together primarily through desk-top research. Site visits will be undertaken as necessary, in order to confirm relevant findings of desktop data gathering and to assess Project effects.

13.6 Key Environmental Receptors and their Value

13.6.1 Unlike most other environmental topics, the sensitivity of receptors within the people and communities topic is not determined by reference to designations or an objective standard. The importance or sensitivity of resources affected by the Project has been categorised based on the perceived type and value of the asset or facility using guidance from DMRB Volume 11, Section 3, Parts 6 and 8 and professional judgement.

13.6.2 Specific groups of receptors to be considered in relation to the Project, are described in Table 13-3.

Table 13-3: Sensitivity Criteria – Community And Private Assets And Development Land Sub-Topics

Value	Description of Receptor
High	<ul style="list-style-type: none"> • Residential or commercial buildings. • Specialised commercial uses (for example uses that are location dependent). • Buildings used by the community e.g. schools, community halls, playing fields. • Land or recreational routes of national significance e.g. national parks, national trails. • Religious sites and cemeteries. • Marine Infrastructure
Medium	<ul style="list-style-type: none"> • Residential or commercial land • Land allocated for development or the subject of a current planning permission. • Community land, open space, recreational routes or facilities of regional significance e.g. country parks.
Low	<ul style="list-style-type: none"> • Locally used community land, e.g. local parks and children’s play areas. • Local recreational routes e.g. Public Rights of Way. • Derelict or unoccupied buildings or land that are not the subject of a current planning permission.

13.6.3 In relation to other sub-topics, notably the assessment of changes to journey length, access to amenities and severance as a result of the Project, receptors will be as follows:

- Pedestrians;

- Cyclists;
- Equestrians; and
- People with disabilities.

13.6.4 For the assessment of driver stress and traveller views, receptors will comprise all road users accessing the proposed route, including both private vehicles and public transport.

13.7 Methodology

Guidance

13.7.1 The people and communities assessment follows the approach set out in DMRB Volume 11 'Environmental Assessment', Section 3, Part 6 'Land Use' Chapter 1 – 11, Section 3 Part 8 'Pedestrians, Cyclists and Equestrians and Community Effects', and Section 3 Part 9 'Vehicle Travellers'. In accordance with DMRB Interim Advice Note 125/15, the people and communities assessment scope incorporates topics previously reported under 'Community and Private Assets' and 'Effects on All Travellers' headings.

13.7.2 The term 'community' not only relates to facilities that provide services and resources for the local population (such as education, healthcare, places of worship, leisure facilities, community centres and areas of public open space), but also looks at how such facilities are accessed and whether any severance of access may take place as a consequence of the proposed works.

13.7.3 In view of the long design-life of the Project, and the fact that the Project is not planned to be decommissioned, it is not considered appropriate for decommissioning of the Project itself to form part of each environmental topic assessment.

Community and Private Assets

13.7.4 The assessment of effects on community and private assets would take into account demolition and/or land-take as a result of the Project. Community facilities that would be identified comprise:

- Doctors surgeries
- Hospitals
- Retirement homes
- Schools
- Shops / Post Offices
- Places of worship
- Recreational facilities (for example areas of formal and informal open space, play areas). This category would also include golf courses and recreational activities associated with the River Thames.

- 13.7.5 Private assets include infrastructure that may be affected by the Project (for example the apparatus of utility companies and marine infrastructure).

Agricultural Businesses

- 13.7.6 The scope of this assessment is presented in Chapter 10: Geology and Soils.

Human Health and Well-Being

- 13.7.7 For each determinant, a qualitative assessment would be undertaken as follows:

- How the health determinant might change and whether this would be beneficial or adverse;
- Duration of change – temporary or permanent;
- Exposure (including identification of vulnerable populations) and
- Intensity (magnitude or severity of the change in the health determinant)

Development Land

- 13.7.8 In order to identify the impact of the Project on development land, it would be necessary to review relevant planning applications (major applications referred to in para 13.4.23) and site allocations from development plans. An overall review to identify new applications would be undertaken on a regular basis.

Local and Wider Economy

- 13.7.9 Socio-economic factors may relate to direct and indirect job creation during both the construction and operation phases and wider accessibility impacts. As such, preparation of the people and communities chapter will be informed by the Homes and Communities Agency's (HCA) 'Additionality Guide 2014'. The guide explains how to assess the additional impact of local economic growth for various interventions such as new infrastructure, and has recently been updated to include new information, research and guidance. The guide states that "*central to good appraisal is the need to assess whether the intervention concerned will bring additional benefits over and above what would have happened anyway in its absence.*" The HCA provides particular guidance in relation to issues such as the extent of the study area and the broad approach to the assessment.

Changes to Journey Length and Severance

- 13.7.10 Changes to journey length will be assessed through reviewing engineering designs, carrying out site visits, engagement with local asset owners and traffic counts where relevant. Key community facilities and associated catchment areas, together with pedestrian and cycle routes to facilities would be identified.

- 13.7.11 The user population would be estimated by mapping residential population statistics on to the catchment areas. Vulnerable groups will be identified. Data for this will come from national statistics (including the

National Census, Annual Population Survey, and the Department for Communities and Local Government Indices of Multiple Deprivation, all of which are publicly available). This information will be refined through engagement with local facility owners and managers.

- 13.7.12 The methodology to identify existing non-motorised traffic will be agreed with local authorities.
- 13.7.13 Following analysis of this data, an estimate will be made of the number of trips that will experience a change in length / journey time. This will be based on assumptions set out in DMRB for average journey speeds: 5km/hr for people on foot, 10km/hr for equestrians, and 20km/hr for cyclists.
- 13.7.14 Temporary and permanent severance caused by the Project will be assessed in line with DMRB guidance in terms of both the change in access to local facilities, and the change in access to PRoW. There are three scaled levels of severance ranging from slight to severe. The scale is based on multi-dimensional criteria covering the change in length to journeys, the type of crossing, and impact on accessing community facilities and is presented in Table 13-5.

Changes in Amenity

- 13.7.15 Changes in amenity refers to the pleasantness of a journey, in particular the time people are exposed to traffic and vehicle fumes, and their fear and safety. This will be assessed through a qualitative analysis of the change to the amenity at each right of way. The DMRB does not provide a scale of impact to use for the assessment; accordingly, a scale has been proposed by which to assess the Project (set out in Table 13-6).

Traveller Views

- 13.7.16 Volume 11 Section 3 Part 9 of the DMRB sets out the requirements for a vehicle travellers assessment. This is categorised into two components – an assessment of traveller views, and of driver stress.
- 13.7.17 Traveller views refers to the views that vehicle users see from the road on their journey. These will be assessed through site visits to the proposed route. The assessment will take account of the vertical alignment of the proposed carriageway in relation to existing ground level and mitigation measures (which could include environmental barriers (for noise and visual screening), green tunnels, false cutting and tree and shrub planting).
- 13.7.18 There is overlap between this assessment and the landscape assessment being carried out for the Project (see chapter 8). The two methodologies are very similar, although there are some differences in the categorisation of impacts. A high-level assessment of travellers' views will be carried out in accordance with DMRB guidance Volume 11 Section 3 Part 9, ensuring that this is in line with the main landscape assessment

Driver stress

- 13.7.19 Driver stress is a term used to refer to adverse mental health effects that can be experienced by drivers using the road network. DMRB guidance

refers to three aspects, namely frustration, fear of potential accidents, and uncertainty in terms of route directions.

- 13.7.20 The DMRB provides tables on the standard levels of stress that are associated with varying levels of peak traffic flow and speed. The levels are qualitative scores (high/ moderate/ low), (DMRB Vol 11, Section 3, Part 9, Chapter 4). These will be applied to the forecast levels of peak traffic flow and speed that are likely to be generated by the proposed route in order to estimate the potential impacts on driver stress caused by the Project.

Study Area for the EIA

- 13.7.21 The spatial scope for the assessment of effects by sub-topic is set out in Table 13-4.

Table 13-4: Spatial Scope For Assessment

Study Area	Description	Relevant Sub-Topic
The Application Boundary	Relates to all land within the red line boundary for the Project. The study area will be used to assess effects of the Project in terms of permanent and temporary land-take.	Community and private assets Development land
Local Study Area	The local study area corresponds to an area extending approximately 200m from the application boundary. The study area will be used to assess effects of the Project on topics including community facilities, local businesses and recreational routes. It would include all roads and other PRow that meet or cross the planned area of the Project.	Community and private assets Development land Changes to journey length and severance Changes to amenity Traveller views

Study Area	Description	Relevant Sub-Topic
Wider Study Area	The wider study area includes the relevant Local Planning Authorities (LPAs) for the Project, including Thurrock Council, Gravesend District Council, London Borough of Havering. The counties of Kent, Essex and the Greater London area would also be included for comparative purposes. The purpose of the wider study area is to primarily consider the socio-economic impacts of the Project (for example job creation, accessibility).	Local and wider economy Human health and well-being

13.7.22 In addition, to the above, there are other, less tangible study areas that will be used as a basis for assessment, for example in relation to severance or driver stress. DMRB Volume 3, Section 3 Parts 8 (NMUs) and 9 (Vehicle Travellers) do not specify a defined distance to include in a study area. The assessment of the impacts of severance is based on an assessment of changes to journey length rather than necessarily identifying origin / destination information.

13.7.23 Although the assessment of severance would be based on data gathered at the site of the proposed scheme, a broad area has been identified to provide an indication of the distance within which people may be affected, using a 200m boundary.

Assessment Periods/Scenarios

13.7.24 The construction phase for the whole Project is approximately a five-year timeframe. However, the construction phase is likely to be carried out using a staged approach and consequently the impacts on individual rights of way will need to be considered in relation to localised construction phases which may be less than five years.

13.7.25 Operational impacts would be assessed based on the assumption that the impacts are permanent.

Future Baseline

13.7.26 Future baseline information would be collected in relation to predicted population and economic growth, as well as data relating to planning applications and development sites.

13.7.27 For each of the components of the people and communities assessment, the baseline conditions would be explored assuming the scenario that no new crossing is built and that traffic congestion continues to grow.

Significance Criteria

13.7.28 The ES will set how significance of effects are to be determined for the People and Communities topic.

13.8 Description of Possible Significant Effects on Receptors

13.8.1 Possible significant effects on receptors are described for both construction and operation phases.

Construction

13.8.2 Principal impacts likely to result from the construction of the Project are described in the following paragraphs.

Community and Private Assets

13.8.3 Potential impacts relating to community and private assets will include land-take from residential, commercial and community properties and facilities, severance of access as well as potential effects on river usage and navigation from the construction and use of a jetty. As outlined in section 1.14 of this EIA Scoping Report, the current development boundary includes a number of residential and commercial properties both north and south of the River Thames. However, it is too early to say which properties would need to be demolished as every effort will be made to minimise impacts on properties as the Project design evolves.

Development Land

13.8.4 Potential impacts on development land may include the disruption of other construction projects as a result of traffic diversion or delays, as well as impacts associated with temporary land-take.

Local and Wider Economy

13.8.5 There is the potential for beneficial socio-economic effects as a result of Project construction, for example job creation and training for the local population in the engineering and construction industries, skills which would then be transferable to other local construction projects. In addition, the construction work is likely to create demand for goods and services from local firms, for example local hotels and suppliers as well as spend in the local community by construction workers.

Changes to Journey Length and Severance

13.8.6 Some PRoW would be temporarily severed during the construction phase. This may lead to a change in the route that NMUs take to access local facilities, and a change in journey length accordingly. There may be a temporary impact on access to facilities and communities as public rights of way are severed and diverted.

Changes in Amenity

13.8.7 Construction could also affect the amenity of public rights of way, local residents and businesses, through the generation of noise, dust and the movement of construction vehicles.

Traveller Views

13.8.8 There is likely to be some limited reduction of travellers' views during the construction phase, particularly in the proximity of construction sites.

Driver Stress

13.8.9 During the construction phase, driver stress along the existing routes may increase. Travel disruption is likely to be caused by construction works including the transportation of construction materials and vehicles. This could cause congestion, possible restrictions to access road facilities, leading to increased stress for road users. Temporary severance of rural paths could also lead to an increase in fear of accidents for NMUs.

Operation

13.8.10 Effects of the Project during the operational phase are considered in the following paragraphs.

Community and Private Assets

13.8.11 The impacts during operation would relate to the permanent land-take and severance that may be associated with the Project.

Development Land

13.8.12 Development land may be affected by permanent land-take; beneficial impacts may relate to improvements in accessibility to employment and services as a result of the Project.

Local and Wider Economy

13.8.13 Socio-economic benefits resulting from the Project would relate to improved accessibility to jobs and services and potential job creation.

Changes to Journey Length and Severance

13.8.14 PRoW permanently severed by the Project would be mitigated by the provision of a footbridge or underpass. The impact on journey length on these affected public rights of way in the long term is consequently likely to be minimal. Table 13-10 presents a summary of the number of affected routes that may need to be mitigated.

Table 13-5: Number of Severed Public Rights of Way

Type of path	Number of affected paths
Bridleway	3
Cycleway	3
Footpath	17
Subway	0

13.8.15 Current cross-river provision for cyclists is a vehicle that drives cyclists across the Dartford Crossing on a limited timetable, and a ferry across the river at the site of the proposed route. The Project would not impact upon these currently limited services.

Changes to Amenity

13.8.16 Changes to amenity as a result of the Project could relate to changes in noise and air quality, although appropriate mitigation would be provided.

Traveller Views

- 13.8.17 Typically within the rural landscape south of the River Thames, between the junction with the A2 and the southern tunnel portal, views out would be limited as the carriageway would be in cutting. Along this section it is anticipated that the structures at the proposed junction with the A2, the cutting slopes and potential chalk rock outcrops, and the southern tunnel portal would be the main features in the view for vehicle travellers.
- 13.8.18 North of the River Thames where the carriageway emerges on embankment as it crosses the River Thames floodplain, there is potential for views out across the urban fringe landscape of Thurrock, although screening mitigation such as false cuttings, environmental barriers and tree and shrub planting could limit these views. Elsewhere the new carriageway would pass through sections of cutting and embankment with associated mitigation measures. In this section it is anticipated that the northern tunnel portal and the structures at the proposed junctions with the A13 and M25 with their associated tree and shrub planting would form the main features of the view for vehicle travellers north of the River Thames.

Driver Stress

- 13.8.19 Once the new route is operational, driver stress is likely to reduce. As the proposed route provides a larger clearer road to travel on, motorised user frustration, fear of accidents and uncertainty is likely to reduce.

13.9 Potential Mitigation Measures

- 13.9.1 Potential mitigation measures to prevent, reduce or offset any significant adverse effects on the environment are outlined below for both construction and operation phases.

Construction

- 13.9.2 A CEMP would be prepared before any construction work commences and would outline appropriate induction to be given to ensure contractors act considerately in relation to local residents, particularly for any works that may be programmed to take place at night.
- 13.9.3 The Project would be developed to minimise the land required temporarily for construction. The right to compensation and methods / procedures for assessing appropriate levels of such, would be undertaken in accordance with the Compensation Code. Where appropriate consultation with landowners, occupiers and agents would continue as the Project develops to manage and reduce impact on property owners as far as practicably possible.
- 13.9.4 Local residents and businesses in close proximity to the Project during construction may experience reductions in amenity from changes in air quality, visual amenity and noise and vibration. Detailed information relating to mitigation for these areas would be prepared in relation to individual topics.
- 13.9.5 The potential effects of new marine infrastructure will be minimised through the careful design of structures, including the location of

potential jetties and consideration given to mooring, berthing and manoeuvring arrangements. Any marine infrastructure affected by the work, will be re-instated to its pre-Project condition.

- 13.9.6 Construction mitigation that may be necessary in relation to farm businesses may include:
- The reinstatement of land following construction in order to reduce the quantity of permanent land-take required
 - The construction programme to take into account potential crop loss through accommodating harvesting periods where possible
 - Maintenance of farm access points where possible and reinstating these as soon as possible
 - Minimising impacts of for example, dust and noise on crops and livestock
- 13.9.7 In order to minimise disruption to NMU routes, PRow, footways and cycle routes, temporary diversions would be put in place together with appropriate signage. This would be carried out in consultation with the local highways authority and other interested stakeholders.
- 13.9.8 During the construction phase, temporary alternative routes for PRow that are affected would be required. Information in advance and during the closures would help to reduce any inconvenience caused to users of the PRow.
- 13.9.9 Consideration would need to be taken when designing foot bridges and underpasses for accessibility of all members of the public including use of wheelchairs, and ensuring safety to vulnerable users, including for example, lighting at night.
- 13.9.10 Travellers' views could be improved through keeping road side barriers low and minimising the use of undercuttings, where this is possible given other mitigation priorities (for example relating to noise management). Where there is no option but to have travellers' views blocked, innovative approaches to creating a positive environment through planting and lighting could be used.
- 13.9.11 During the construction phase, the transportation of construction equipment and waste materials would require careful planning to minimise the impact on existing road users and local communities.

Operation

- 13.9.12 Local residents and businesses in close proximity to the Project may experience changes in amenity from changes in air quality, visual amenity and noise and vibration. Detailed information relating to mitigation for these areas would be prepared in relation to individual topics.
- 13.9.13 Driver stress could be minimised along the new route through ensuring minimised congestion, maximising safety, and through positive driver views. Traveller stress of NMUs could be minimised by creating a safe environment for PRow that cross the route. Safety barriers, and planting would help to reduce fear of accidents and stress.

13.10 Aspects/Impacts Scoped out of the EIA

13.10.1 No aspects of the People and Communities assessment have been scoped out.

13.11 Any Other Information

13.11.1 At this stage, there is no further information to report.

14 Road Drainage and Water Environment

14.1 Introduction

14.1.1 This chapter details the proposed scope of work relating to the approach to the assessment of the Project and potential effects on road drainage and the water environment during both construction and operational phases.

14.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment
- Present the consultations undertaken and proposed
- Explore the baseline information that has been collected to date
- Provide information on what would be collated through further desk study or surveys work
- Identify the key receptors that would be considered in the EIA
- Detail the methodology that would be used to assess effects on road drainage and the water environment
- Outline the potential significant effects that would occur
- Describe the potential mitigation measures
- Identify (and justify) any aspects/impacts scoped out of the assessment

14.1.3 The Project has the potential to result in effects on road drainage and the water environment, and in particular on the flood risk, water quality and water resource attributes of surface water and groundwater receptors within the study area.

14.1.4 There may be interrelationships related to the potential effects on road drainage and the water environment, and other disciplines comprising:

- Chapter 7 Cultural Heritage
- Chapter 9 Nature Conservation
- Chapter 10 Geology and Soils

14.2 NPSNN Requirements

14.2.1 The NPSNN (Department for Transport, 2014) sets out the need for, and Government's policies to deliver, development of NSIPs on the national road and rail networks in England.

14.2.2 Paragraph 5.221 sets out that where a development is likely to have significant adverse effects on the water environment, NPSNN requires that the applicant ascertain the existing status of, and carry out an assessment of the impacts of the proposed project on, water quality, water resources and physical characteristics as part of the environmental statement, which should describe:

- The existing quality of waters affected by the proposed project
- Existing water resources affected by the proposed project and the impacts of the proposed project on water resources
- Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project, and any impact of physical modifications to these characteristics
- Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive (WFD) and Source Protection Zones (SPZs) around any potable groundwater abstractions
- Any cumulative effects

- 14.2.3 The NPSNN also states that development proposals should have regard to the relevant River Basin Management Plan (RBMP) and the requirements of the WFD (including Article 4.7) and its daughter directives, including those on priority substances and groundwater. In terms of WFD compliance, the overall aim of projects should be no deterioration of the ecological status of waterbodies.
- 14.2.4 All of the characteristics listed in paragraph 14.2.2 that are relevant to the water environment within the study area have been included in the scope of this assessment. A WFD Assessment would be prepared and appropriate design and mitigation measures would be incorporated into the Project to facilitate WFD compliance.
- 14.2.5 NPSNN encourages pre-application discussions with all relevant regulators to begin as early as possible. Details of the consultation undertaken to date and proposed in future stages of the environmental assessment are summarised in Table 14-1.
- 14.2.6 Paragraph 4.48 of NPSNN highlights that discharges from a project which affect water quality or the marine environment may be subject to separate regulation under the pollution control framework or other consenting or licensing regimes. It also highlights that activities that take water from the water environment are subject to the regulatory abstraction licensing regime. There are also control regimes relating to works to, and structures in, on, or under a controlled water. The NPSNN requires that relevant permissions are obtained for any such activities within the development that are regulated under those regimes.
- 14.2.7 It is proposed to consult with the relevant regulatory authorities with regard to consents and licensing for Project activities. This will also require engagement with the ecology team.
- 14.2.8 With regard to flood risk and surface water drainage, the NPSNN supports the NPPF (Communities and Local Government, 2012) and Paragraphs 5.92 to 5.94 explain that essential transport infrastructure is permissible in areas of high flood risk, subject to satisfaction of the NPPF Exception Test. An objective of the NPSNN is for schemes to contribute towards reducing the risk of flooding, stating that considerations during design should include design standards for drainage systems, interactions with floodplains and watercourses and maintenance

standards. Applications for all projects in Flood Zones 2 and 3 and projects of 1 hectare or greater in Flood Zone 1, should be accompanied by a Flood Risk Assessment (FRA). The Project should adhere to any national standards for Sustainable Drainage Systems (SuDS).

- 14.2.9 The Project would be subject to a detailed FRA that considers all sources of flood risk. The FRA would be informed by consultation with the Environment Agency (EA) and relevant Lead Local Flood Authorities (LLFA). The FRA would also be informed by the results of any hydrological and hydraulic modelling undertaken to define baseline flood risk, quantify any Project impacts on this baseline, and to inform the design of any necessary flood risk management measures. A drainage strategy would also be prepared that centres on the application of SuDS, appropriate to local conditions, to manage surface water runoff.

14.3 Consultations Undertaken and Proposed

- 14.3.1 To date, consultation has been undertaken with the EA and each of the Lead Local Flood Authorities. Key issues raised by the EA include risks associated with construction near or through landfills, groundwater sensitivity and management of the waste arising from bored tunnel construction. The EA has also highlighted that the tidal flood defences which afford the study area protection from routine inundation, may need improvement in future years to keep up with climate change to deliver the polices set out in the Thames Estuary 2100 Plan (Environment Agency, 2012). The EA welcome that a detailed FRA and a WFD Screening Assessment (Stage 1) and any necessary further stages of assessment would be prepared for the Project. A WFD Assessment Scoping Note has recently been submitted to the EA as a basis for further consultation to agree the methodology and spatial scope of this assessment. This approach is advocated by the PINS Advice Note 18: The Water Framework Directive.
- 14.3.2 The LLFAs have highlighted the need to ensure that the Project’s strategy for managing surface water runoff adheres to relevant local drainage and planning policies and where possible delivers local benefits, for example, contributing to local surface water flood risk management.
- 14.3.3 During the future stages of the assessment it is proposed to consult further with the EA, in addition to the relevant LLFAs and other bodies with an interest in the water environment, as summarised in Table 14-1.

Table 14-1: Summary of Proposed Consultation

Consultee	Purpose
EA	To discuss Main River flood protection and mitigation measures, consent and permitting requirements, FRA and WFD Assessment scope and methodologies, flood defence integrity monitoring requirements.

Consultee	Purpose
	To collect data regarding surface and groundwater quality (including saline intrusion), groundwater level monitoring data, licensed abstractions and consented discharges, existing flood defences (condition and standard of protection), modelled flood data and associated reports, River Thames sediment chemical analysis data.
Kent County Council; Essex County Council; Thurrock Council; London Borough of Havering (LLFAs) and Gravesham Borough Council	To discuss requirements in terms of surface water drainage arrangements and ordinary watercourse consent. To collect data regarding flood risk and flooding history from 'local sources'.
North Kent Marshes Internal Drainage Board (IDB)	To discuss requirements in terms of surface water drainage arrangements and ordinary watercourse consent. To collect data regarding flood risk and flooding history from 'local sources'.
British Geological Society (BGS)	To collect data and mapping regarding aquifer vulnerability, borehole logs, and mapping indicating areas susceptible to groundwater flooding.
Environmental Health Officers at the Local Planning Authorities	To collect records of any private (including unlicensed) water supplies supported by surface or groundwater resources within the study area and information about 'exempted' discharges to surface water and to ground. Records describing the existing drainage of local roads would also be requested.
Marine Management Organisation & Port of London Authority	To discuss licensing requirements linked to the proposed dredging and piling works within the River Thames to facilitate the potential construction of a new jetty to allow the marine transport of waste materials and to agree the scope of any environmental assessments needed to qualify the impacts of these activities on the hydrodynamics and sediment transport/scour regimes of the River Thames.
Thames Water, Southern Water and Essex and Suffolk Water	To collect records of actual abstraction rates and discuss abstraction borehole details and water quality concerns.

Consultee	Purpose
Natural England	To collect records of water level and/or water quality for surface water features or groundwater at designated sites.
RSPB	To collect actual abstraction rate data records linked to licensed abstractions at the Shorne Marshes Reserve, in addition to any records of water quality or water level data.

14.4 Baseline Information Obtained/Surveys Undertaken

14.4.1 During the options stage of the Project, baseline information was collected via a desk study, drawing on published data, to identify those waterbodies likely to be affected by the Project. The hydrology and hydrogeology of the study area was characterised and whilst no site specific surveys were undertaken, preliminary hydrodynamic modelling was carried out to quantify the hydrodynamic and geomorphological regimes and tidal range of the Thames Estuary. The baseline data obtained to date is presented in Figures 14.1 to 14.5 in Appendix F.

Surface water, drainage and flood zones

14.4.2 As illustrated in Figure 14.1 in Appendix F, to the south of the Thames crossing, the Project traverses undulating ground that generally falls towards the Thames Estuary, with the Thames floodplain extending approximately 1.4km south of the Thames shoreline. The floodplain is classified as EA Flood Zone 3, but benefits from the protection of the Thames tidal flood defences.

14.4.3 The primary surface water features south of the crossing comprise unnamed main rivers and ordinary watercourses. The Thames and Medway Canal, also flows through the study area. None of these waterbodies are monitored under the second cycle of the Water Framework Directive. The Project crosses the South Thames Estuary and Marshes SSSI and the Thames Estuary and Marshes Ramsar, which are drained by a network of ditches.

14.4.4 Land to the south of the Thames crossing is primarily in agricultural use. Most rainfall runoff drains to the underlying permeable chalk geology, with the remainder flowing into the marsh areas. The limited existing development to the south of the crossing is not thought to be served by foul sewer networks and runoff from local roads is understood to drain to ground via infiltration.

14.4.5 Immediately to the north of the Thames the Project traverses land that has a flat topography, which gives way to undulating ground that generally rises as the development boundary extends northwards. The Project traverses the River Thames floodplain in one location and the Mardyke floodplain in two locations; areas defined as Flood Zone 3 but mostly benefitting from flood defences, as illustrated in Figure 14.1 (Appendix F).

- 14.4.6 The primary surface water features are the Mardyke and other unnamed main rivers, as well as numerous ordinary watercourses. The Mardyke is monitored under cycle 2 of the WFD and achieves Moderate Potential, as illustrated in Figure 14.5, within Appendix F. The study area also includes the West and East Tilbury Marshes, both of which lie within the River Thames floodplain.
- 14.4.7 Land is primarily in agricultural use and rainfall runoff mostly drains to field drainage systems and watercourses. Areas of built development are served by the public surface water and combined sewer network, maintained by Essex and Suffolk Water, and highway drainage systems.

Groundwater

- 14.4.8 Figure 14.2 within Appendix F, a schematic block diagram for the whole route, presents a summary of the hydrogeology of the study area; the spatial arrangement of aquifers, aquifer designations, the bedrock water table, groundwater abstractions and an estimate of existing saline intrusion from the River Thames. Aquifers comprise superficial deposits, in particular the river terrace deposits and related fluvial glacial deposits (potentially of high permeability). Bedrock aquifers comprise Palaeogene geological units (layered sand and clayey strata) as well as the underlying Cretaceous Chalk aquifer. The Chalk aquifer is a regionally important potable water resource, particularly south of the Thames; groundwater provides approximately 80% of the water supply in Kent, mostly from the Chalk aquifer.
- 14.4.9 The geological units, which form the basis of the hydrogeological units within the study area, are described in detail in Chapter 10: Geology and Soils. The hydrogeology of the study area is described below.
- 14.4.10 To the south of the River Thames the Chalk aquifer is mostly unconfined and the Chalk group generally crops out at ground surface. There are no significant superficial aquifers here (refer to Figure 14.3, within Appendix F). Eastwards along the A2 there are outcrops of overlying sands and clays and locally perched water may exist and may support small, isolated pond features. In the vicinity of the A2 and the North Downs the bedrock (Chalk aquifer) water table is tens of metres below ground surface. Significant potable water well abstractions are located on the North Downs although the route does not pass over source protection zones. The edge of a SPZ3 crosses the A2 junction and eastwards along the A2 another SPZ3 exists. An SPZ2 is located on the north-west corner of the existing A2/M2 junction (refer to Figure 14.5, within Appendix F).
- 14.4.11 The groundwater WFD water body south of the River Thames is identified as the North Kent Medway Chalk, currently with a WFD status of 'Poor' for both quantitative and chemical quality.
- 14.4.12 For the River Thames Figure 14.2, within Appendix F, shows gravels underlying the river; this scenario could mean hydraulic connection of the river with the underlying Chalk aquifer. Alternatively, low permeability alluvium may lie beneath the river, acting to limit the hydraulic connection.

- 14.4.13 Saline intrusion of the Chalk aquifer, in vicinity of the River Thames, has been identified from historical data and may be less significant on the south side of the River Thames.
- 14.4.14 North of the River Thames, the Chalk aquifer is covered by superficial deposits and/or other bedrock (Figure 14.1, within Appendix F). Licensed groundwater abstractions here are generally from the Secondary A fluvial sands and gravels aquifer. There are two known Chalk aquifer licensed abstractions, one of them in vicinity of Linford, and the route passes across an SPZ2 (Figure 14.5, within Appendix F).
- 14.4.15 The groundwater (WFD) water bodies north of the River Thames, are identified as the South Essex Thurrock Chalk and the Essex South Lower London Tertiaries, both of which currently have “good” WFD quantitative and chemical status.

14.5 Other Baseline Information to be Obtained

- 14.5.1 Limited field testing to record the pH, electrical conductivity, Dissolved Oxygen and temperature of surface waterbodies is proposed during the forthcoming Water Features Survey. The data would be used to aid understanding of possible interactions between surface and groundwater bodies (for example, saline/freshwater distribution particularly in the designated wetland sites).
- 14.5.2 However; no long term water quality sampling and analysis is proposed as it is considered that sufficient baseline data is available to generally characterise the water quality of surface water receptors. This approach will be confirmed in consultation with the EA.
- 14.5.3 Understanding with regard to baseline groundwater quality will be enhanced by data collected during the project specific ground investigation.
- 14.5.4 With regard to surface and groundwater resource use, aquifer vulnerability and surface and groundwater quality options stage data sets would be refreshed in consultation with the EA, BGS and Environmental Health teams at Kent County Council, Gravesham Borough Council and Thurrock Council (for records of private water supplies).
- 14.5.5 The details collected with regard to surface and groundwater resource use would be supplemented and verified through undertaking a Water Features Survey. This survey, through desk study and field walkovers, would record the presence, location, condition and current use of boreholes, wells, ponds, lakes, springs, seepages, wetlands and watercourses. A Method Statement has been submitted to the EA as a basis for agreeing the survey area and methodology. The survey area would reflect those features that could potentially be significantly affected.
- 14.5.6 With regard to flood risk a number of published documents would be reviewed to extract relevant baseline information, including the Thameside (Kent) and Thurrock Strategic Flood Risk Assessment’s (SFRA) (Entec, 2009 and Scott Wilson, 2010), Surface Water

Management Plans (SWMPs) (JBA, 2013 and Thurrock Council, 2014) and Local Flood Risk Management Strategies (LFRMSs) (Kent County Council, 2013 and Thurrock Council, 2015). The EA's Thames RBMP (Environment Agency, 2015) and Thames Estuary 2100 Flood Risk Management Plan (Environment Agency, 2012) would also be examined.

- 14.5.7 Data to define the condition and standard of protection (SOP) provided by existing flood defences would be collected from the EA and construction phase flood defence monitoring requirements would be agreed. EA Flood Product data packs would also be requested to inform the FRA.
- 14.5.8 Further understanding of ground conditions and soil/underlying rock strata permeability would be gathered from review of available Project specific Ground Investigation data and reports. This information would be used to inform the highway drainage design and specification of appropriate SuDS techniques, as well as production of the hydrogeological risk assessment.
- 14.5.9 A desk study would be undertaken to review public documents reporting on sediment contaminants in the Thames Estuary, with the aims of identifying which contaminants could be present. Requests would also be made to the EA, MMO and PLA for any sediment chemical analysis data from samples taken from the Thames Estuary close to, up and downstream of the Project. If existing data is lacking, the requirement for sediment sampling and subsequent chemical analysis at a potential construction jetty location(s) would be discussed and agreed with these consultees.
- 14.5.10 All of this information would be used to develop a 'baseline' with regard to sediment quality at and near to the potential jetty and associated dredge location(s). Where applicable, chemical analysis results would be compared to suitable environmental quality standards in order to understand the potential for impacts on water quality to occur due to jetty construction and associated dredging. The data would also be compared to Centre for Environment, Fisheries and Aquaculture (Cefas) Action Levels which relate to the suitability of the sediment for disposal in marine waters, and Waste Acceptance Criteria (WAC) which relate to the characterisation of waste for disposal in a landfill site. Some of this assessment would be used to support the WFD Assessment and the analysis would also inform Chapter 11: Materials.
- 14.5.11 The preliminary hydrodynamic modelling carried out at the options stage of the Project would be revisited and updated as necessary to quantify any impacts of jetty construction and associated dredging on the baseline hydrodynamic and geomorphological regimes of the Thames Estuary.
- 14.5.12 The following information would also be used to inform the assessment of pollution risk to surface and groundwater from routine highway runoff and in the event of accidental spillage incident, in accordance with the methodologies set out in HD45/09 (Highways Agency, 2009):

- Two-way traffic flow (AADT) for the design year Do-Minimum and Do-Something scenarios
- Percentage of HGVs
- Areas (impermeable and any permeable) draining to highway drainage outfalls are soakaways
- Proposed surface water drainage outfall and soakaway locations

14.6 Key Environmental Receptors and their Value

- 14.6.1 Within the study areas described in Sections 14.7.3 and 14.7.4 below, water environment receptors have been identified and their attributes and the services that these waterbodies support/provide have been characterised using the baseline data sets collected to date.
- 14.6.2 Value (or importance) has then been assigned with consideration of existing quality, scale, rarity and substitutability, to one of the categories (ranging from Very High to Low) defined in table A4.3 of HD45/09.
- 14.6.3 Table 14-2 presents a summary of the key environmental receptors within the study area, their assigned value and reasoning behind the values assigned.
- 14.6.4 For groundwater features, which may have more than one attribute (e.g. a SPZ1 in a Secondary aquifer) then the most appropriate value will be selected on a case by case basis, in consultation with the Environment Agency. Typically a SPZ1 is considered as requiring the most stringent protection (Environment Agency (2017) and this is reflected in the assigned values in Table 14-2.

Table 14-2: Summary Of Water Environment Receptors And Their Value

Receptor	Attribute	Value	Rationale
River Thames Estuary	Water quality	Medium	WFD waterbody achieving Moderate status
	Flow conveyance and storage	Very High	Floodplain or defence protecting more than 100 residential properties or industrial premises/key infrastructure from flooding
	Water supply and transport/dilution of wastes	High	Receives large scale consented discharges of waste water and supports abstractions for water supply.

Receptor	Attribute	Value	Rationale
Mardyke	Water Quality	Medium	WFD waterbody achieving Moderate status
	Flow Conveyance and storage	High	Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
	Water supply and transport/dilution of wastes	Medium	Receives consented discharges of waste water
Unnamed Main Rivers and Ordinary watercourses	Water Quality	Low	WFD unclassified waterbodies, low rarity at the local scale
	Flow conveyance contribution to the land drainage regime	Medium	Key to the land drainage regime at the local scale
Surface or groundwater dependent designated sites: Thames Estuary and Marshes	Biodiversity	Very High	Designated Ramsar site and SSSI
Principal aquifer providing a regionally important resource or supporting site protected under EC and UK habitat legislation. Also SPZ1.	Water resource	Very high	Regional importance
Principal aquifer providing locally important resource or supporting river ecosystem. Also SPZ2.	Water resource	High	Local importance

Receptor	Attribute	Value	Rationale
Aquifer providing water for agricultural or industrial use with limited connection to surface water. Also SPZ3.	Water resource	Medium	Local importance
Unproductive strata	Water resource	Low	Low quality

14.7 Methodology

Guidance

- 14.7.1 The assessment of potential effects on the water environment would follow the guidance set out in Part 10 of Volume 11 of the DMRB (Highways Agency, 2009).
- 14.7.2 Reference would also be made to Environment Agency 2017 guidance on preventing groundwater pollution (UK.GOV, 2017): and various CIRIA publications which set out current best practice measures toward preventing and mitigating construction phase impacts on surface and groundwater resources.

Study Area for the EIA

- 14.7.3 With regard to surface water resources, the study area has been defined to include the area within the development boundary, in addition to downstream reaches of the Rivers Thames and Mardyke and any other surface water receptor within 500m of the application boundary.
- 14.7.4 Groundwater receptors and resources located within 3km of the development boundary would be included in the study area.
- 14.7.5 These study areas have been defined to reflect the surrounding water environment and following consideration of the distance over which significant effects can reasonably have the potential to occur.

Assessment Periods/Scenarios

- 14.7.6 The assessment would consider the construction phase of the Project, assuming a construction period of approximately 5 years, and the operational phase. In line with DMRB guidelines, the significance of the environmental effects of the operational phase would be defined for Do-Minimum and Do-Something scenarios in the opening year and a future (design) year. The future year is typically defined as Year 15 following completion of all construction works.
- 14.7.7 Where relevant, the assessment would differentiate between short term, temporary effects and long term/permanent effects. With regard to the surface water environment, examples of short term effects include temporary loss of floodplain storage volume due to establishing construction compounds in the floodplain, or the short term pollution risk associated with the construction of permanent watercourse crossings.

Future Baseline

- 14.7.8 With regard to flood risk and drainage, future baseline conditions would be forecast, drawing on current best practice guidelines, taking into account the likely impacts of climate change on river flows, rainfall intensities, tidal flood levels/ storm surge and groundwater levels. These future conditions would be represented in any quantitative modelling assessments undertaken to inform the Project drainage design and FRA. The flood risk management policy direction that is set out in the EA Thames Estuary 2100 Management Plan would be taken into account.
- 14.7.9 The likely effects of implementation of future cycles of WFD management plans on the ecological and chemical quality of waterbodies would be considered when assigning value to water environment resources and receptors.
- 14.7.10 Traffic modelling data, specifically modelled average AADT and percentage of HGVs, relevant to the assessment periods and scenarios described in paragraph 14.7.6 would be used to inform the methods set out in HD45/09 (and any subsequent updates) of the DMRB for assessing the pollution impacts of the Project on surface and groundwater bodies.

Significance Criteria

- 14.7.11 The assessment of the magnitude of impacts and resulting significance of effects on the water environment would be made using assessment criteria drawn from Part 10 of Volume 11 of the DMRB – HD45/09, reflecting any published Highways England updates, which it is understood are upcoming.
- 14.7.12 The criteria for assigning impact magnitude consider the scale/extent of the predicted change and the nature and duration of the impact. Magnitudes range from Major Adverse, representing a total loss of an attribute to Negligible where an impact is of insufficient magnitude to affect use or integrity, to Major Beneficial. Whilst examples of each category of impact magnitude are provided in table A4.4 of HD45, professional judgement may be needed in assigning a magnitude of impact. Potential impacts would be identified in the absence of mitigation, but considering any measures embedded in the Project design.
- 14.7.13 Estimating the significance of effects would then be undertaken with reference to the matrix table (table A4.5) presented in HD45/09, which combines the importance (value) of the attribute of a water feature and the predicted magnitude of impact. Significance ranges from Very Large to Neutral and may be positive or adverse, as illustrated in Table 14-3.
- 14.7.14 When more than one significance outcome is possible, professional judgement is used to determine which is most appropriate, on a case by case basis and ensuring regard to the precautionary principle.

Table 14-3: Criteria For Determining The Significance Of Effects

MAGNITUDE OF IMPACT

		Negligible	Minor	Moderate	Major
VALUE OF ATTRIBUTE	Very High	Neutral	Moderate	Large	Very Large
	High	Neutral	Slight/ Moderate	Moderate/ Large	Large/ Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Moderate

Flood Risk Assessment (FRA)

14.7.15 When preparing the FRA, the following will be considered for each sub-catchment:

- Historic flooding incidents
- Potential sources of flooding to the development
- How flood risk affects the development
- Undertake the sequential test and the exception test where necessary
- Whether the development will increase flood risk elsewhere
- Strategies to manage flood risk to the site and the local area as a result of development, allowing for future climate change
- Measures for the management of residual flood risk
- Potential flood risk alleviation afforded by the development

14.7.16 Statutory consultees in the preparation and development of the FRA will comprise:

- Environment Agency
- Kent County Council
- Essex County Council
- Gravesham Borough Council (Local Lead Flood Authority)
- Thurrock Council (Local Lead Flood Authority)
- London Borough of Havering (Local Lead Flood Authority)

14.8 Description of Possible Significant Effects on Receptors

Construction

14.8.1 Infrastructure development can have adverse effects on the water environment, including groundwater, inland surface water, transitional waters and coastal waters. During construction the Project could lead to an increased demand for water, lowering of groundwater levels due to groundwater control and dewatering and involve discharges to water or ground of potentially polluting materials such as silt, concrete and hydrocarbons. Additionally, the Project could impact the existing surface

water drainage regime and cause adverse ecological and hydro-geomorphological effects resulting from physical modifications to the water environment.

- 14.8.2 There may also be an increased risk of spills and leaks of pollutants to the water environment. These effects could lead to adverse impacts on health, the integrity of existing surface and groundwater users e.g. private/potable water supplies, or on protected species and habitats. In particular, such effects could result in surface waters, groundwater or protected areas failing to meet environmental objectives established under the WFD or other designations.
- 14.8.3 Whilst the bored tunnel element of the Project would largely avoid any effects on the River Thames, should jetty construction be required to facilitate the transport of construction waste materials, there could be potential for localised effects on the existing sediment transport/deposition and hydrodynamics regime, associated with piling and dredging for jetty construction.
- 14.8.4 The construction of the tunnel, in particular the portals and to a lesser extent the cross passages, could locally lower the groundwater level in the Chalk and overlying sediments. This has the potential to alter the groundwater flow regime beneath the Ramsar site to the south of the river.
- 14.8.5 There may be a risk of increasing saline intrusion of the Chalk aquifer in the vicinity of the River Thames as a result of construction phase groundwater control.
- 14.8.6 Human health impacts relating to road drainage and the water environment would also be assessed in the EIA. This could include chronic conditions caused to construction workers (given the long duration of the construction phase). Pollution related impacts to human health would also be assessed in Chapter 10: Geology and Soils and would be considered as part of the Cumulative Effects (Chapter 16).

Operation

- 14.8.7 Possible significant effects for surface waters include increased flood risk as a result of works in close proximity to, or the crossing of, existing flood defences, the introduction of impermeable surfaces and loss of floodplain storage where the linking highway network is constructed. Possible effects on groundwater include long term changes in groundwater level.
- 14.8.8 In addition, there is also potential for detriment to the water quality of groundwater and surface waterbodies associated discharges of runoff from the highway, both under routine circumstances and linked to accidental spillage events.
- 14.8.9 Relevant human health impacts e.g. chronic illness due to pollution of a potable water supply, would also be considered in the assessment.

14.9 Potential Mitigation Measures

- 14.9.1 Potential mitigation measures include:

- Design of appropriate watercourse crossings or watercourse diversions, and provision of compensatory storage to replace any volume of floodplain storage that is lost.
- Design to minimise possible deleterious groundwater level lowering and groundwater quality changes, based on the findings of a Hydrogeological Risk Assessment.
- Implementation of best-practice construction phase pollution prevention methods as outlined in industry standard guidance.
- Treatment of construction and operational drainage discharges prior to entry into the water environment utilising SuDS features such as swales and ponds.
- Construction phase monitoring of existing flood defences (for settlement/structural integrity, triggering remedial action if required).
- Provision of storage to attenuate the rates of discharge of surface water drainage from the operational Project.

14.10 Aspects/Impacts Scoped out of the EIA

14.10.1 Based on the baseline research undertaken to date it is considered that there are no aspects/impacts relevant to road drainage and the water environment that can be scoped out of the EIA at this stage.

14.11 Any Other Information

14.11.1 At this stage, there is no further information to report.

15 Climate

15.1 Introduction

15.1.1 This chapter details the proposed scope of work for the assessment of the Project's potential effects on the climate during both construction and operational phases. Climate has been divided into the following two subsections:

- Climate change adaptation – Describes the vulnerability of the Project to climate change in the South East and how climate change would potentially manifest itself in the future; and
- Greenhouse Gas Emissions (GHG) – Describes how the Project would impact the climate in relation to GHG emissions.

15.1.2 The aims of this chapter are to:

- Detail the requirements of the NPSNN for the assessment;
- Present the consultations undertaken and proposed;
- Explore the baseline information that has been collected to date;
- Provide information on what would be collated through further desk study or surveys work;
- Identify the key receptors that would be considered in the EIA;
- Detail the methodology that would be used to assess climate change adaptation and GHG emissions;
- Outline the potential significant effects that would occur;
- Describe the potential mitigation measures; and
- Identify (and justify) any aspects/impacts scoped out of the assessment.

15.1.3 There may be interrelationships between the assessment of potential effects on climate and other disciplines.

15.1.4 Therefore, please refer to the following Chapters:

- Chapter 6: Air Quality;
- Chapter 7: Cultural Heritage;
- Chapter 8: Landscape;
- Chapter 9: Nature Conservation;
- Chapter 10: Geology and Soils;
- Chapter 11: Materials;
- Chapter 13: People and Communities; and
- Chapter 14: Road Drainage and the Water Environment.

15.2 NPSNN Requirements

- 15.2.1 The NPSNN sets out how the NPS puts Government policy on climate change adaptation into practice, and in particular how applicants and the Secretary of State should take the effects of climate change into account when developing and consenting infrastructure. Climate change mitigation is essential to minimise the most dangerous impacts of climate change, as previous global greenhouse gas emissions have already committed us to some degree of continued climate change for at least the next 30 years. Climate change is likely to mean that the UK will experience hotter, drier summers and warmer, wetter winters. There is an increased risk of flooding, drought, heatwaves, intense rainfall events and other extreme events such as storms and wildfires, as well as rising sea levels.
- 15.2.2 In relation to climate change adaptation paragraph 4.38 of the NPSNN states:
- “Adaptation is necessary to deal with the potential impacts of these changes that are already happening. New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the provision of green infrastructure.”*
- 15.2.3 Paragraph 4.44 states:
- “Any adaptation measures should be based on the latest set of UK Climate Projections, the Government’s national Climate Change Risk Assessment and consultation with statutory consultation bodies. Any adaptation measures must themselves also be assessed as part of any environmental impact assessment and included in the environment statement, which should set out how and where such measures are proposed to be secured.”*
- 15.2.4 Further to this, Paragraph 4.47 states:
- “Where adaptation measures are necessary to deal with the impact of climate change, and that measure would have an adverse effect on other aspects of the project and/or surrounding environment, the Secretary of State may consider requiring the applicant to ensure that the adaptation measure could be implemented should the need arise, rather than at the outset of the development.”*
- “New national networks infrastructure will be typically long-term investments which will need to remain operational over many decades, in the face of a changing climate. Consequently, applicants must consider the impacts of climate change when planning location, design, build and operation. Any accompanying environment statement should set out how the proposal will take account of the projected impacts of climate change.”*
- “The applicant should take into account the potential impacts of climate change using the latest UK Climate Projections available at the time and*

ensure any environment statement that is prepared identifies appropriate mitigation or adaptation measures. This should cover the estimated lifetime of the new infrastructure.”

“The applicant should demonstrate that there are no critical features of the design of new national networks infrastructure which may be seriously affected by more radical changes to the climate beyond that projected in the latest set of UK climate projections. Any potential critical features should be assessed taking account of the latest credible scientific evidence.”

- 15.2.5 The delivery of adaptation and mitigation measures set out in Section 15.9 of this Chapter will support adherence to the requirements of the NPSNN.

15.3 Consultations Undertaken and Proposed

- 15.3.1 During the options phase, organisations such as local councils, Natural England and the Environment Agency (EA) were consulted regarding the proposed route options. No responses specifically in relation to climate were received.
- 15.3.2 During the preparation of the ES it is proposed the following stakeholders will be consulted:
- Environment Officer, EA (South East Region);
 - Environment Officers of Kent and Essex County Councils; and
 - Environment Officers of Medway and Thurrock Councils.
- 15.3.3 The consultation will aim to:
- To consult on climate targets, aims, commitments, other projects, plans and policy that affect climate and baseline data; and
 - To consult on any future developments, including transport infrastructure projects in close proximity to the Project.

15.4 Baseline Information Obtained/Surveys Undertaken

Climate Change Adaptation

- 15.4.1 Across England as a whole, land temperature in the decade 2005 - 2014 was 1.0°C warmer than 1961-1990 (Met Office, 2009). There has been a significant human influence on the observed warming in annual Central England temperature since 1950. Statistical results from extreme value analysis suggest that the UK daily maximum and minimum temperature extremes have increased by just over 1°C since the 1950s, and that heavy seasonal and annual rainfall events have also increased (Met Office, 2009).
- 15.4.2 There has been a small observed increase in annual mean rainfall in recent decades. Between 1961-1990 and 1981-2010 annual mean rainfall increased by 3.2%. However, this change is not statistically

significant in the context of rainfall totals over the last century (Met Office, 2009).

15.4.3 It is predicted that climate will increase the frequency and severity of some types of extreme weather events in England. The UK Climate Projections 2009 UKCP09 generally show that warmer, drier summers are more likely along with warmer, wetter winters. The projections for the South East in the 2020s under a high emissions scenario suggest a central estimate of:

- An increase in winter mean temperature of 1.4°C
- An increase in summer mean temperature is 1.5°C
- An increase in summer mean daily maximum temperature is 2.0°C
- An increase in summer mean daily minimum temperature is 1.7°C
- No change in annual mean precipitation
- A 7% change in winter mean precipitation
- A -4% change in summer mean precipitation

15.4.4 By the 2050s (2040-2069), the high emission central estimate provides the following projection:

- An increase in winter mean temperature of 2.5°C
- An increase in summer mean temperature is 3.1°C
- An increase in summer mean daily maximum temperature is 4.3°C
- An increase in summer mean daily minimum temperature is 3.4°C
- No change in annual mean precipitation
- A 19% change in winter mean precipitation
- A -19% change in summer mean precipitation

GHG Emissions

15.4.5 The total GHG emissions from transport in UK are presented in Table 15-1 (Department for Energy and Industrial Strategy, 2016). These figures are by source, which means that they include direct emissions and do not include emissions resulting from the production of the fuels used.

Table 15-1: Total GHG Emissions from Domestic Transport in UK

Year	Tonnes of CO _{2e}
2010	120,100,000
2011	118,300,000
2012	117,700,000
2013	116,500,000
2014	117,800,000
2015	120,000,000

15.5 Other Baseline Information to be Obtained

- 15.5.1 A review of recent relevant past extreme weather events in the study area and their direct and indirect impacts on road infrastructure would be conducted using the UKCP09 weather generator data.
- 15.5.2 This review of recent events would allow the Project's potential vulnerability to climate change and future extreme weather events to be better understood. A better understanding of the consequences of weather events would provide a starting point for raising awareness of the risks and initiating a more considered approach to dealing with weather and climate impacts.
- 15.5.3 Baseline conditions for GHG emissions would also be established through a desktop research by calculating what carbon emissions would have been in the absence of the Project and the planned measures aiming to reduce GHG emissions.

15.6 Key Environmental Receptors and their Value

- 15.6.1 As part of the approach to climate the vulnerability of the Project to climate change will be considered and this will then inform the development of the Project. This may well require the incorporation of measures into the Project to ensure its future resilience to climate change. That design will then be assessed by other topics to understand how that design will influence other receptors; the value of which will be presented in other chapters (e.g. Chapter 6: Air Quality, Chapter 7: Cultural Heritage, Chapter 8: Landscape, Chapter 9: Biodiversity Conservation, Chapter 10: Geology and Soils, Chapter 11: Materials, Chapter 13: People and Communities and Chapter 14: Road Drainage and the Water Environment).

15.7 Methodology

Guidance

- 15.7.1 The overarching Act in relation to climate is the Climate Change Act 2008. The Act sets up a framework for the UK to achieve long-term goals of decreasing GHG emissions by 34% compared to the 1990 baseline by 2020 and by 80% by 2050 and to ensure steps are taken towards adapting to the impact of climate change. The Act introduces a system of carbon budgeting which constrains the total amount of emissions in a specific time period, and establishes a procedure for assessing the risks of the impact of climate change for the UK.
- 15.7.2 In addition to the above Act, reference would be made to the following national guidance and legislation relating to climate:
- Highways England (2016) Climate Adaptation Risk Assessment Progress Update
 - Institute of Environmental Management and Assessment (IEMA) (2017) Environmental Impact Assessment Guide to: Assessing GHG Emissions and Evaluating their Significance

- The Green Construction Board (2016) PAS 2080:2016 Carbon Management in Infrastructure
- The Department for Transport (DfT) (2016) WebTAG (the Transport Analysis Guidance – Data Book)
- Department for Environment, Food & Rural Affairs (Defra) (2017) The UK Climate Change Risk Assessment
- The Department of Energy and Climate Change (2011) The Carbon Plan: Delivering our Low Carbon Future

Study Area for the EIA

- 15.7.3 In relation to climate change adaptation, the study area would comprise of the South East of England.
- 15.7.4 In relation to GHG emissions, the study area would comprise the application boundary and the traffic model area that will be used to assess GHG emissions and will inform the appraisal of the traffic, air quality and noise effects of the Project.

Assessment Periods/Scenarios

- 15.7.5 The Project's related impacts on the receptors would be measured on a spatial and temporal basis, and will be numerically quantified or employ a qualitative judgement.

Climate Change Adaptation

- 15.7.6 The vulnerability of the Project to climate change and incorporation of appropriate adaptation measures into the Project design will be part of the iterative design process. A risk assessment will be undertaken in conjunction with the design team and the details of this risk assessment will be reflected in the Project's description that will be subsequently assessed in other environmental topic chapters.
- 15.7.7 Both construction and operational phases of the Project would be considered for climate change adaptation. The climate change risk assessment of the construction phase would be based on an approximate construction period of five years commencing in 2021.
- 15.7.8 The climate change risk assessment of the operational phase would be based on a maximum design life of 40 years for the highway element of the Project and a design life of 120 years for the tunnel element.

GHG Emissions

- 15.7.9 Following the Environmental Impact Assessment Guide to: Assessing GHG and Evaluating their Significance (IEMA,2017), the assessment undertaken to inform this EIA Scoping Report has consisted of qualitative desk study using readily available published data. More detailed, site-specific quantitative assessments would be undertaken as part of the EIA.
- 15.7.10 The usual scope of the GHG assessment is summarised in Table 15-2 and is consistent with the principles set out in PAS 2080:2016.

Table 15-2: Scope of GHG Emissions Assessment Broken Down by Life Cycle (LC) Stages

LC Stage	Description
Construction	
Transport	Represents transport related GHG emissions associated with the delivery of construction material, such as concrete and steel, and construction equipment to construction sites along the Project from the point of production (or point of storage in the case of plant and machinery).
Onsite operations	Represents GHG emissions from construction activities including: Temporary works, ground works, and landscaping; Materials storage and any energy; Transport of materials and equipment onsite; Installation of materials and products; Emissions associated with site water demand; Carbon sequestration from tree planting; Waste management activities (transport, processing, final disposal) associated with waste arising from the Project; and GHG implications associated with land use change.
Maintenance, repair, replacement and refurbishment	Represents the GHG emissions resulting from activities of works and new materials for the maintenance, repair, replacement and refurbishment of the Project during the operation.
Operation	
Energy	Represents the GHG emissions resulting from the energy used by the Project's infrastructure, minus any electricity generated through onsite low carbon energy sources not exported to the grid.
Water	Represents the GHG emissions resulting from the provision of water required by the Project to enable it to operate and deliver its service. For example, this includes water used in the maintenance and cleaning.
Other operational processes	Represents other process GHG emissions arising from the Project to enable it to operate and deliver its service including management of operational waste
Users utilisation	Represents the GHG emissions associated with the operation of the Project.

LC Stage	Description
Post-operation	
End of life	Represents the GHG emissions resulting from activities of deconstructing, demolishing and decommissioning the Project. Essentially these are onsite GHG emissions from plant equipment.

15.7.11 As detailed above, the GHG emissions assessment would be based on a LC approach. Best practice criteria, based on professional knowledge and the predicted low GHG emissions, for the exclusion of inputs and outputs (cut-off rules) of the scope has been applied. The scope of the Project’s GHG emissions assessment is outlined in Table 15-3.

Table 15-3: Scope Of Project’s GHG Assessment

LC Stage	Included	Excluded
Construction	<ul style="list-style-type: none"> • Transport of construction materials from the factory gate to the construction site • Construction processes 	<ul style="list-style-type: none"> • Transport of plant and equipment to the construction site
Operation	<ul style="list-style-type: none"> • Carbon sequestration from tree planting • Operation of the Project • Maintenance, repair, replacement and refurbishment 	<ul style="list-style-type: none"> • Operational water use • Other operational processes.
Post-operation	N/A	<ul style="list-style-type: none"> • End of life deconstruction, demolishing and decommissioning, transport and waste processing and disposal

15.7.12 Both construction and operational phases of the Project would be considered for the GHG assessment. The assessment would therefore be carried out for the following time periods:

- Start of construction;
- Project opening; and
- 40 years of operation after opening.

Proposed Assessment Methodology – Climate Change Adaptation

- 15.7.13 Workshops will be held with the designers and the other environmental topic specialists to complete a risk assessment to understand the vulnerability of the Project to climate change.
- 15.7.14 The risk assessment will be used to inform the evolution of the Project design during all project phases.
- 15.7.15 This design will then be assessed in the ES and each topic chapter will consider the potential effects of the measures that have been incorporated into the Project from an adaptation perspective.
- 15.7.16 Table 15-4 presents some examples of the adaptation measures that may need to be incorporated into the Project’s design.

Table 15-4: Example Table To Demonstrate Summary Of Effects And Mitigation Measures By ES Topic

Aspect	Effect (construction (C) and operation (O))	Adaptation / Mitigation Measures	Relevant ES Topic
Increased wind / gusting of X mph	Wind damage to planting (O)	Consideration of wind damage in landscape planting design	<ul style="list-style-type: none"> • Landscape (planting mix) • Biodiversity (e.g. due to requirement for different species mix)
Increased wind / gusting of X mph	Damage to structures plus health and safety risk (C, O)	Designing structures for extreme wind events	<ul style="list-style-type: none"> • Larger structures with increased material usage, landtake / ecological effect and visual impact
Increased wind / gusting of X mph	Dust raising (C)	CEMP requirements to include mitigation	<ul style="list-style-type: none"> • Air Quality • Biodiversity
Increased precipitation of X mm in winter	Increased flooding (C, O)	Raising of earthworks above predicted flood level	<ul style="list-style-type: none"> • Air Quality • Biodiversity • People and Communities (e.g. landtake)
Increased temperature of X degs in summer	Damage to / failure of planting (O, M)	Choice of planting. Maintenance regime	<ul style="list-style-type: none"> • Air Quality • Biodiversity

Proposed Assessment Methodology – GHG Emissions

- 15.7.17 The GHG emissions assessment would take a LC approach consistent with the principles set out in PAS 2080:2016. The GHG emissions associated with the construction and operation of the Project would be reported in the form of the ‘carbon footprint’ - reported in tonnes of carbon dioxide equivalent (tCO_{2e}).
- 15.7.18 Direct and indirect emissions would be considered in line with GHG reporting and the total carbon footprint that would be reported in CO₂ equivalents (CO_{2e}). This would allow for the emissions of the six key GHG: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF₆); to be expressed in terms of their equivalent global warming potential in mass of CO_{2e}.

Construction

- 15.7.19 While international standards and guidance documents exist for compiling GHG Inventories, there are currently no accepted criteria for quantifying the GHG emissions of construction activities. In the absence of such guidance, the assessment would be undertaken using professional judgement and utilising the HE Carbon Tool, Project’s Bill of Quantities and Bath University’s Inventory of Carbon and Energy (ICE) Database.
- 15.7.20 The HE Carbon Tool model would be used to calculate the carbon footprint associated with construction of the Project as it is based on the widely-used GHG Protocol. The HE Carbon Tool contains carbon factors related to the types of materials commonly used in road construction.
- 15.7.21 The HE Carbon Tool measures the GHG impacts of construction activities in terms of carbon dioxide equivalent emissions (CO_{2e}). It does this by calculating the embodied CO_{2e} of materials and the associated emissions of their transport. Plate 15.1 below represents how the embodied CO_{2e} of materials would be calculated.

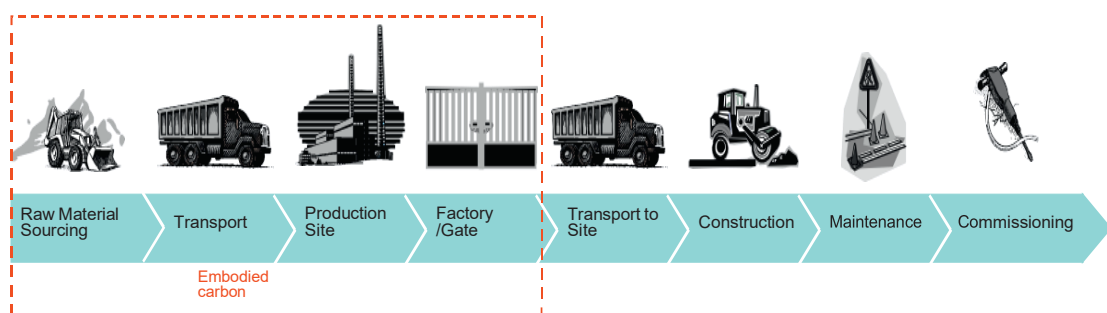


Plate 15-1: Diagrammatic Representation of The Measure of Embodied Carbon in Relation to Material Life Cycle

- 15.7.22 In addition to the calculation of embodied emissions of materials, the emissions of construction activities would also be considered. This would include emissions associated with waste arisings, water use, transportation of waste arisings, construction site energy for the duration of the construction period, workers commute and land use change.

15.7.23 The construction related emissions would be based on the construction and logistics information for the Project. This would include information relating to specific design elements (e.g. tunnel) across the entire Project in terms of:

- Volume (m³) of material resources;
- Type of material resources (e.g. concrete);
- Transport distances (km) of material resources;
- Volume (m³) of waste generated (both construction and demolition);
- GHG emissions coefficients;
- Overall carbon emissions of each design element; and
- Functional units (e.g. tonnes of carbon dioxide CO_{2e} per metre and year of design element) if available.

Operation

15.7.24 Transport related GHG emissions will be calculated using WebTAG.

15.7.25 Carbon sequestration from tree planting would also be calculated in CO_{2e}.

Significance Criteria

Climate Change Adaptation

15.7.26 As noted in Section 15.6, appropriate adaptation measures would be incorporated into the Project design during both construction and operation to reduce the vulnerability of the Project to climate change. These measures would be incorporated into the Project design and then assessed as required in other relevant environmental topic chapters. The risk assessment undertaken to understand the Project's vulnerability to climate change will be reported in the climate change chapter. Therefore, there are no specific significance criteria for the assessment of climate change adaptation effects.

GHG Emissions

15.7.27 With regards to GHG emissions there are no recognised significance criteria. However, the information presented will demonstrate the levels of emissions predicted during construction and operation.

15.7.28 In addition, GHG emissions from operation activities would be compared to the South East and England Emissions and the associated reduction targets.

Assumptions and Limitations

15.7.29 The climate assessment is inherently uncertain in relation to climate change projections and the variation of information availability in relation to different climate hazards.

15.7.30 The climate change mitigation assessment will be based on a number of assumptions. For example, construction site carbon emissions relating to fuel and energy use would consider carbon emissions associated with machinery and plant used.

15.7.31 A series of alternative future scenarios will be assessed in order to illustrate the sensitivity of the Project’s carbon footprint to key assumptions; this assessment will be set out in the ES.

15.8 Description of Possible Significant Effects on Receptors

Climate Change Adaptation

Construction

15.8.1 During construction, drought, high rainfall intensities and high winds could give rise to an increased risk of dust or water pollution, damage the landscape planting design and raise earthworks above the predicted flood level.

Operation

15.8.2 Climate change is projected to increase peak rainfall intensity, and thus increase highway runoff rates and volumes. Flooding in watercourses are similarly expected to increase; therefore scour, bank erosion and exceedance of design rates for bridges and culverts would be more likely in the future.

15.8.3 An increase in climatic variability could lead to higher groundwater levels and more saturated soils, but also increased risk of extreme drought. Both mechanisms can affect ground stability in locations on vulnerable soils. Low to high emissions scenarios could lead to soil moisture fluctuations and therefore, increased risk of shrink-swell related failures.

15.8.4 Vegetation stress due to drought conditions could be a risk to the Project depending on the width of soft estate, steepened slopes and potential damage to root systems. Adding in the effect of increased wind velocities due to climate change, it is feasible that increasing loss/damage to trees could occur.

15.8.5 Table 15-5 presents the primary weather events currently affecting the study area and provides a high-level overview of the potential effects.

Table 15-5: Summary Of Primary Weather Events And Potential Effects

Primary Weather Event	Potential Effect
Heavy rain / flooding	<ul style="list-style-type: none"> • Raised river levels, flooded drains, collapsed culverts • Roads and/or tunnel closures • Contaminated water
High winds	<ul style="list-style-type: none"> • Damage to structures and Power cuts • Fallen trees • Roads and/or tunnel closure

Primary Weather Event	Potential Effect
Heat wave	<ul style="list-style-type: none"> • Health impacts from breathing problems and sunstroke • Impact to biodiversity (e.g. loss of fish) • Fires • Structural damage
Lightening	<ul style="list-style-type: none"> • Structural damage • Power surge and tripping electricity breakers • Fires • Health impacts from direct strikes
Snow and Ice	<ul style="list-style-type: none"> • Dangerous driving conditions • Damage to roads and/or tunnel • Health impacts from slipping on ice and chest illnesses
Fog	<ul style="list-style-type: none"> • Dangerous driving conditions

Greenhouse Gas Emissions

Construction

15.8.6 In order to construct the Project, a large amount of natural resources (i.e. materials and energy) would be required, which would contribute towards GHG emissions and therefore climate change.

15.8.7 The construction phase of the Project would also have the potential to increase GHG emissions due to:

- Emissions from construction plant onsite
- Emissions from water consumption
- Exhaust emissions from construction phase road traffic

15.8.8 It is estimated that additional vehicle movements and emissions, within the study area, associated with the construction of the Project would be a very small percentage of the total emissions within the study area, thus would have a negligible effect on regional climate change.

Operation

15.8.9 As a result of the operation of the Project GHG emissions would mainly result from vehicular movements with other emissions, e.g. due to maintenance likely to be minimal.

15.9 Potential Mitigation Measures

Climate Change Adaptation and Greenhouse Gas Emissions

15.9.1 The Project would adhere to the EA’s guidance on allowances for rainfall and flood probability due to climate change, within the context of flood

risk assessments. This would require that more extreme predictions of climate models are considered and be relevant to construction and operation.

- 15.9.2 The Contractor would ensure appropriate measures within the CEMP are implemented and, as appropriate, additional measures to ensure the resilience of the proposed mitigation of impacts during extreme weather events. For example, dampening of soils and stockpiles.
- 15.9.3 The principal aspect for which climate change is most important is that of flood risk particularly as it affects road safety. The current 20% uplift in attenuation capacity is supported by a sensitive test providing for a 40% uplift within certain regions in line with the EA guidance. Where uplift is considered necessary then the Project would be designed to cope with the increase in rainfall.
- 15.9.4 As the Project's soft estate would be a stressful location for trees, species would be selected that can withstand such conditions. Adaptive measures would also include the selection of drought tolerant species. As a consequence, it is considered that they would be well able to accommodate climate change.
- 15.9.5 The presence of noxious weeds, if any, would be controlled by an appropriate management regime.
- 15.9.6 Appropriate water drainage, considering capacity, would be incorporated within the design of the Project.
- 15.9.7 Whilst climate change has the potential to bring about changes in the groundwater regime (for example groundwater depths and gradients), there is insufficiently detailed evidence to predict with certainty the impact that climate change would have on the assessment and remediation of contaminated land. Therefore, it is not considered feasible to predict climate change mitigation measures at this stage. However, the detailed assessment of contamination and the detailed design of remediation would consider potential changes in the groundwater regimes, and other potential impacts, to ensure that remediation designs are resilient.
- 15.9.8 Allowances for increased river flows due to climate change would be incorporated in design of elements.
- 15.9.9 Water use during construction would be minimised and the reuse would be encouraged. The water abstraction required for construction would be coordinated with the needs of the local community.
- 15.9.10 The Project's design would ensure that flow paths are not obstructed by including conveyance in structures such as culverts in embankments.

15.10 Aspects/Impacts Scoped out of the EIA

- 15.10.1 Both the construction and operational impacts of the Project would be assessed therefore no aspect would be scoped out of the assessment.

15.11 Any Other Information

- 15.11.1 At this stage, there is no further information to report.

16 Cumulative Effects

16.1 Introduction

- 16.1.1 This chapter sets out the scope of the Cumulative Effects Assessment (CEA) that would be completed as part of the EIA. The CEA would be undertaken following the guidance in PINS Advice Note 17: Cumulative Effects Assessment. The CEA would identify where two or more sources of effects interact to give rise to impacts on environmental resources or receptors.
- 16.1.2 Two types of cumulative effects would be considered:
- Intra-Project Effects – The combined action of a number of different environmental topic specific effects upon a single resource/receptor.
 - Inter-Project Effects – The combined action of a number of different projects, in combination with the project being assessed, on a single resource/receptor.

16.2 Method

Intra-Project Cumulative Effects

- 16.2.1 Intra-Project effects will be presented for receptors which could be affected by more than one ES topic. Where a receptor has been identified as only experiencing one effect or where only one topic has identified effects on that receptor there is no potential for intra-project effects to occur.
- 16.2.2 Intra-Project cumulative effects will therefore only be identified where more than one ES chapter has identified a residual effect on an individual or group of receptors.
- 16.2.3 The results will be presented within the ES in a Cumulative Effects Assessment (CEA) chapter within a matrix.

Inter-Project Cumulative Effects

- 16.2.4 Inter-project effects arising from the Project in combination with 'other development' schemes during the construction and operational phases would be assessed.
- 16.2.5 The EIA Regulations (2009) as amended, require an assessment of potentially significant cumulative effects of a project along with other developments. There are no legislative or policy requirements which set out how a CEA should be undertaken. However, PINS has issued an Advice Note which sets out the staged approach that applicants are encouraged to adopt in CEA for NSIPs. The Advice Note suggests a process, involving four 'Stages'. These four 'Stages' are outlined below in Plate 16-1 and explained in detail further below.

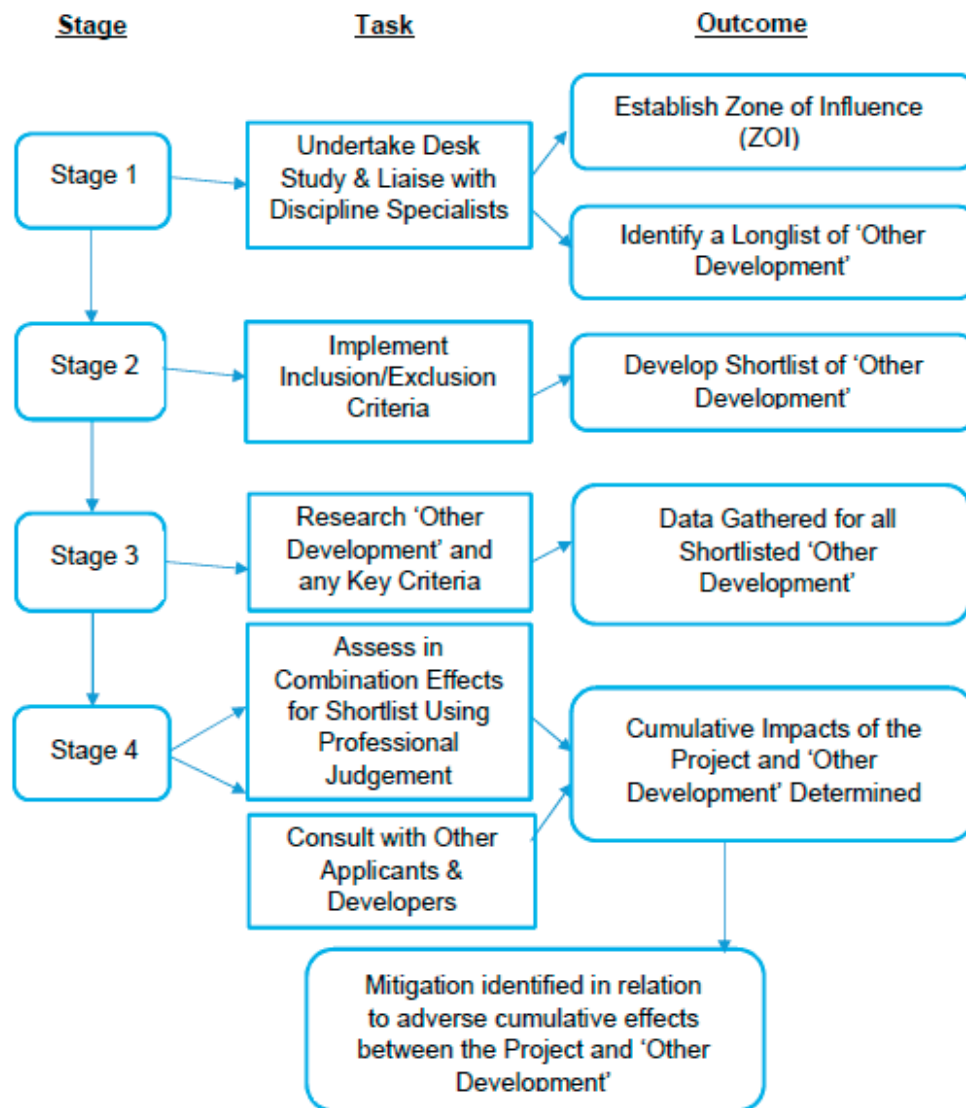


Plate 16-1: Flow Diagram Showing The Critical Processes Involved In The CEA

- 16.2.6 Stage 1 of the process involves establishing an appropriate 'Zone of Influence' (ZOI) to help identify 'other development' relevant to the CEA. Through liaison with technical specialists for each individual ES topic, ZOIs have been established using professional judgement. The resultant ZOI determined for each topic is presented in Table 16.1 below.
- 16.2.7 A 500m ZOI addresses localised cumulative effects from topic areas such as people and communities, meanwhile a 3km ZOI addresses the potential for cumulative effects associated with Road Drainage and the Water Environment which has a greater ZOI due to the reach of development impacts on specific receptors.

Table 16-1: The Established ZOIs For Environmental Topics

Environmental Topic	Zone of Influence
Air Quality	Refer to Plate 2-1
Cultural Heritage	1km
Landscape	1km
Biodiversity	2km
Geology and Soils	1km
Noise and Vibration	Refer to Plate 2-1
People and Communities	500km
Road Drainage and the Water Environment	3km
Climate	Refer to Plate 2-1
	As per Air Quality, Noise and Vibration, Road Drainage and the Water Environment, and People and Communities

- 16.2.8 Following the establishment of the ZOIs for each topic, a desk study was undertaken to search for 'other development'. This used the furthest ZOI as the maximum extent of the study area in which the 'other development' was searched for to create a 'long list'. The desk study was undertaken to obtain all available information about the 'other development' which is planned. In the absence of a developed traffic model it is recognised that there will be other schemes that need to be considered as part of the assessment as the model extent will be more than 5km. This will form part of the assessment presented in the ES and is also likely to include schemes within the Department for Transport's Road Investment Strategy 2015/16 – 2019/20 (DFT, 2015).
- 16.2.9 A tiered approach was applied to consider the level of certainty of 'other development' being carried out that falls within the ZOI.
- 16.2.10 The tiers assigned were as follows
- Tier 1(a): Under construction (although if it is expected to be completed at the time of the Project commencement, the 'other development' will form part of the baseline as requested within the PINS advice note).
 - Tier 1(b): permitted application(s), whether under the PA2008 or other regimes, but not yet implemented.
 - Tier 1 (c): submitted application(s) whether under the PA2008 or other regimes but not yet determined.
 - Tier 2: projects on the Planning Inspectorate's Programme of Projects where a scoping report has been submitted.

- Tier 3: projects on the Planning Inspectorate's Programme of Projects where a scoping report has not been submitted.
 - Tier 3: identified in the relevant Development Plan (and emerging Development Plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited.
 - Tier 3: identified in other plans and programmes (as appropriate) which set the framework for future development consents/approvals, where such development is reasonably likely to come forward.
- 16.2.11 Following completion of the desk study and in line with Stage 2 within PINS Advice Note 17, it was then deemed appropriate to apply threshold criteria to exclude or include 'other development' from the 'longlist' to develop a 'shortlist'.
- 16.2.12 This was undertaken to keep the CEA proportionate and focussed so that 'other development' is only taken through to further assessment stages if it has potential to give rise to significant cumulative effects by overlaps in temporal scope; and due to the scale and nature of the 'other development'.
- 16.2.13 This threshold criteria were created based on professional judgement as well as the definition of large developments defined within the Town and Country Planning (Development Management Procedure) (England) Order 2015.
- 16.2.14 The proposed 'other development' criteria are therefore:
- Developments which may have the potential to overlap on a temporal scale with the Project
 - Development's comprising more than 10,000m² of gross development floor area or more than 100 units
 - Minerals and waste developments
 - Nationally Significant Infrastructure Projects
- 16.2.15 A process of shortlisting was then undertaken with reference to planning applications, relevant development plans and other relevant sources, to identify which developments within the ZOIs fall within the 'other developments' that are relevant to the assessment of potential cumulative effects.
- 16.2.16 The resulting list is presented in Appendix E. These 'other developments' are also mapped on figure 16.1 within Appendix F. This list and map reflects the temporal scope and scale and nature of the 'other development', in line with Stage 2 of the Advice Note.
- 16.2.17 It should be noted that there are no Tier 1(a) developments included within the shortlist of 'other development' presented in Appendix E.
- 16.2.18 Following agreement from PINS and statutory consultees, more detailed information will be gathered for the ES on the 'other developments'. This information will then be reviewed by each environmental topic area to inform the final short list for the CEA. Clear justification for inclusion or

exclusion of development will be provided and there will be engagement with the statutory consultees during this process to agree the developments. Engagement with the traffic modelling team will also be required in relation to the development log used to inform the traffic models.

- 16.2.19 Following this stage, the CEA will be undertaken (Stage 4) in accordance with the Advice Note. Throughout the process of CEA the 'other development' identified will be reviewed periodically to ensure that the most up to date information is used at key points during the evolution of the ES. This includes reviewing the status of 'other development' and any new applications which may be registered within the ZOI.

17 Proposed Structure of the Environmental Statement

- 17.1.1 The ES would comprise three volumes:
- Volume 1A – Main Environmental Statement Text
 - Volume 1B – Environmental Statement Figures
 - Volume 2 – Environmental Statement Appendices
- 17.1.2 A Non-Technical Summary would also be produced.
- 17.1.3 The ES would reflect the new requirements of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.
- 17.1.4 Volume 1A of the Environmental Statement is currently anticipated to be structured as below – subject to further discussion with the Statutory Environmental Bodies (SEBs):
- Introduction
 - Project Description
 - Design Iterations and Alternatives
 - Consultation
 - EIA Methodology
 - Air Quality (the structure of the air quality chapter would be replicated for other assessment chapters).
 - Introduction
 - Regulatory Framework/NPSNN requirements
 - Methodology
 - Existing and future baseline
 - Receptors potentially affected
 - Mitigation and enhancement measures (note that only mitigation measures that can be secured appropriately would be used in the assessment)
 - Residual Effects
 - Monitoring
 - Cultural Heritage
 - Landscape
 - Biodiversity
 - Geology and Soils
 - Materials
 - Noise and Vibration

- People and Communities
- Road Drainage and the Water Environment – this would be supported by a Flood Risk Assessment and a Hydrogeological Risk Assessment Introduction
- Climate
- Cumulative Effects

17.1.5 A number of plans would be produced that would support the preparation of the ES and the results presented therein and would also be a mechanism for securing the required mitigation. These are likely to include:

- A CEMP including a Pollution Prevention Plan
- Environmental Masterplan

18 Transboundary Screening

- 18.1.1 PINS Advice Note 7: Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping states that within the EIA Scoping Report the applicant may wish to provide a completed transboundary screening matrix (as presented in PINS Advice Note 12: Regulation 24 of the EIA Regulations) dealing with the effect of the Project on other European Economic Area (EEA) States.
- 18.1.2 This matrix would facilitate the consideration by the Secretary of State under Regulation 24 of the EIA Regulations of whether the Project is likely to have significant effects on the environment in these states. Table 18-1 identifies where in this EIA Scoping Report the relevant information is presented to inform the transboundary screening exercise.

Table 18-1: Information To Inform A Decision Regarding Likely Significant Effects On Another EEA State

Transboundary Screening Criteria	Commentary and Location of Relevant Information in the EIA Scoping Report
Characteristics of the development	Information about the characteristics of the Project are described in Chapter 2: The Project.
Geographical area	The Project would not require any physical works in any area under the jurisdiction of any other EEA State and based on the current understanding there would be no significant environmental effects on any other EEA State.
Location of development	The Project lies within the counties of Essex and Kent and Thurrock Unitary Authority and would cross beneath the River Thames in a bored tunnel. Details of the location of the Project are provided in Chapter 1: Introduction and shown on Figure 1.1, within Appendix F. The nearest EEA state is France which is approximately 110km away.
Cumulative impacts	There are a number of other schemes being developed near the Project and these are identified in Chapter 16: Cumulative Effects and shown on Figure 16.1, within Appendix F. Potential cumulative impacts would be assessed within the ES.
Carrier	The pathways by which impacts could be spread are via air, land and water. Potential impact pathways are identified where relevant in Chapters 6 to 15 of this EIA Scoping Report.

Transboundary Screening Criteria	Commentary and Location of Relevant Information in the EIA Scoping Report
Environmental importance	All environmental resources that are identified as potentially experiencing significant environmental effects all lie within the UK. Details of relevant environmental receptors and their importance are provided in Chapters 6 to 15 of this EIA Scoping Report.
Extent	Based on the information collated to date as part of the scoping exercise, no significant effects are identified that could impact on another EEA Member State. This position would be clarified as the environmental topic assessments proceed and confirmed in the ES.

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20 Abbreviations

ARN	Affected Road Network
ALC	Agricultural Land Classification
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
AQSO	Air Quality Strategy Objectives
ARG	Amphibian and Reptile Group
AADT	Annual Average Daily Traffic
AONB	Area of Outstanding Natural Beauty
ADMS	Atmospheric Dispersion Modelling System
BNL	Basic Noise Level
BCT	Bat Conservation Trust
BVML	Best and Most Versatile Land
BPM	Best Practicable Means
BAP	Biodiversity Action Plan
BHS	Biological Heritage Site
BT	Bored Tunnel
BSBI	Botanical Society of Britain and Ireland
BR	Bridge
BGS	British Geological Society
BRITPITS	British Pits
BS	British Standard
BST	British Summer Time
BTO	British Trust for Ornithology
BRES	Business Register and Employment Survey
CRN	Calculation of Rail Noise
CRTN	Calculation of Road Traffic Noise
CO _{2e}	Carbon Dioxide Equivalent Emissions
CEH	Centre for Ecology and Hydrology
CIEEM	Chartered Institute for Ecology and Environmental Management
CAZ	Clean Air Zone
CRRN	Compliance Risk Road Network
CSM	Conceptual Site Model

CEMP	Construction Environmental Management Plan
CIRIA	Construction Industry Research Information Association
CTMP	Construction Traffic Management Plan
CD&E	Construction, Demolition and Excavation
CL:AIRE	Contaminated Land: Applications in Real Environments
CWS	County Wildlife Site
CEA	Cumulative Effects Assessment
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DBA	Desk-Based Assessment
DCO	Development Consent Order
EPB	Earth Pressure Balance
ESL	Eastern Southern Link
ERA	Emergency Rescue Areas
EFT	Emission Factor Toolkit
EA	Environment Agency
EIA	Environmental Impact Assessment
END	Environmental Noise Directive
EPR	Environmental Permitting Regulations
ES	Environmental Statement
EDI	Equality, Diversity and Inclusion
EC	European Commission
EEA	European Economic Area
EEC	European Economic Community
EU	European Union
FRA	Flood Risk Assessment
GIS	Geographical Information Systems
GLAAS	Greater London Archaeology Advisory Service
GHG	Greenhouse Gas Emissions
HRA	Habitats Regulations Assessment
HDV	Heavy Duty Vehicle
HGV	Heavy Goods Vehicles
HER	Historic Environment Record
HLC	Historic Landscape Characterisation

HLUD	Historical Land Use Data
HTEF	Historical Tanks and Energy Facilities
HCA	Homes and Communities Agency
HHJV	Hyder-Halcrow Joint Venture
IT	Immersed Tunnel
IROPI	Imperative Reasons of Overriding Public Interest
IAQM	Institute of Air Quality Management
IEMA	Institute of Environmental Management and Assessment
IAN	Interim Advice Note
IDB	Internal Drainage Board
ICE	Inventory of Carbon and Energy
JNCC	Joint Nature Conservation Committee
KCC	Kent County Council
LVIA	Landscape and Visual Impact Assessment
LLFA	Lead Local Flood Authorities
LC	Life Cycle
LSE	Likely Significant Effects
LV	Limit Values
LAQM	Local Air Quality Monitoring
LA	Local Authority
LBAP	Local Biodiversity Action Plan
LFRMS	Local Flood Risk Management Strategy
LNR	Local Nature Reserve
LWS	Local Wildlife Site
LDP	Long Distance Path
LTC	Lower Thames Crossing
LOAEL	Lowest Observed Adverse Effect Level
MPI	Major Projects Instructions
MCZ	Marine Conservation Zone
MMO	Marine Management Organisation
MMP	Materials Management Plan
MEP	Mechanical, Electrical and Plumbing
MOLA	Museum of London Archaeology
NBN	National Biodiversity Network

NCA	National Character Area
NCR	National Cycle Route
NPPF	National Planning Policy Framework
NPSNN	National Policy Statement for National Networks
NTEM	National Trip End Forecasts
NVC	National Vegetation Classification
NSIP	Nationally Significant Infrastructure Project
NE	Natural England
NERC	Natural Environment and Rural Communities
NEWP	Natural Environment White Paper
NO ₂	Nitrogen Dioxide
NOEL	No Observed Effect Level
NIA	Noise Important Areas
NIR	Noise Insulation Regulations
NPSE	Noise Policy Statement for England
NMU	Non-Motorised User
ONS	Office for National Statistics
PPV	Peak Particle Velocity
PINS	Planning Inspectorate
PCM	Pollution Climate Mapping
PPC	Pollution Prevention and Control
PLA	Port of London Authority
pSPA	potential Special Protection Area
PRA	Preferred Route Announcement
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PSSR	Preliminary Sources Study Report
PFA	Pulverised Fuel Ash
rMCZ	recommended Marine Conservation Zone
RIGS	Regionally Important Geological Sites
RBMP	River Basin Management Plan
RSPB	Royal Society for the Protection of Birds
SM	Scheduled Monument
SAQAP	Scheme Air Quality Action Plan

SoS	Secretary of State
SOAEL	Significant Observed Adverse Effect Level
SWMP	Site Waste Management Plan
SSSI	Sites of Special Scientific Interest
SPZ	Source Protection Zones
SAC	Special Area of Conservation
SPA	Special Protection Area
SNRHW	Stable Non-Reactive Hazardous Wastes
SOP	Standard Of Protection
SEBs	Statutory Environmental Bodies
SFRA	Strategic Flood Risk Assessment
SRN	Strategic Road Network
SuDS	Sustainable urban Drainage Systems
TG	Technical Guidance
EDIT	The Equality, Diversity and Inclusion sifting Tool
TRA	Traffic Reliability Area
TAG	Transport Analysis Guidance
TOW	Transport on the Water
TPO	Tree Preservation Order
TBM	Tunnel Boring Machine
TDSCG	Tunnel Design Safety Consultation Group
UXO	Unexploded Ordnance
WAC	Waste Acceptance Criteria
WFD	Water Framework Directive
WQS	Water Quality Standards
WSL	Western Southern Link
WT	Woodland Trust
ZOI	Zone of Influence
ZTV	Zone of Theoretical Visibility
ZVI	Zone of Visual Influence
ZSL	Zoological Society of London

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21 Appendices

- Appendix A – Biodiversity Table of Consultation Contact**
- Appendix B – Biodiversity Desk Study Data Required**
- Appendix C – Biodiversity Survey Methodology**
- Appendix D – Materials Baseline**
- Appendix E – ‘Other Development’ Matrix for Cumulative Effects Assessment**