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Regional Investment Programme A2 Bean and Ebbsfleet Junction Improvements Preliminary Environmental Information Report

Volume 1 – Main Text

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Volume 1

Chapter 1 - Introduction

1.1. Overview of project

1.1.1. The Initial Strategy Shaping and Prioritisation study on improvement options for both junctions was originally carried out by Highways Agency in 2008. As a result of the Government's Comprehensive Spending Review in 2010 the funding commitment to the Kent Thameside Strategic Transport Programme (STP) by the DfT was withdrawn. The Regional Transport Programme and its funding stream was also abolished and, as the two schemes had not reached the stage where they could be considered for inclusion in the Highways Agency's Major Schemes Programme, the funding allocations were lost and no further work was undertaken by the Highways Agency until resurrection of the schemes as part of the 2013 Spending Review (SR13).

1.1.2. In December 2014, the Department for Transport (DfT) published its Road Investment Strategy (RIS) for 2015-2020, announcing £15 billion to invest in England's strategic road network between 2015 and 2020. The RIS sets out the list of schemes that are to be delivered by Highways England over the period covered by the RIS (2015 - 2020). Highways England responded to the RIS with the Highways England Delivery Plan (2015) and a number of schemes have been identified to be constructed within the plan period, including improvements to the A2 Bean and Ebbsfleet Junctions (the Scheme).

1.1.3. As shown on Figure 1.1 in the PEIR Volume 3, the Scheme is located between Dartford and Gravesend in north Kent. Improvements are required at both Bean and Ebbsfleet Junctions to improve capacity and manage forecasted increases in traffic. Bean Junction is the first junction on the A2 to the east of the M25. The existing A2 highway through the study area is a 4-lane dual all-purpose road that reduces to 3-lanes through Bean Junction.

1.1.4. The Scheme comprises adjacent grade-separated junctions at Bean and Ebbsfleet, approximately 1.2 miles (2 km) apart on the A2 trunk road. The A2 Bean Junction connects the A296 and B255 and provides access to the Bluewater Retail Park, a regional shopping centre. The A2 Ebbsfleet Junction connects the A2260 and Southfleet Road. Ebbsfleet Junction was constructed in 2005 to serve the Ebbsfleet International Rail Station and the surrounding Ebbsfleet Valley and Eastern Quarry developments that form part of Ebbsfleet Garden City.

1.1.5. The Scheme is one of the key investments in the Strategic Road Network (SRN) for London and the South-East region. It forms part of the Kent Thameside Strategic Transport Programme (STP) and is needed to support future growth in the area.

1.1.6. The Scheme was announced by Highways England in July 2017 and is due to start construction in 2020. The project sponsor is Highways England and the designer is Atkins.

1.1.7. The Scheme is a Nationally Significant Infrastructure Project (NSIP). Highways England is, therefore, required to submit an application for a 'Development Consent Order' (DCO) for the Scheme.

1.2. Purpose of the Preliminary Environmental Information Report (PEIR)

1.2.1. The Scheme constitutes a NSIP as it meets the thresholds set out in the Highway and Railway (Nationally Significant Infrastructure Project) Order 2013. A planning consent for a NSIP takes the form of a DCO. The DCO combines the grant of planning permission with a range of other separate consents. Further information on the legislative and policy framework is included in the PEIR Volume 2 Appendix A.

1.2.2. The Planning Inspectorate's Advice Note Seven '*Environmental Impact Assessment: Process, Preliminary Environmental Information and Environmental Statements, Republished December 2017*' recommends that Preliminary Environmental Information (PEI) is prepared by the applicant, in this case Highways England.

1.2.3. Under Provision 12 'Consultation Statement Requirements' of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (EIA Regulations) '*preliminary environmental information*' (PEI) is defined as:

> 'information referred to in regulation 14(2) which -
>
> (a) has been compiled by the applicant; and
>
> (b) is reasonably required for the consultation bodies to develop an informed view of the likely significant environmental effects of the development (and of any associated development)'

1.2.4. The PEI is documented in a Preliminary Environmental Information Report (PEIR). The purpose of this PEIR is to enable specialist and non-specialist consultees from the community and consultation bodies to understand the potential pre-mitigation environmental effects of the proposed development. Effects have been predicted at this time for each environmental assessment topic, to inform consultee responses at this DCO pre-application consultation stage. It should be noted that the Scheme design is currently being developed and baseline environmental information, such as surveys, is still being assembled. The PEIR provides a preliminary account of the principal environmental issues and may be subject to change as the environmental impact assessment of the Scheme progresses. The PEIR describes the known information available in respect of the current scheme proposals developed at this preliminary design stage and its environmental effects, timescales for delivery, and alternatives that have been considered, as well as a number of uncertainties and assumptions.

1.2.5. For each environmental topic, the PEIR:

- Describes the study area and environmental baseline data collection work undertaken to date;
- Describes the existing baseline environment, based on data collection to date;
- Identifies further work that is ongoing or that is likely to be undertaken to complete the environmental impact assessment (EIA);
- Provides an assessment of the likely significant environmental impacts of the Scheme based on the currently available information; and

- Describes the range of mitigation measures that will be considered to avoid, reduce/mitigate or offset the identified environmental impact.

1.2.6. The PEIR structure is set out in Table 1.1 below and divided for the purpose of the DCO pre-application consultation as follows:

- PEIR Volumes 1-3 (www.highways.gov.uk/a2be)
  - PEIR Volume 1: Main text that includes Scheme information, alternatives considered, environmental assessments for each environmental topic, glossary and references (highlighted in text as
  - PEIR Volume 2: Appendices that describe the study areas, planning legislation and policy, methodology and relevant tables for each environmental topic; and
  - PEIR Volume 3: Figures that include plans for environmental assessment topic chapters in the PEIR Volume 1.
- PEIR Summary (www.highways.gov.uk/a2be)
  - PEIR Summary – A separate document that summarises the environmental assessment and current preliminary findings for each topic and includes an environmental context plan.

Table 1.1: Structure and contents of the PEIR

PEIR Summary

PEIR Volume 1 – Main Text
Chapter 1 – Introduction
Chapter 2 – The Project
Chapter 3 – Assessment of Alternatives
Chapter 4 – Environmental Assessment Methodology
Chapter 5 – Air Quality
Chapter 6 – Noise and Vibration
Chapter 7 – Biodiversity
Chapter 8 – Road Drainage and the Water Environment
Chapter 9 – Landscape
Chapter 10 – Geology and Soils
Chapter 11 – Cultural Heritage
Chapter 12 – Materials and Waste
Chapter 13 – People and Communities
Chapter 14 – Climate
Chapter 15 – Assessment of Cumulative Effects
Chapter 16 – Summary
References
Abbreviations and Glossary

PEIR Volume 2 – Appendices

PEIR Volume 3 – Figures

1.3. Preliminary design pre-application consultation

1.3.1. Pre-application consultation with key stakeholders and the local community is an important requirement of the DCO planning process. It provides an opportunity for interested parties to comment on the proposals while they are at a formative stage, and for potential issues to be taken into account and, where necessary, address the issues before the application is submitted for examination. A flow diagram setting out the Preliminary Design DCO pre-application process is included in the PEIR Volume 2 Appendix B.

1.3.2. An Environmental Scoping Report was published on the Planning Inspectorate (PINS) website in November 2017. A Scoping Opinion was received from PINS in January 2018 based on feedback from statutory consultation bodies. A response from Highways England to the Scoping Opinion comments from PINS included in Table 3.1 included in the PEIR Volume 2 Appendix C. Detailed feedback from the statutory consultation bodies included in the Scoping Opinion from PINS are being considered as part of this Preliminary Design Stage and will be addressed in the ES.

1.3.3. Highways England published a Statement of Community Consultation (SoCC) for the Scheme in November 2017. In accordance with Regulation 10 of the Infrastructure Planning (EIA) Regulations 2009 (as amended), the SoCC sets out how Highways England will consult with the local community on the PEIR, and the Scheme, the consultation programme and methods of communication.

1.3.4. Following consultation, Highways England will take account of all comments and suggestions received from the consultees in relation to the proposed development and the PEIR. Highways England will integrate them into further Environmental Impact Assessment (EIA) work that will be documented in an Environmental Statement (ES) and submitted as part of the DCO application to the Planning Inspectorate towards the end of 2018.

1.3.5. The DCO application will also include a Consultation Report that will document the outcomes of the consultation and how this has informed the design development of the final proposal.

1.4. Competent experts

1.4.1. In accordance with the EIA Regulations and Highways England guidance, the coordination of the environmental assessment process and inputs into each environmental topic area are being undertaken by a team of competent and qualified specialists. These specialists will work in close collaboration with the design engineers, responsible for the design of the Scheme, as part of an iterative design, consultation and assessment process. This process maximises the opportunity to avoid or reduce adverse environmental effects at source and to identify mitigation measures to address those effects that cannot be avoided or reduced at source.

Chapter 2 - The Project

2.1. Need for the project

2.1.1. The proposed improvements to the Bean and Ebbsfleet Junctions form part of the Kent Thameside Strategic Transport Programme (STP) and is needed to support the predicted significant growth in the future. This could lead to the development of 50,000 homes and the creation of 58,000 jobs.

2.1.2. Development is already under way at Ebbsfleet Garden City that will create up to 15,000 homes and 30,000 jobs that would be served by the Bean and Ebbsfleet Junctions. (Source: Ebbsfleet Development Corporation).

2.1.3. Growth in Dartford is also underway, excluding development at Ebbsfleet. 3,438 houses have been built in the last five years; a further 340 are under construction; and 8,900 have been granted permission (April 2017). Bean Junction will give access to much of this housing, which is north of the A2 and east of Dartford town centre.

2.1.4. Traffic modelling at the Option Selection Stage has indicated that without improvements to both junctions to improve capacity and manage increases in traffic, the road network will become highly congested resulting in considerable delays and associated environmental issues:

- The Bean Junction proposed development will result in traffic using the A2 Bean Junction (including the A296) increasing by 50-60% during weekday and weekend peak periods by 2037 compared to 2014 traffic levels; and
- The Ebbsfleet Junction proposed development will result in traffic using the A2 Ebbsfleet Junction increasing between 170 – 200% during weekday peak periods by 2037 compared to 2014 traffic levels. As a consequence, improvements will be required at both junctions to improve capacity and manage these increases in traffic.

2.1.5. Based on data collected at the Option Selection Stage, in 2014 most of the local road network and the slip roads at the Bean and Ebbsfleet Junctions are, for much of the time, operating within the nominal capacities, with respect to the existing demand in the area, although it should be noted that the A2 Bean eastbound on-slip is approaching capacity in the evening peak.

2.1.6. For the peak directions, between the B262 Hall Road - Pepper Hill Junction and the M25 J2 westbound in the morning peak, and M25 J2 and the B262 Hall Road - Pepper Hill Junction eastbound, in the evening peak, traffic modelling at the Option Selection Stage indicated traffic volume to capacity ratios range between 76% and 90% in the period of data collection late June-July 2014.

2.1.7. The A2 mainline has little reserve capacity to support future development in the A2 study area and surrounding areas especially as new local development traffic wanting to use the A2 to access and egress the local area would have to compete with new traffic arising from development outside the A2BE area making longer distance trips.

2.1.8. The operation of the A2 Bean and Ebbsfleet junction improvements would be affected by the available capacity of the A2 mainline and A2 junctions in conjunction with the capacity of the local road network.

2.1.9. Further detail on the problems at Bean and Ebbsfleet Junctions are included in the Scheme Assessment Report published at the Option Selection Stage (Highways England, 2017a – see PEIR Volume 1 Chapter 17 References).

2.2. Project objectives

2.2.1. The improvements to A2 Bean and Ebbsfleet junctions as originally stated in the RIS should '*enable major developments in the vicinity of Ebbsfle*et' and '*support the development of a Garden City*' to facilitate housing growth to accommodate the growing population. As stated on the Highways England website '*the aim of this scheme is to support growth in the Kent Thameside area'*.

2.2.2. The current challenges at the A2 Bean and Ebbsfleet junction improvements as noted above include:

- Traffic congestion at Bean Junction during peak hours;
- Traffic flows along this section of the A2 at or near route capacity; and
- Traffic levels at both junctions are expected to increase considerably as a result of major development plans in the Kent Thameside area.

2.2.3. The objectives for the Scheme were developed in conjunction with the Department for Transport and local authorities. Improving the junctions will:

- Support economic and housing growth in north Kent, including Ebbsfleet Garden City;
- Increase capacity of the junctions and minimise the impact on the A2;
- Improve journey times;
- Improve road safety;
- Minimise impact on the environment;
- Provide value for money.

2.2.4. Alongside the objectives for the Scheme, Highways England aims to:

- Minimise environmental impact as measured in accordance with Design Manual for Roads and Bridges (DMRB).
- Where possible improve air quality with regard to vehicle emission generally and specifically at the existing declared Air Quality Management Areas (AQMA).

2.2.5. In addition, Highways England sets out its own approach to meeting the key performance indicators identified within the RIS of "no net loss of biodiversity by 2020". The Highways England Delivery Plan 2015-2020 also sets targets to mitigate noise in at least 1,150 Noise Important Areas (NIAs) between 2015/2016 and 2019/2020. This document also demonstrates the ability of the project to meet the requirements within Highways England licence, specifically in relation to the environment.

2.2.6. Highways England published 'The Road to Good Design' in January 2018, which sets out design principles with view to delivering the aspiration to *'deliver safer, better, beautiful roads which connect people and connect our country*'.

2.3. Key environmental constraints

2.3.1. The A2 was built in the 1970s and links London to Dover. In 2008 the road east of Bean Junction was widened to 4 lanes. It follows the existing undulating topography, falling east from Bean to a low point at the B262 Pepper Hill Junction.

2.3.2. West of Bean Junction, the A2 Bean Hill cutting is enclosed by Darenth Wood, which is ancient woodland, and designated a Site of Special Scientific Interest (SSSI). Darenth Wood retains a medieval boundary that is a scheduled monument abutting the highway boundary of the A2.

2.3.3. At Bean Junction highway planting merges with existing mature vegetation, including The Thrift and two other areas of ancient woodland and the semi-mature planting around Bluewater Retail Park. This planting helps to buffer receptors from the A2 including: adjacent housing; and, the undulating arable farmland and Bean village that lies within Green Belt to the south of the A296 Watling Street (Roman Road) and A2.

2.3.4. To the north of A2 and A296 Watling Street (Roman Road), the quarried landscape, shaped by the former cement industry in this area, is defined by steep chalk cliffs and mature vegetation along the A296 Watling Street (Roman Road). This area is in a state of transformation with new housing and mixed-use areas being developed as part of Ebbsfleet Garden City.

2.3.5. At Ebbsfleet Junction, the wide verges and structured planting form what is considered to be the vehicular ‘entrance gateway’ to the Ebbsfleet Valley. Expansive open views from the A2 and junction approaches look across the rural landscape to the Kent Downs. The numerous transmission lines and railway infrastructure are dominant and detracting features.

2.3.6. An area around the A2 is known to have dated back to the Romano-British period and includes Springhead Roman site scheduled monument that lies immediately adjacent to the A2 at Ebbsfleet Junction as well as prehistoric remains from the Palaeolithic and Neolithic periods.

2.3.7. Other sensitive areas and environmental constraints within 1 km of the Scheme include:

- Swanscombe Skull Site SSSI approx. 900 m north of the Scheme, and Baker’s Hole SSSI approx. 500 m north of the Scheme;
- Five Grade II listed buildings - Stone Castle, Lower Bean Farmhouse, Barn South East of Lower Bean Farmhouse, Swanscombe Cutting footbridge crossing A2 east of A296 Junction, and Blue House;
- Country Parks include Swanscombe Heritage Park to the north, Beacon Wood to the south and Darenth Country Park to the west of the Scheme; and,
- Four Local Wildlife Sites.

2.3.8. Of the Eleven Air AQMAs identified – four are designated by Dartford Borough Council and seven designated by Gravesham Borough Council. The Scheme is located within the Dartford AQMA No.4 and Gravesham A2 AQMA. Seven Defra NIAs are located within 1 km of the Scheme, on stretches of the A2 between Bean and Ebbsfleet, the B262, and Watling St (Roman Road).

2.3.9. There are seven source protection zones within the study area. There are also two groundwater abstraction points east of Ebbsfleet Junction within the Scheme limits. Flood Zones 2 and 3 to the north east of Ebbsfleet Junction along the River Ebbsfleet.

2.3.10. The geology and the number of disused landfill sites that accepted inert waste in the study area means that the area is sensitive to pollution incidents.

2.3.11. Environmental constraints are shown on Figure 2.1 in the PEIR Volume 3.

2.4. Project description

Scheme Overview

2.4.1. Figure 2.2 Scheme drawings (Sheets 1-5) are included in the PEIR Volume 3. The Scheme has been developed over previous project stages and is the result of analysis and assessment of traffic, engineering, buildability and environmental factors as well as consultation with stakeholders and the local community. Although the layout of the Scheme has been developed to a sufficient level of detail to show the size and location of the various elements that comprise it, further design and assessment will take place during this stage as part of the preliminary design development to refine it and provide more certainty on the layout of the Scheme. As such there is some level of uncertainty on the design of the Scheme at this point in the process. Highways England are asking for feedback on the following options to inform the assessment of the final design as part of the pre-application consultation process.

Slip roads

2.4.2. As a direct result of the feedback received during the last consultation, Highways England have been reviewing whether the B255/A296 slip road can be kept open. While some congestion would remain on the A296 Watling Street (Roman Road), there will be no loss of lanes on exit from Bluewater. Highways England will need to rerun traffic flow models to find out what impact this has on the rest of the network. The Scheme currently considered in the PEIR topic chapters is described in paragraph 2.4.15.

2.4.3. At Ebbsfleet Junction Highways England are looking to see if the slip road accesses to the Pepper Hill estate and the A2 can be combined. This would reduce the environmental impact and the number of exits at this junction. The Scheme currently considered in the PEIR topic chapter is described in paragraphs 2.4.18.

2.4.4. The DCO pre-application consultation brochure includes options diagrams with specific advantages and disadvantages for each.

Gantries

2.4.5. Highways England are reviewing the location of gantries, as some of them will be moved to accommodate changes to the slip roads. This will also help to manage future traffic flows using new technology.

Embankments

2.4.6. There are many areas that will require retaining walls or embankments. Highways England are working to understand where these structures will be required. Investigations into ground conditions are planned for later in the year which will help inform elements of the design.

Pedestrian and cycling routes

2.4.7. Options are being considered for pedestrian and cycling routes. Highways England are in discussion with Ebbsfleet Development Corporation, Dartford Borough Council, Gravesham Borough Council and Kent County Council to ensure an integrated approach, and people get routes that take them where they want to go.

Ancient woodland

2.4.8. Since the last consultation Highways England have been developing the proposed design to avoid direct impacts on Ancient Woodland at Darenth Wood SSSI or Thrift Wood. Highways England are also refining the layout of the slip road onto the A2 eastbound at Bean Junction as part of the ongoing design development of the Scheme with the aim of avoiding the Ancient Woodland within the Bean Triangle.

Bean Junction Improvements (Bean Option 5)

2.4.9. The proposed Bean Junction improvements broadly retain the existing layout but with an additional bridge over the A2 adjacent to the existing bridge and a new slip road on to the A2 for eastbound traffic. The existing roundabouts will be enlarged and converted to full traffic signal control.

2.4.10. The Bean northern roundabout will be widened to the east to provide for the new southbound link to the roundabout adjacent to Hope Cottages, for the new eastbound on-slip and to accommodate full traffic signal control. This will result in the demolition of all eleven Ightham Cottages.

2.4.11. A new bridge over the A2 east of the existing Bean Lane Overbridge will be provided for southbound traffic from the roundabout. The existing Bean Lane Overbridge will be used for northbound traffic.

2.4.12. The existing hard shoulder is being converted to a running lane on the eastbound carriageway of the A2 from the end of the new slip road to the existing eastbound on-slip at the A296. The layout of the slip road onto the A2 eastbound at Bean Junction is being reviewed as part of the ongoing design development of the Scheme with the aim of avoiding the Ancient Woodland within the Bean Triangle. Swanscombe Cutting Footbridge will be retained by continuing the narrow lanes through the structure.

2.4.13. The A2 west bound off-slip will be widened to three lanes on the approach to the roundabout with all three lanes available for right turn movement to Bean Lane (link road). The existing dedicated left turn lane from Bean Lane to the westbound on-slip will be removed.

2.4.14. The relocation of the Bean southern roundabout will benefit some residents of Hope Cottages compared to the (previous) preferred route design.

2.4.15. As a result of feedback from the last consultation, the B255/A296 slip road closure is being reconsidered. An alternative design is being presented that proposes the slip road to remain open. The DCO pre-application consultation information describes both options and requests further feedback.

Ebbsfleet Junction Improvements (Ebbsfleet Option 1)

2.4.16. The proposed Ebbsfleet Junction improvements broadly follow the existing road layout but with the existing roundabouts enlarged and with full traffic signal control. Access is provided at the junctions to the new and ongoing developments.

2.4.17. The link road between the roundabouts will be widened from the existing single carriageway to a dual two-lane carriageway with additional widening to three lanes on the approach to the roundabouts. The existing eastbound and westbound off-slips will be retained, with the westbound on-slip converted to two lanes along its full length with provision for a ghost island merge layout onto the A2 westbound carriageway.

2.4.18. The Ebbsfleet eastern roundabout will be extended to the north and an additional arm added to accommodate access to the Station Quarter South development. The A2 eastbound on-slip will be widened to two lanes and separated from the one-way link road to the Pepper Hill Junction. A combined on-slip similar to the existing arrangement but with additional lanes is being considered as an alternative as part of the preliminary design. The DCO pre-application consultation information describes both options and requests feedback.

2.4.19. The eastbound off-slip will be widened at the approach to the roundabout with a dedicated signal controlled two lane left turn lane. The west roundabout will be extended to the south and will be fully signalised. The west arm at the roundabout will provide access to the Ebbsfleet Green development currently under construction. The circulatory carriageway will be widened to provide for three lanes on the south circulatory carriageway with three lanes provided on the exit from the roundabout northbound on the A2260 for 150 m before tapering back to tie into the existing 2 lanes. The entry to this roundabout from the north will also be widened from existing two lanes to three lanes on the approach to the junction.

Non-motorised user provisions for walkers, and cyclists

2.4.20. A number of Public Rights of Way (PRoW), footways and cycleways, pass in close proximity to both the Bean and Ebbsfleet Junctions. The Non-motorised User (NMU) route links the A296 Watling Street (London Road) via Bean Lane in front of Ightham Cottages and Hope Cottages. Further footways are located on either side of the existing B255 Bean Lane Overbridge with a signalised pedestrian crossing adjacent to Hope Cottages and at the end of the A2 westbound on-slip. The Bean Junction improvements will reinstate this NMU route. In response to comments received during the public consultation, further opportunities will be considered as part of this preliminary design stage. Highways England are working to understand desire lines and where safe routes can be provided and joined up with other developments. Highways England are aware of the need for a route from Bean village to Bluewater Retail Park and also from Bean village to the coach park within the Bean Triangle. The existing Sandy

Lane Subway and Swanscombe Cutting Footbridge to the east of Bean Junction will be retained.

Land take

2.4.21. The preliminary draft DCO pre-application site boundary or Order Limits (also known as the 'red line boundary') is shown on the Scheme drawings in Figure 2.2 (Sheets 1-5) in the PEIR Volume 3 and includes both permanent and temporary land take for all works proposed, including both the scheme and construction areas. The limits may be subject to minor change as the detailed design of the Scheme progresses.

2.4.22. The total permanent land take (i.e. the areas outside the existing highway boundary but within the proposed highway boundary) required for the Scheme will be included in the ES.

2.4.23. The requirement for and extent of temporary land take is also currently being developed. An area in which necessary construction activities might take place has been included within the preliminary draft DCO pre-application boundary shown on the Scheme drawings in Figure 2.2 (Sheets 1-5) in the PEIR Volume 3 in which necessary construction activities might take place. As a general principle a 10m strip has been provided around the permanent works to enable safe construction access, this is expected to be temporary but in some areas this may be larger to accommodate specific features such as access to existing equipment like soakaways or gantry communications cabinets. The temporary land take will be returned to the original owners when the Scheme has been built. As far as possible the land will be returned in the same condition as it was before the works commenced. Where this is not possible measures will be put in place to achieve this, including management operations over a long period of time. In some cases, it may be possible to return the land in an enhanced condition in agreement with the original landowner.

2.5. Construction, operation and long-term management

2.5.1. Specific construction, operational and long-term management arrangements are not known in detail at this stage of the Scheme. Potential locations of construction compounds for the contractor have been identified and are included within the temporary land take for the Scheme. The assessments of construction effects will assume best practice, based on industry guidance and professional experience.

Construction

2.5.2. Material will be generated as the result of new and modified highway earthworks and the excavation of drainage features. The total volume of materials generated, and required for the construction not known in detail at this stage of the Scheme. A number of structures are proposed to be demolished and extended on site, including retaining walls, gantries and culverts. New structures and extensions to be built on site include the new Bean southbound overbridge structure over the A2 and westbound on-slip.

Construction, operation and long–term management

2.5.3. Specific construction, operational and long–term management arrangements are not known in detail at this stage of the Scheme. Potential locations of construction compounds for the contractor have been identified and are included within the temporary land take for the Scheme. The assessments of construction effects will assume best practice, based on industry guidance and professional experience. Construction of the Scheme is planned to commence in March 2020, with the Scheme planned to be open for traffic in 2022/2023. Maintenance of the Scheme will be the responsibility of Highways England, although some elements will be handed over to Kent County Council by agreement and recognising the Highway Authority boundaries.

Decommissioning

2.5.4. In view of the indefinite design life of the Scheme, it is not considered appropriate for this to form part of the environmental assessment. The focus of the Scheme will be upon seeking to minimise disruption and to re–use materials that will also form part of the materials assessment. Decommissioning of the Scheme has therefore not been included in the PEIR.

2.6. Preliminary Outline Environmental Design

2.6.1. The Preliminary Outline Environmental Design (draft) drawings Figures 2.3 and 2.4 in the PEIR Volume 3, indicate the locations identified during preliminary assessment work, where it is considered that new screen planting, the reinstatement of existing screen planting and/or ecological mitigation for habitat loss will be required.

2.6.2. The drawings also show opportunities for increasing the existing baseline in terms of screening vegetation and ecological features and habitats, with the aim of achieving an overall net gain for the Scheme.

2.6.3. The proposed planting will take into account the landscape character at each of the junctions. Planting will be restricted to native plants of local provenance to the Bean Junction and the southern side of the A2 at Ebbsfleet, whilst to the northern side of the A2 at Ebbsfleet the existing ‘gateway’ landscape planting will be replicated.

2.6.4. The proposed preliminary environmental design includes:

- New screen planting to the village of Bean from the changes to the Bean southern roundabout;
- Translocation of the colony of man orchids;
- Replacement planting to the embankment facing Lower Bean Farmhouse;
- Screen planting to Woodbine Cottage;
- Reinstatement of the amenity planting at Ebbsfleet;
- Marginal and emergent planting where appropriate to drainage features; and
- Species rich grassland and hibernacula and log piles.

2.6.5. The proposals at this stage are outline and based on the current preliminary design presented at consultation. Figure 2.5 in the PEIR Volume 3 includes cross

sections that compares the existing location of the Bean southern roundabout with the Option Selection Stage location and the current location presented at consultation.

2.6.6. During the on-going iterative design process every effort will be made to minimise the loss of existing mature vegetation and the more recently established highway planting. The finalised earthworks design is required to fully understand the effects on existing woodland and the mitigation required. An archaeological survey will be required over the field to the south east of the Bean southern roundabout, to ensure there is no underlying archaeology which would be compromised by tree planting.

2.6.7. Further information will be provided relating to environmental (noise) barriers when the assessments have been concluded. Currently, no new noise barriers are proposed and existing barriers have either been retained or will be replaced where affected by construction.

Chapter 3 - Assessment of Alternatives

3.1.1. A staged approach was undertaken in developing options for the Scheme that included: development of high level alternative junction arrangements; development of a 'long list' of high-level, strategic solutions; and the development of a 'short list' of more detailed scheme options.

3.1.2. The 'short list' of more detailed scheme options were assessed in terms of technical feasibility, safety, engineering, value for money and environmental considerations.

3.1.3. This chapter provides a summary of the options assessed at each stage.

3.2. Development of alternatives

3.2.1. A workshop was held on the 24 July 2014 with key stakeholders at which it was agreed that the Client Scheme Requirements for the Project should be expanded to ensure that a wider range of options were considered for the improvements. As a result, high level alternative junction arrangements were developed for Bean and Ebbsfleet Junctions.

3.2.2. High level concept options were presented to key stakeholders at a workshop held on 26 March 2015. At the workshop, it was identified that:

- Bean Concept Option 4 (Free flow layout) did not provide a connection between the A2 and the A296 Watling Street (Roman Road) and was therefore rejected at the workshop.
- Ebbsfleet Concept Options 3 and 4 removed access to development areas as indicated in the current development masterplans and relocated access to within the development area. While this would greatly simplify the traffic movements at the junction it would require modification to existing masterplans for the proposed developments and so would not meet the Client Scheme Requirements as agreed with key stakeholders. Therefore, these options were rejected.

3.3. Long list options

3.3.1. The initial 'long list' of strategic options was developed for both junctions to accommodate initial forecast 2041 traffic flows and taking into account topography and environmental and physical constraints.

3.3.2. Design Options were reviewed and rejected during the development of the 'long list' are listed below, which included options identified at the project identification stage. Further details are available in the Scheme Assessment Report 2017 published in support of the Preferred Route Announcement but in summary:

- Bean Junction Option 1a and 1b the northern and southern roundabouts were found not to accommodate the forecast traffic flows and an alternative layout was developed (Bean Option 1c) to provide additional capacity;
- Bean Junction Option 2b and 2c whilst Option 2b was found to be a slight variation of 2a, 2c showed that the southern roundabout would not have sufficient capacity;

- Although initially rejected at the workshop on 26 March 2015, variations to the Bean Concept Option 4 were developed which retained connections to the A296 and modified slip road layouts on the Bean eastbound carriageway. This resulted in a number of schemes incorporating a dumb-bell layout to the west of Hope Cottages and a modified slip road layout to the A2 eastbound carriageway was provided.
- Ebbsfleet Concept Option 2 was rejected during the development of the long list options as traffic modelling showed that the junction could not be made to operate due to the relatively high forecast traffic movements between the A2 eastbound carriageway to the Pepper Hill Link road having to pass through the whole of the gyratory resulting in greater conflict with other traffic movements compared to Ebbsfleet Concept Option 1.

3.4. Short list options

3.4.1. A review of the 'Long List' options was undertaken to identify the design options to be taken forward for assessment. The review culminated with a workshop on the 14th April 2016 with representatives of Highways England. Bean Option 5 was developed to overcome the buildability issues associated with the widening of the existing Bean Road overbridge required in Bean Option 1c. A new overbridge crossing would be provided immediately to the east of the existing overbridge. This would require widening of Bean northern roundabout to the east resulting in the demolition of the cottages.

3.4.2. This left the following renamed options to inform the 'short list':

- Bean Junction Option 3a renamed as Bean Option 3;
- Bean Junction Option 4b renamed as Bean Option 4;
- Bean Junction Option 5 reference was retained as Bean Option 5;
- Ebbsfleet Junction Option 1b renamed as Ebbsfleet Option 1.

3.4.3. The rejected options are included in Table 3.1 with the reason for rejection.

Table 3.1: Rejected long list options

Option Name	Reason for Rejection
Bean Junction – Option 1c	This option was rejected as to enable the existing Bean Road overbridge to be widened a temporary bridge crossing would be required to accommodate traffic diverted from the existing bridge. This would be located west of Hope Cottages requiring a temporary access road. To enable the baily bridge to be constructed the existing Bean northern roundabout would need to be modified to provide sufficient space for construction. The temporary road layout would not have sufficient capacity to accommodate traffic flows resulting in unacceptable levels of congestion during construction.
Bean Junction – Option 2a	This option was rejected in favour of Option 4b.
Bean Junction – Option 4a	This option was rejected as widening of the B255 north of the existing bridge over the A296 was considered beyond the scope of the project.

Option Name	Reason for Rejection
Bean Junction – Option 4c	This option was rejected as widening of the B255 north of the existing bridge over the A296 was considered beyond the scope of the project.

3.4.4. Options 3 and 4 at Bean were assessed in detail, but were rejected due to their overall performance against assessment criteria, low value for money and cost of scheme in combination with Ebbsfleet Option 1b exceeding the Scheme budget, and impact on The Thrift and Darenth Wood ancient woodland and SSSI. Further details are available in the Technical Appraisal Report 2017 published to inform the non-statutory public consultation at the end of the Option Identification Stage.

3.4.5. In addition, Options 3 and 4 have the greatest potential for adverse effects on the following:

- The Thrift and Darenth Wood ancient woodland and SSSI;
- Darenth Country Park;
- Darenth Wood and Bean Woods;
- Medieval woodland boundary in Darenth Wood scheduled monument' and
- Receptors such as Bean Village, residents of North Bean, Bean Farm, Hope and Ightham Cottages, and Bean House.

3.4.6. Further details are available in the Technical Appraisal Report 2017 and the Environmental Assessment Report 2016 (www.Highways.gov.uk/A2BE) published to inform the non-statutory public consultation at the end of the Option Identification Stage.

3.5. Preferred option

3.5.1. As a result of the assessments undertaken during the Option Identification and Selection Stages, a single option (with proposed junction improvements at both the Bean and Ebbsfleet Junctions) was developed as the preferred Scheme and given Preferred Route status in August 2017, comprising Bean Option 5; and Ebbsfleet Option 1 as described in Sections 2.4.9 to 2.4.19.

Chapter 4 - Environmental Assessment Methodology

4.1.1. Environmental Impact Assessment (EIA) is a process for identifying the likely environmental effects (positive and negative) of proposed developments, and their significance, before development consent is granted.

4.1.2. The aim of EIA is to ensure that the following are undertaken:

- A thorough assessment of likely effects of a proposed development on the environment;
- Consideration of mitigation measures and alternatives in light of potential environmental effects; and
- Assessment of the cumulative effects of proposed development.

4.1.3. Through this process, the development should include measures to prevent, reduce or offset any significant, adverse environmental effects of the proposals, and enhance the positive impacts. The findings of the assessment are presented in an Environmental Statement (ES).

4.1.4. The purpose of the ES is to help the decision maker, statutory consultees, other stakeholders and the public to properly understand the predicted effects and the scope for reducing them, before a decision is made as to whether to permit the development activity. For the Scheme, the DCO application for Highways England will be supported by an ES produced in accordance with the EIA Regulations.

4.1.5. The EIA Regulations impose procedural requirements for carrying out EIA for NSIPs which fall to be considered as 'EIA development'. The ES is the document that reports on the likely impacts on the environment resulting from the proposed development. The ES must as a minimum comply with Schedule 4 Part 2 of the EIA Regulations. Advice published by the Planning Inspectorate states that the ES should clearly explain the processes followed, the forecasting methods used and the measures envisaged to prevent, reduce and where possible offset any significant adverse effects. This has been undertaken in respect of the PEIR, and will continue to be carried out throughout the EIA process.

4.2. EIA stages

4.2.1. The stages in the EIA process prior to an application for a DCO being submitted are:

1. Existing data review;
2. Screening to determine the need for an EIA;
3. Scoping to identify significant issues to be covered in the assessment, determine the subject matter of the assessment and determine the methodologies for undertaking the EIA. Baseline surveys are conducted as part of the assessment to establish the existing environmental conditions in the study area;
4. Providing information related to the assessment and the project to the statutory and non-statutory stakeholders (referred to as consultees) and the

public so that the parties can make informed contributions to the development of the proposals and the EIA process taking into account the concerns raised by the consultees;

5. Assessment and Iteration to assess the likely significant impacts of the project (including alternatives) on people, environment and communities, identify mitigation measures, if any, through design modifications and environmental management during the project life cycle comprising of construction and operation; and re-assess the residual effects of the mitigated development; and
6. Preparation of an ES and a Non-Technical Summary (NTS).

4.3. Baseline

4.3.1. The existing baseline conditions are defined to enable the assessment of changes or impacts that would be caused by the Scheme on the existing scenario. The identification of the baseline requires the description of the existing situation and then a prediction of how it is likely to evolve in the absence of the Scheme, i.e. 'future baseline scenario' based on available of environmental information and scientific knowledge.

4.3.2. The description of the baseline conditions should clearly identify receptors that may be affected by the Scheme and their 'value' or 'sensitivity' to potential changes.

4.4. Study area

4.4.1. Study areas are defined individually for each environmental topic in the relevant topic appendices in the PEIR Volume 2 by the specialist(s) undertaking that assessment. Each study area is based on recognised professional guidance where this is available together with the geographic scope of the potential effects relevant to the topic.

4.5. Design and mitigation process

4.5.1. The design process allows mitigation measures to be incorporated in the proposals. This is termed "embedded mitigation". Where potentially significant adverse environmental effects have been identified during the assessment process, developing appropriate mitigation will be an iterative part of design development following the hierarchy below:

- Avoidance - incorporate measures to avoid the effect, for example, alternative design options or modifying the construction programme to avoid environmentally sensitive periods;
- Reduction - incorporate measures to lessen the effect such as implementing a code of construction practice to reduce the potential impacts from construction activities; and
- Compensation - to be considered in the circumstances where mitigation at the affected location is not possible to avoid or reduce a significant effect, such as offsite provision of new ecological habitat.

4.5.2. In addition, it may be possible to include 'enhancement' i.e. provision of measures over and above those needed to mitigate the adverse impacts, and/or maximising the opportunities for beneficial impacts from the proposals. Environmental effects of the proposals that remain after mitigation measures are taken into consideration (whether embedded in the design, or provided as additional mitigation after an assessment of the proposals), are referred to as 'residual effects'. Therefore, the key outcome of the EIA assessment is the significance of the residual effects after mitigation or enhancement. Each topic chapter sets out the residual effects of the Scheme (as indicated in the structure above).

4.6. Assessment years and scenarios

4.6.1. The assessment of effects compares a scenario with the Scheme operational against the scenario without the Scheme over time including how the baseline scenario would evolve to form the 'future baseline scenario'.

4.6.2. The absence and presence of the Scheme are referred to as the 'Do Something' and 'Do Minimum' scenarios respectively. The 'Do Minimum' scenario represents the future baseline without improvements at the A2 Bean and Ebbsfleet Junctions. No new infrastructure would be constructed as part of the Scheme. The 'Do Something' scenario on the other hand, represents the situation when the Scheme takes place.

4.6.3. Depending on the topic, the effects are assessed for the 'Do Minimum' and 'Do Something' scenarios, during construction, in the opening year and in a future assessment year. For example, assessments might be undertaken for 15 years after opening, or the worst year in the first 15 years of operation.

4.6.4. The current implementation strategy proposes that, subject to the DCO being approved by the Secretary of State, main construction works would commence in 2020. The main works would be completed such that the site would become operational in 2022/2023. For the purposes of environmental assessment, it is assumed that the site will be used to its maximum capacity from opening, albeit it is likely that in practical terms the reality will be that there will be period of growth in throughput over a number of years before the actual maximum capacity is reached.

4.6.5. Topic specific chapters of this PEIR set out the environmental assessments of the construction and operational effects of the Scheme. The environmental assessment includes the consideration of effects arising from the construction and operation of the Scheme. Considering infinite design life, the environmental assessment process will not assess any decommissioning activities at the end of operational life of the Scheme as the same is not relevant for the Scheme.

4.7. Identification of potential effects

4.7.1. Schedule 4 Part 1 Regulation 20, of the EIA Regulations requires:

4.7.2. 'A description of the likely significant effects of the development on the environment, which should cover the direct effects and any indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative effects of the development, resulting from:

- The existence of the development;

- The use of natural resources;
- The emission of pollutants, the creation of the nuisances and the elimination of waste;
- The description by the applicant of the forecasting methods used to assess the effects on the environment'.

4.7.3. A range of environmental topics may be affected by the Scheme. Effects may be negative or positive, temporary or permanent. They may also be described as:

- **Direct or Primary Impacts**: caused by activities which are an integral part of the proposals resulting in a change in environmental conditions, such as construction works causing an increase in dust concentrations in the air;
- **Indirect or Secondary Impacts**: due to activities that affect an environmental conditions or the receptors, which in turn affects other aspects of the environment or receptors;
- **Cumulative**: comprising multiple effects from different sources within the proposals (synergistic or interrelationships), or cumulatively with other developments (additive), on the same receptors; and
- **Residual**: effects that remain after the positive influence of mitigation measures are taken into account.

4.7.4. Each of these effects can persist over a period of time and can be considered as:

- **Short term**: effects that would last for a limited duration, for example, noise generated during construction of the proposed new infrastructure corridor; and
- **Long term:** permanent effects from the operational activities.

4.8. Assessment of significance

4.8.1. The significance of an environmental effect is typically a function of the 'value' or 'sensitivity' of the receptor and the 'magnitude' or 'scale' of the impact. Combining the environmental value of the resource or receptor with the magnitude of change produces a significance of effect category. In arriving at the significance of effect, the assessor also considers whether the effect is direct, indirect, secondary, cumulative, short, medium or long-term, permanent or temporary, positive or negative.

4.8.2. Methods and requirements specific to each assessment topic are set out in the relevant topic chapters (PEIR Volume 1 Chapters 5 to 14), however, the proposed general approach will be adopted in accordance with relevant guidance and best practice.

4.8.3. With the receptors identified and their sensitivity classified, the potential impacts of the proposed works to these aspects, for construction and operation where appropriate, will be determined and the magnitude of the impact determined.

4.8.4. In accordance with guidance in DMRB Volume 11, Part 5, for each topic the assessment will combine the magnitude of the impacts and the sensitivity of the resources/receptors that could be affected in order to classify the effect (see Table 4.1) to establish their significance (from very large to neutral). General descriptors for the significance of effect are provided in Table 4.2.

Table 4.1: Significance of effects

Environmental value (Sensitivity)	Magnitude of impact (degree of change)				
	Major	Moderate	Minor	Negligible	No change
Very high	Very large	Large or very large	Moderate or large	Slight	Neutral
High	Large or very large	Moderate or large	Slight or moderate	Slight	Neutral
Medium	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral
Negligible	Slight	Neutral or slight	Neutral or slight	Neutral	Neutral

Table 4.2: Descriptors of the Significance of Effect Categories

Significance Category	Typical descriptors of effect
Very Large	Only adverse effects are normally assigned this level of significance. They represent key factors in the decision-making process. These effects are generally, but not exclusively, associated with sites or features of international, national or regional importance that are likely to suffer a most damaging impact and loss of resource integrity. However, a major change in a site or feature of local importance may also enter this category.
Large	These beneficial or adverse effects are considered to be very important considerations and are likely to be material in the decision-making process.
Moderate	These beneficial or adverse effects may be important, but are not likely to be key decision-making factors. The cumulative effects of such factors may influence decision-making if they lead to an increase in the overall adverse effect on a particular resource or receptor.
Slight	These beneficial or adverse effects may be raised as local factors. They are unlikely to be critical in the decision-making process, but are important in enhancing the subsequent design of the project.
Neutral	No effects or those that are beneath levels of perception, within normal bounds of variation or within the margin of forecasting error.

4.8.5. The classification of effects also considers the following descriptors:

- Adverse, neutral or beneficial;
- Permanent or temporary;
- Duration/frequency or likelihood;
- Direct or indirect;
- Secondary; or
- Cumulative.

4.8.6. The duration of the effect will be assessed to be either temporary or permanent where:

- Temporary (e.g. demolition and construction phase):
  - Short term (< 5 years);
  - Medium term (5-10 years); or
  - Long term (> 10 years); and
- Permanent (e.g. once the proposed works are completed and operational).

4.8.7. Whilst the criteria derived vary between disciplines (from a very formal set of criteria based on nationally recognised standards for air quality, to more qualitative criteria derived to assess landscape impact or heritage) each specialist will have used the common terminology set out above alongside their topic-specific guidance and their professional judgement to assess the significance of effects. Effects that are moderate, large or very large are generally deemed to be significant; slight or neutral effects are not significant. However, where this deviates and an alternative basis of assessment applies, this is explained in the appropriate chapter.

4.9. Cumulative effects

4.9.1. Schedule 4, Part 1, Regulation 20, of EIA Regulations requires an ES to include the assessment of cumulative effects. Cumulative effects are the result of multiple actions on environmental receptors. There are principally two types of cumulative impact:

- The combined action of a number of different environmental topic specific impacts upon a single resource/receptor (synergistic or interrelationships); and
- The combined action of a number of different projects, in combination with the project being assessed, on a single resource/receptor (additive).

4.9.2. Further details on the scope of the assessment is provided in Chapter 15. Schedule 3 Regulation 14(b) of the EIA Regulations refers to the cumulation of impacts with other development. Therefore, the environmental effects of the Scheme will also be assessed in combination with the effects of other projects as part of the EIA process, where relevant information is available. What projects that should be considered as part of a 'cumulative' assessment for these purposes is not defined in the EIA Directive or Regulations and there is no standard approach to the assessment of cumulative effects, with different projects adopting different approaches. However, potential cumulative impacts with other major developments need to be identified, as required by the Directive. To aid in this, Planning Inspectorate's Advice Note 17 suggests the categories of developments that should be included in such cumulative assessments.

4.9.3. The cumulative assessment for the Scheme within this PEIR therefore includes developments which fall into the following categories but are not necessarily limited to:

- Trunk road and motorway projects which have been confirmed (i.e. gone through the statutory processes);

- Development projects with valid planning permissions as granted by the Local Planning Authority, and for which formal EIA is a requirement or for which non-statutory environmental impact assessment has been undertaken;
- Applications for consent which have been made, but which have not yet been determined (see thresholds below);
- Allocated sites in emerging or adopted Local Plans; and
- Other types of application which could have implications for the Scheme.

4.9.4. Using these categories, developments have been identified with reference to local knowledge, published information and consultation with local planning authorities in the area.

4.9.5. Preliminary environmental information for the cumulative effects assessment is provided in each individual topic chapter and the PEIR Volume 1 Chapter 15 Assessment of Cumulative Effects.

4.10. Major accidents and disasters

4.10.1. In line with the new requirements for major accidents and disasters outlined in Article 3(1) of the EIA Directive, the ES will consider:

- Vulnerability of the Scheme to risks of major accidents and/or disasters; and
- Any consequential changes in the predicted effects of that Scheme on environmental topics.

4.10.2. In considering these elements of vulnerability, the ES will:

- Apply professional judgement to develop Scheme specific definitions of major events. It should be noted that there is no definition of ‘major’ in this context;
- Identify any ‘major’ events that are relevant to and can affect the Scheme. Major events shall include both man-made and naturally occurring events. Not all events warrant assessment and evidence should be provided to support the view that they should be classified as major events;
- Where Major events are identified, describe the potential for any change in the assessed significance of the Scheme on relevant environmental topics in qualitative terms. Report the conclusions of this assessment within the individual environmental topics; and
- Clearly describe any assumed mitigation measures, to provide an evidence base to support the conclusions and demonstrate that likely effects have been mitigated/managed to an acceptable level.

4.10.3. Major events will be reported within the relevant environmental topic chapters in the ES. Due to the proximity of the Scheme to existing railway, overhead electricity line, and a high pressure gas main infrastructure, these will be considered in the ES within the relevant topic chapters.

4.11. Dealing with uncertainty

4.11.1. EIA is an iterative process, and the Scheme may include somewhat uncertain aspects. At the time that the ES is submitted, it is proposed that no aspects of design would vary so much as to represent effectively different schemes. The

EIA would ensure it addresses the potential for a range of impacts resulting from any undecided parameters.

4.11.2. The Rochdale Envelope principle would be applied in accordance with the Planning Inspectorate's Advice Note 9: Using the Rochdale Envelope (Planning Inspectorate, 2012). The ES will assume the 'worst case' clearly explaining any elements of the Scheme yet to be finalised, with justification. Where flexibility is sought in the scheme design, the maximum potential adverse impacts of the Scheme will be assessed. The ES will confirm maximum and other dimensions of the Scheme, and that any changes to the development within such parameters would not result in significant impacts not previously identified and assessed.

4.12. Transboundary impact screening

4.12.1. EIA Regulation 32 requires PINS to notify other European Economic Area (EEA) States and publicise an application for development consent if it is of the view that the proposed development is likely to have significant effects on the environment of another EEA Member State, and where relevant to consult with the EEA State affected. No transboundary effects are anticipated due to distance and the likely magnitude of impacts from the Scheme.

4.13. Habitat Regulations Screening

4.13.1. In accordance with the requirements of PINS Advice Note 10: Habitat Regulations Assessment, screening was undertaken at the Options Selection Stage. The current outcome of the screening is that a Habitat Regulations Assessment is not required for this Scheme, which will be discussed and agreed with Natural England as part of the Preliminary Design Stage.

4.14. Health Impact Assessment and Equalities Impact Assessment

4.14.1. The assessment of the effect of the Scheme on Population and Human Health is a requirement under the 2017 EIA regulations. This assessment will be reported in ES topic chapters: Air Quality, Noise, Road drainage and the Water Environment; and People and Communities.

Chapters 5-15

Chapter 5 - Air Quality

5.1. Introduction

5.1.1. This section provides the preliminary environmental assessment of the Scheme, based upon information available as of January 2018. The following should be taken into account:

- The assessment has been based on the air quality assessment of the Scheme as assessed at Option Selection Stage, as the final design and traffic modelling has not yet been completed;
- Details of changes in traffic during the construction phase are currently unknown, but will be assessed once this information is available; and
- A full assessment will be provided in the ES when a final design is confirmed and the associated traffic model is completed.

5.1.2. This section should be read in conjunction with the air quality information provided in the PEIR Volume 2 Appendix D, which lists the key legislation and policy, study area, methodology and all the tables for the air quality assessment and further pollutant information and Figures 5.2 to 5.4 in the PEIR Volume 3.

5.2. Consultation

5.2.1. No consultation has been undertaken to date. Consultation with local authorities will be undertaken to obtain relevant air quality monitoring data, supplementary to that presented in this PEIR, and to ensure relevant receptors have been included in the assessment. To date both Dartford and Gravesham Borough Councils have been contacted to obtain the most recent Local Air Quality Management (LAQM) Reports, as noted in the baseline conditions Section 5.3 below.

5.3. Baseline conditions

5.3.1. Information on existing ambient air quality i.e. baseline conditions, and identification of potential air quality constraints to the Scheme have been determined through reference to the following sources:

- AQMA mapping (Defra, 2017a – see PEIR Volume 1 Chapter 17 References);
- Defra Pollution Climate Mapping (PCM) model data for the latest available year (2015 – see PEIR Volume 1 Chapter 17 References);
- Highways England project specific NO_2 diffusion tube survey data;
- LAQM Reports (Dartford Borough Council, 2017a; Gravesham Borough Council, 2017 – see PEIR Volume 1 Chapter 17 References);
- Kent and Medway Air Quality Monitoring Network (Kent Air, 2017– see PEIR Volume 1 Chapter 17 References);
- Natural England's Multi-Agency Geographic Information for the Countryside (MAGIC) website to identify boundaries of designated ecological sites; and
- Ordnance Survey (OS) base mapping to identify locations of sensitive receptors (residential properties, schools, hospitals and elderly care homes).

5.3.2. Figure 5.2 in the PEIR Volume 3 shows the air quality constraints within the Scheme study area, including sensitive human health receptors and designated ecological sites.

Pollutants

5.3.3. The air pollutants of concern in the context of the local air quality assessment for the Scheme are NO_2 and PM_{10}, as these pollutants are most likely to be present in ambient air at concentrations close to or above statutory limit values at receptors near to roads. In addition, the ecological assessment considers NO_x and nitrogen deposition. The regional assessment of vehicle emissions associated with the Scheme considers NO_X, PM_{10} and carbon dioxide (CO_2). Air quality criteria are provided in Table 5.1 in the PEIR Volume 2 Appendix D.

Nitrogen dioxide/ Oxides of nitrogen

5.3.4. NO_2 is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and NO_2 are collectively termed NO_x. About a quarter of the UK NO_x emissions are from road transport. The majority of NO_x emitted from vehicles is in the form of NO_2, which oxidises rapidly in the presence of ozone (O_3) to form NO_2. In high concentrations, NO_2 can affect the respiratory system and can also enhance the response to allergens in sensitive individuals. Additionally, there is an increasing awareness of an association between long-term average concentrations (chronic exposure) of NO_2 and mortality. NO does not have any observable effect on human health at the range of concentrations found in ambient air. Elevated concentrations of NO_x can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from NO_x emissions contribute to acidification and/or eutrophication of sensitive habitats.

Particulate matter

5.3.5. The principal sources of 'primary' polluting particles are combustion processes, which include traffic and industry. Road transport produces 13% of primary PM_{10} emissions in the UK, of which the majority of emissions are from diesel engines. Finer fractions of particulate matter appear to be associated with a range of symptoms of ill health including effects on the respiratory and cardiovascular systems, on asthma and on mortality.

Carbon dioxide

5.3.6. CO_2 is a greenhouse gas and is used as an indicator of the wider scale, non-local effects of transport schemes. Exposure to CO_2 does not affect human health or ecology at ambient levels and so it is not significant as a local pollutant but is important for its national and international role in climate change.

Other pollutants

5.3.7. National assessments have demonstrated that there is no risk of exceedance of the air quality objectives set for 1,3-butadiene, benzene, carbon monoxide, lead or sulphur dioxide due to emissions from traffic anywhere in the UK. These pollutants are therefore not considered further as there is not considered to be a potential for significant effects associated with these pollutants.

5.3.8. In addition to these air pollutants, dust may be generated during the construction phase in areas adjacent to the Scheme and associated works areas. Dust per se

is not considered as a local air pollutant but may cause a perceived loss of amenity and can give rise to soiling (dust deposition).

Air Quality Management Areas (AQMAs)

5.3.9. There are four AQMAs designated within the Dartford Borough Council administrative area. All of these AQMAs have been declared for exceeding the annual mean NO_2 objective. Dartford AQMA No.1 is also declared for exceeding the 24-hour mean PM_{10} objective. The closest AQMA to the Scheme is Dartford AQMA No. 4. The other AQMAs may be affected depending on the ARN derived at the Preliminary Design Stage. Dartford AQMA No. 1 was considered to be affected at Option Selection Stage.

5.3.10. There are seven AQMAs designated within the Gravesham Borough Council administrative area, all of which have been declared for exceedances of the annual mean Air Quality Strategy (AQS) objective for NO_2, and three of which have additionally been declared for exceeding the 24-hour mean AQS objective for PM_{10}. The closest AQMA to the Scheme is Gravesham A2 AQMA. The other AQMAs may be affected depending on the ARN derived at the Preliminary Design Stage.

Details of the AQMAs are provided in Table 5.2 in the PEIR Volume 2 Appendix D and shown in Figure 5.2 in the PEIR Volume 3.

Defra Pollution Climate Mapping (PCM)

5.3.11. Defra's PCM model outputs are used in annual reporting to the EU regarding compliance with the limit values. This model provides estimates of roadside concentrations of pollutants, including annual mean NO_2 and PM_{10}.The modelled roadside concentration comprises a background component together with a roadside increment.

5.3.12. Not all roads are included within the PCM model. For 2015, the most recent year for which data is available, none of the roads within the Defra's PCM model in the vicinity of the air quality study area are shown as exceeding the roadside annual mean NO_2 and PM_{10} limit values of 40 µg/m^3. Defra PCM links are illustrated in Figure 5.2.

Air quality monitoring

5.3.13. Air quality monitoring data from continuous monitoring stations (CMS) and passive diffusion tubes in and close to the air quality study area are described below.

Highways England monitoring

5.3.14. Highways England undertook air quality monitoring specifically for the Scheme for a twelve-month period between September 2013 and August 2014. The results have been annualised, using a factor of 1.05 following analysis of data from three background continuous monitoring stations within 50 miles of the Scheme (London Bexley, Rochester Stoke, and Thurrock) in accordance with LAQM (TG(16)), to represent a full data capture for the year 2016, which will be the base year for the air quality assessment at Preliminary Design Stage. The annualised results were then adjusted using a factor of 0.91 derived from Defra's bias adjustment spreadsheet for diffusion tubes prepared by Staffordshire

Scientifics Group using 20% triethanolamine (TEA) in water. Highways England air quality monitoring data is presented in Table 5.3 in the PEIR Volume 2 Appendix D for sites in the vicinity of the assessment study area. It shows that exceedances of the annual mean NO_2 objective were recorded at the majority of sites.

Local authority monitoring

5.3.15. Dartford Borough Council operates three CMS, including one at the Bean Junction, within the extent of the Scheme, and one on the A226 at St Clements. The other CMS is located outside of the assessment study area to the west of the M25. Dartford Borough Council operates two CMS sites: Gravesham A2 at Painters Ash School, located within the vicinity of the Scheme in the A2 AQMA; and Gravesham Industrial Background monitoring site located in the Northfleet Industrial Area AQMA. The locations of the CMS sites are shown in Figure 5.2 in the PEIR Volume 3.

5.3.16. Table 5.4 in the PEIR Volume 2 Appendix D provides the annual mean NO_2 concentrations from the CMS sites close to the study area. The results show that NO_2 concentrations exceeded the annual mean AQS Objective from 2010 to 2016 at the two Dartford CMS sites, but not at either Gravesham CMS. The 1-hour mean AQS Objective was exceeded at the Dartford Bean Interchange site in 2015 and 2016; and at the Dartford St Clements site in 2010, 2012, 2013, 2014 and 2016. However, this objective was not exceeded at either of the Gravesham sites.

5.3.17. Table 5.5 in PEIR Volume 2 Appendix D provides the ratified annual mean PM_{10} concentrations from the CMS near to the air quality study area between 2010 and 2016. At all sites, PM_{10} concentrations were below the annual mean and daily mean AQS objectives in all years.

5.3.18. Passive monitoring of NO_2 using diffusion tubes has been undertaken by both local authorities. A summary of the Dartford Gravesham Borough Council's monitoring data from 2010 to 2016 (where available) at sites close to the Scheme are presented in Table 5.6 in the PEIR Volume 2 Appendix D. Annual mean NO_2 concentrations have exceeded the AQS objective of 40 µg/m³ at a number of sites in Dartford Borough Council, particularly around the Bean Interchange, while there has been only one exceedance at any of the Gravesham Borough Council sites in any of these years.

5.4. Potential impacts

5.4.1. The Scheme has the potential to affect local air quality, both during construction and once in operation.

Construction

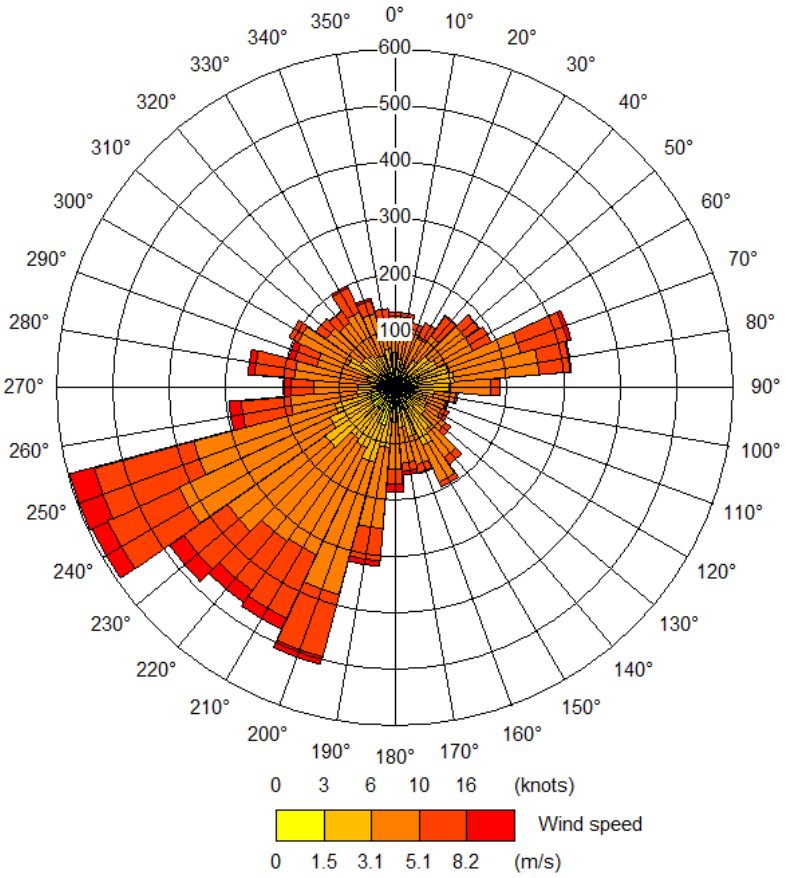
Dust emissions

5.4.2. There is the potential for elevated dust deposition and soiling at properties within 200 m of the indicative construction site boundary as a consequence of the works, if dust raising activities are not effectively controlled and mitigated. The level and distribution of dust emissions would vary according to the duration and

location of activity, weather conditions, and the effectiveness of suppression measures.

5.4.3. The prevailing winds recorded at Gravesend meteorological station (approximately 4 km north east of the Scheme) are from the south-west as shown in the windrose in Figure 5.1 below. The highest windspeeds are also recorded from this direction. This suggests that the wind is more likely to transport dust raised on site towards the north east of the construction works. Figure 5.3 in the PEIR Volume 3 shows the area potentially likely to be affected by construction dust.

Figure 5.1: Windrose for Gravesend meteorological station (2016)



Construction traffic

5.4.4. An increase in vehicle movements is expected during the construction period, associated with the transport of materials, plant and labour to and from site. At this stage, the numbers of expected vehicle movements are not yet known, so cannot be quantitatively assessed. Details of any traffic management, or any need for diversion of traffic during the construction phase are not yet known, so no assessment of these changes has been carried out. Any impact would be expected to be less than that during operation, and would be temporary. This will be examined once information on changes in traffic movements is available.

Operation

Local air quality

5.4.5. The estimated pollutant concentrations at human health receptors assessed at Option Selection Stage are provided in Table 5.8 and Table 5.9 in the PEIR Volume 2 Appendix D for annual mean NO_2 and PM_{10} concentrations respectively; details of the selected receptors are provided in Table 5.7 in the PEIR Volume 2 Appendix D and Figure 5.4 in the PEIR Volume 3. Concentrations of NO_2 were estimated in accordance with IAN 170/12 v3 (LTTE6), as this approach was considered the most realistic for estimating future concentrations, taking into account uncertainty in long term trends. There were not expected to be any exceedances of any AQS objectives in any scenarios.

5.4.6. The largest annual mean NO_2 concentrations are estimated at receptor R7 (located at Hope Cottages on Bean Lane, immediately south of the A2/B255 interchange) in all scenarios, and are expected to be 31.9 µg/m^3 in the 'Do Minimum' scenario and 31.2 µg/m^3 in the 'Do Something' scenario. The change in NO_2 concentrations is determined by Scheme associated changes in traffic and/or changes in road alignment. Changes in NO_2 are greater (for an equivalent change in traffic) where receptors are located nearer to the roadside.

5.4.7. With the previous design, the largest change in annual mean NO_2 concentrations was expected to occur at receptor R17 (located at Hope Cottages on Bean Road), with an increase of 1.9 µg/m^3 (classified as a 'small' magnitude of change). With the revised design of the Bean South Roundabout, the increase at this receptor is only expected to be 0.4 µg/m^3 (still classified as a 'small' magnitude of change). The largest decrease is expected to occur at receptor R9 (residential property on Littledale, 0.7 km west of the A2/B255 interchange), which shows a decrease in annual mean NO_2 concentrations of 1.4 µg/m^3. In addition, receptors R7 and R7a (located at Hope Cottages on Bean Road) and R8 (located on the A296 Watling Street (Roman Road)) are all expected to have a 'small' decrease in concentrations. The change at all other receptors is considered to be 'imperceptible'.

5.4.8. In line with Defra's LAQM.TG16 there are not expected to be any exceedances of the 1-hour mean AQS objective given that annual mean NO_2 concentrations are all estimated to be less than 60 µg/m^3.

5.4.9. The change in annual mean PM_{10} concentrations is considered to be 'imperceptible' (less than 0.4 µg/m^3), other than at R9, where a decrease in PM_{10} concentrations of 0.6 µg/m^3 is expected (small magnitude of change), due to a decrease in traffic flows along the A296 Watling Street (Roman Road). In addition, there were no receptors where concentrations were expected to exceed the PM_{10} daily mean AQS objective.

Compliance risk assessment

5.4.10. Compliance with the EU Air Quality Directive has been considered using the principles in IAN 175/13 where Defra PCM model links coincide with the model domains to aid the assessment of significance of effect.

5.4.11. Defra Air Quality Plans were published in 2017, which aid the consideration of compliance (Defra, 2017b – see PEIR Volume 1 Chapter 17 References). The closest PCM links to the study area include the A296 between the A282 and St

James' Lane; the A226 between the A282 and Northfleet; and the A206 between the A282 and the A226; and the B262 between the A226 and Waterdales. These links are located in either Zone UK0001 (Greater London Urban Area) or Zone UK0031 (South East). Based on the latest Defra PCM data published (taken from the Defra 2017 action plan, with a reference year of 2015), in the opening year of the Scheme (2023) the maximum annual mean NO_2 concentrations for these links in the PCM model is 28.4 µg/m³ for the A296, 24.9 µg/m³ for the A226, 24.7 µg/m³ for the A206, and 20.8 µg/m³ for the B262, which are all below the EU limit value.

5.4.12. Based on the illustrative receptor modelling the maximum increase in annual mean NO_2 concentrations is an increase of 1.9 µg/m^3. Hence the highest roadside NO_2 annual mean concentration within the air quality study area in 2023 would be 30.3 µg/m^3. This is below the EU Limit Value of 40 µg/m^3 and therefore it is considered unlikely that the Scheme would affect compliance.

Ecological assessment

5.4.13. The NO_x concentrations in Darenth Wood SSSI as estimated for the Scheme at Option Selection Stage, are presented in Table 5.10 in the PEIR Volume 2 Appendix D for the Base Year, 'Do Minimum' and 'Do Something' scenarios. The receptor transect points are shown in Figure 5.4 in the PEIR Volume 3.

5.4.14. The results show that the NO_x concentrations are expected to exceed the critical level for vegetation of 30 µg/m³ at a distance of up to 110 m from the road centre line in both the 'Do Minimum' and 'Do Something' scenarios.

5.4.15. With the 'Do Something' scenario, total NOx concentrations are expected to be lower than with the 'Do Minimum' Scenario, for both the north and south sides of the A2 (i.e. concentrations decrease as a result of the Scheme, due to an improvement in traffic on the section of A2 adjacent to the SSSI). The greatest difference in NO_x concentrations between the 'Do Minimum' and 'Do Something' scenarios is expected at the receptor N1_10m (i.e. within 10 m of the A2 road centreline on the northern transect), and is of medium magnitude (>2 to 4 µg/m^3). The changes along the rest of the northern transect (N) are however expected to be of small (>0.4 to 2 µg/m^3) magnitude further away, up to 50 m from the A2 centreline, and of imperceptible (<0.4 µg/m3) magnitude beyond 50 m. For the southern transect (S), changes in concentrations are of a small magnitude up to 20 m from the A2 centreline and imperceptible further away.

5.4.16. The estimated nitrogen (N) deposition rates in Darenth Wood SSSI for the Base, 'Do Minimum' and 'Do Something' scenarios are presented in Table 5.11 in the PEIR Volume 2 Appendix D. The results show the total N deposition rates in the Base and Opening Year scenarios are above the UNECE critical load range of 10-20 kg/N/ha/year. There are no increases in total N deposition rates as a result of the Scheme, as N deposition is expected to either decrease or not change.

Significant effects

Construction

5.4.17. Any air quality effects due to construction would be temporary and could be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant effect on air quality due to the construction of the Scheme.

Operation

5.4.18. In accordance with IAN 174/13, Table 5.12 in the PEIR Volume 2 Appendix D outlines the evaluation of local air quality significance of the Scheme. It can be seen that the Scheme is not expected to have a significant effect on either human health or ecological receptors.

5.5. Potential mitigation measures

Construction

5.5.1. Mitigation measures to control dust emissions during construction would be included in the Construction Environmental Management Plan (CEMP) prior to construction of the Scheme. The precise measures would depend on the intended construction methods and the potential degree of dust generation at each site. Such measures may include but not necessarily be limited to:

- Regular water-spraying and sweeping of unpaved and paved roads to minimise dust and remove mud and debris;
- Using wheel washes, shaker bars or rotating bristles for vehicles leaving the site where appropriate to minimise the amount of mud and debris deposited on the roads;
- Sheeting vehicles carrying dusty materials to prevent materials being blown from the vehicles whilst travelling;
- Enforcing speed limits for vehicles on unmade surfaces to minimise dust entrainment and dispersion;
- Ensuring any temporary site roads are no wider than necessary to minimise their surface area;
- Damping down of surfaces prior to their being worked; and
- Storing dusty materials away from site boundaries and in appropriate containment (e.g. sheeting, sacks, barrels etc.).

5.5.2. If necessary monitoring parameters and a programme will be established.

Operation

5.5.3. The assessment at Option Selection Stage indicated that there are not expected to be any significant adverse effects with the Scheme for the human health receptors or designated ecological sites. This will be investigated and confirmed for the assessment for the ES, and if necessary, mitigation options will be examined and monitoring parameters and a programme will be established.

5.6. Residual impacts

Construction

5.6.1. Any air quality effects due to construction would be temporary and could be suitably minimised by the application of standard and appropriate mitigation measures. On this basis, there is unlikely to be a significant effect on air quality due to the construction of the Scheme.

Operation

5.6.2. The results from the Option Selection Stage assessment noted that in accordance with IAN 174/13, the Scheme is not expected to have a significant effect on human health or ecological receptors. As no mitigation measures are proposed, the residual impacts will be the same as those without mitigation.

5.7. Cumulative effects

5.7.1. Committed developments in the area are provided in the PEIR Volume 1 Chapter 15 Assessment of Cumulative Effects. During construction, four of these proposals: The Eastern Quarry; Ebbsfleet; and two proposals at Ebbsfleet Green could potentially affect receptors within the air quality study area for construction, if construction occurs over the same period.

5.7.2. At Option Selection Stage, specific committed developments were taken into account within the traffic modelling outputs for the air quality assessment, meaning that the air quality assessment during operation already takes into consideration cumulative effects.

5.7.3. This will be revisited and updated as necessary for the air quality assessment for the ES.

5.8. NPS compliance

5.8.1. In line with the national guidance described in paragraph 5.1.5 of the Planning and Policy Context section in PEIR Volume 2 Appendix D, the NN NPS requires a judgement to be made as to the risk of a project affecting the UK's ability to comply with the Air Quality Directive. Modelling undertaken at the Options Selection Stage indicates that the changes in local air quality at the selected receptors are all small or imperceptible. The Scheme is not expected to result in a significant adverse effect on air quality. There is not expected to be a compliance risk as regards the UK's ability to comply with the Air Quality Directive. The Scheme is therefore expected to be compliant with the NN NPS.

5.9. Assumptions and limitations

5.9.1. The information presented here is currently based on the work undertaken at the Options Selection Stage. The traffic model for the Scheme is currently being updated to take into account the latest available information. The air quality assessment will then be updated in the ES that may result in possible variations from the current findings.

5.10. Summary

5.10.1. There are two AQMAs which are likely to be directly affected by the Scheme. These AQMAs are located at the Bean Interchange between the A2 and A296 (Dartford AQMA No. 4), and on the A2 in Gravesham (Gravesham A2 AQMA). In addition, there are a number of AQMAs in the vicinity of the Scheme, which could potentially be affected.

5.10.2. Baseline air quality monitoring data indicates that there are multiple exceedances of the annual mean objective for NO_2 within the extent of the Scheme (notably at the Bean Interchange). However, there were no exceedances of the annual

mean NO_2 or PM_{10} EU limit values at roads included within the Defra PCM mapping.

5.10.3. Some construction activities such as earthworks and track out from any unpaved roads are likely to generate dust which has the potential to temporarily affect nearby properties if uncontrolled. With the application of standard and appropriate mitigation measures, any adverse effects would be minimised, such that there is unlikely to be a significant effect on air quality.

5.10.4. Changes in traffic during the construction phase have the potential to affect local air quality at receptors near to any affected roads. Data is not currently available to undertake a qualitative assessment, however, any effect on air quality will be temporary and is likely to be less than the effect of the Scheme during operation.

5.10.5. The assessment at Option Selection Stage showed that there were not expected to be any exceedances of the NO_2 or PM_{10} AQS objectives in the opening year with either the 'Do Minimum' and 'Do Something' scenario. The estimated magnitude of change at all receptors is expected to be small or imperceptible.

5.10.6. There are not expected to be any Defra PCM links in the air quality study area that exceed in 2023 and changes in concentrations would not result in exceedences in 2023 or beyond. There is not expected to be a compliance risk due to the Scheme.

5.10.7. NO_X concentrations and nitrogen deposition rates are estimated to decrease with the Scheme at the Darenth Wood SSSI, as a result of improved traffic flows on the A2.

5.10.8. The Scheme is not expected to lead to a significant impact on local air quality. This will be further investigated for the assessment to be presented in the ES using detailed dispersion modelling. If necessary, mitigation options will be examined.

Chapter 6 - Noise and Vibration

6.1. Introduction

6.1.1. The potential for noise and vibration impacts to occur at nearby receptors as a result of the Scheme has been considered in previous design phases. This chapter provides preliminary environmental information relating to the baseline conditions, the expected impacts and the mitigation measures that may be required to avoid significant effects from occurring.

6.1.2. This section should be read in conjunction with the noise information provided in the PEIR Volume 2 Appendix E, which lists the key legislation and policy, study area, methodology and tables for the noise assessment and Figures 6.1 to 6.3 in the PEIR Volume 3.

6.2. Consultation

6.2.1. The Local Authorities, of Dartford and Gravesham, will be contacted with regards to the Scheme, in order to discuss the assessment approach, to identify areas but existing noise and vibration concerns, and to establish the presence of any further noise sensitive receptors that should be included in the assessment from other proposed or committed developments.

6.3. Baseline conditions

6.3.1. Information regarding the existing ambient noise climate i.e. baseline conditions, and identification of potential noise impact constraints to the Scheme has been determined through reference to the following sources:

- OS base mapping to identify locations of residential and non-residential noise sensitive receptors (residential properties, schools, hospitals and elderly care homes);
- Natural England's MAGIC website (Defra, 2018 – see PEIR Volume 1 Chapter 17 References) to identify boundaries of designated ecological sites that may be considered as sensitive to noise;
- Extrium Noise Map Viewer (2012 - see PEIR Volume 1 Chapter 17 References) showing Defra NIA mapping; and
- Extrium Noise Map Viewer showing Defra Strategic Noise Mapping for Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended) (2015- see PEIR Volume 1 Chapter 17 References).

Noise sensitive receptors

6.3.2. The scheme consists of two junction improvements on the A2, at Bean and Ebbsfleet, in Kent.

6.3.3. To the north of the A2, beyond the Bluewater Retail Park and the disused cement works and quarry, there are residential properties within 1 km from the Scheme at Greenhithe, Swanscombe and Ebbsfleet Green.

6.3.4. To the south of the A2 it is more rural, with the areas of the villages of Bean and Betsham within 1 km of the Scheme. To the east, there are properties within Gravesend that are within 1 km of the Scheme.

6.3.5. The receptors will include all of the Defra NIAs within the study area, details of which have been provided from paragraph 6.4.11, and in Table 6.5 in the PEIR Volume 2 Appendix E and Figure 6.1 in the PEIR Volume 3.

6.3.6. A number of other notable noise sensitive receptors have been identified within 1 km of the Scheme, including Bean Primary School, Ebbsfleet Academy and two care homes in Greenhithe.

6.3.7. A number of ecological receptors are located in the study area and are considered in the PEIR Volume 1 Chapter 7 Biodiversity.

Noise climate

6.3.8. It is expected that the main source of noise influencing noise levels in the study area is the busy A2 dual carriageway, which serves as one of the main routes linking the port of Dover with the rest of the UK. Other potential sources of noise in the area include the railway noise from the High Speed 1 (HS 1) - the Channel Tunnel Rail Link (CTRL), and Ebbsfleet International station, plus a number of industrial premises, all located close to the A2 Ebbsfleet Junction. There is also potential for aircraft noise to contribute to the noise climate, given the proximity of the site to flightpaths to and from London City Airport.

6.3.9. A noise survey will be undertaken at the Preliminary Design Stage to ascertain the baseline noise levels at noise sensitive receptors within the study area of the Scheme. The final design of the Scheme will be used to further inform the production of the Preliminary Design Stage noise model.

6.3.10. The measured noise levels obtained during the baseline noise survey will be supplemented with information from publicly available online mapping sources. Strategic noise maps were published during 2015 by Defra for both major road and railways sources to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended).

6.3.11. The NIAs were identified to highlight any particular constraints on the design options for the Scheme. NIAs are the locations where 1% of the population most affected by the highest noise levels from major roads and railways are located according to the strategic noise mapping undertaken by Defra.

6.3.12. Table 6.5 in the PEIR Volume 2 Appendix E lists the NIAs that have been identified for the Scheme. The locations of the NIAs in proximity to the Scheme are shown on Figure 6.1 in the PEIR Volume 3.

6.4. Potential impacts

Construction

6.4.1. The main construction activities that are likely to take place are site preparation, demolition, earthworks, retaining wall construction and road works. All activities have the potential to cause some disturbance at nearby sensitive receptors. Demolition works and piling works (for new structures and retaining walls) are likely to cause some of the highest noise levels dependent on the methods

chosen. Should it be required to close the A2 to undertake any part of the works then the potential for adverse noise impacts at night is very high. This would also be coupled with the potential wider impacts of re-routed traffic during the night-time.

6.4.2. A construction programme detailing the specific activities that will take place, phasing and duration of each activities, and a plant list are not yet available for the Scheme.

6.4.3. There are ecological receptors identified close to the scheme such as Darenth Wood SSSI and Ebbsfleet Marshes Local Wildlife Site (LWS). Loud impulsive or impact sounds, typically characterised as 'bangs' or 'clangs', can startle birds and cause them to temporarily fly away. Responses to sound vary between different species of bird - during a prolonged period of construction works, some birds may become used to construction noise whereas others that are more sensitive to impact or impulse sounds may permanently leave the area.

6.4.4. The need for temporary noise mitigation during the construction phase will be determined by undertaking a BS5228-1:2009+A1:2014 assessment once the required information becomes available. The assessment will take into account the following factors:

- The ambient noise environment at the closest noise sensitive receptors to the construction works;
- The distance between the nearest noise sensitive receptor and the construction works;
- The duration and time of day that the construction works occur; and
- The noise produced by the plant or equipment involved in the construction activities, which is influenced by the sound power of the equipment and its usage pattern.

6.4.5. An increase in vehicle movements is expected during the construction period, as a result of workers and heavy goods vehicles (HGVs) travelling to and from site. At this stage the numbers of expected vehicle movements are not yet known, so cannot be quantitatively assessed. It is also not yet known if existing traffic will need to be diverted during the construction phase. Consequently, it is not possible to undertake a construction traffic noise impact assessment at this time, however, the impacts from this will be assessed once the required information becomes available.

Operation

6.4.6. Once the Scheme is operational, the noise climate could be affected (positively or negatively) by changes in vehicle activity (flows, speeds and composition). Additionally, noise levels at nearby receptors could also be affected by any changes to the distance between carriageways and noise sensitive receptors, as a result of changes to the horizontal and vertical road alignment for the operational Scheme.

6.4.7. Detailed predictions have been carried out for a total of 2,246 residential dwellings and 3 identified other sensitive receptors. The other sensitive receptors identified in the DMRB defined study area are Bean Primary School, Hasington Residential Home; and, Rosewood (Care Home Facility).

6.4.8. At the Option Selection Stage, detailed predictions were undertaken for the preferred option, for Bean Option 5 and Ebbsfleet Option 1 (B05E01). The detailed predictions considered the short term changes to noise levels in the opening year of the Scheme and the long term changes to noise levels 15 years after the opening of the Scheme. For opening year impacts comparison was made between the 'Do Something' and 'Do Minimum' scenarios in 2023; for the long term impacts, comparison was made between the 'Do Something' scenario in 2038 and the 'Do Minimum' scenario in 2023.

6.4.9. At the Option Selection Stage, the number of receptors exceeding the significance of adverse effect level (SOAEL) was not considered, and will be carried out at this Preliminary Design Stage. In the ES, any increases in NIAs and increases of more than 1dB for properties already exceeding the SOAEL daytime threshold, will be considered significant in the short and long term.

6.4.10. The following information is taken from the Options Selection Stage, and not from the current scheme being assessed at at this Preliminary Design Stage. The traffic model for the at this Preliminary Design Scheme will be updated to take into account the latest available information and data, with the noise and vibration assessment updated in the ES.

6.4.11. Table 6.6 in the PEIR Volume 2 Appendix E shows the noise changes for all modelled receptors within the detailed calculation area in the short-term (opening year), categorised into the noise change bands corresponding to the magnitude impact ratings, as required by DMRB as provided in Table 6.3 in the PEIR Volume 2 Appendix E.

6.4.12. Table 6.6 in the PEIR Volume 2 Appendix E demonstrates that the majority of short-term changes in noise level due to the Scheme were predicted to be negligible. Minor noise increases were predicted at 4 residential properties and no non-residential properties. Minor noise decreases were calculated at 6 residential and no non-residential properties. There were no moderate or major changes in noise predicted. Figure 6.2 in the PEIR Volume 3 illustrates the impacts in the opening year.

6.4.13. Table 6.7 in the PEIR Volume 2 Appendix E shows the noise changes for all modelled receptors within the detailed calculation area in the long-term (future year) categorised into the noise change bands. The Option Selection Stage assessment did not take into account the more stringent impact categorisation used on properties that already exceed the SOAEL.

6.4.14. Table 6.7 in the PEIR Volume 2 Appendix E demonstrates that the majority of long-term changes in noise level due to the Scheme were predicted to be negligible. Minor noise increases were predicted at 3 residential properties and no non-residential properties. Minor noise decreases were calculated at 28 residential properties and no non-residential properties. There were no moderate or major changes in noise predicted. Figure 6.3 in the PEIR Volume 3 illustrates the impacts over the long term.

6.4.15. The results presented in Table 6.8 in the PEIR Volume 2 Appendix E for the identified Defra NIAs within the study area conclude that with the Scheme there are no adverse changes in road traffic noise levels in the long or short term that exceed 1dB, which suggests that there are no perceptible detrimental effects on these Important Areas.

6.4.16. The new alignment of the Bean southern roundabout is expected to minimise the potential increase in noise levels at Hope Cottages, with most benefit to the properties furthest from the A2.

6.4.17. Other potential changes to the Scheme, such as the slip road off the B258 and possible changes to Ebbsfleet roundabout, will be addressed in the ES once traffic data has been made available.

6.5. Potential mitigation measures

Construction

6.5.1. To mitigate any potential noise problems during the construction phase, the construction contractor should consult with the Environmental Health Departments at the relevant Local Planning Authorities to obtain guidance on their requirements for managing and controlling noise and vibration from construction works.

6.5.2. A CEMP will be created and implemented by the contractor and be approved by the Local Authorities prior to the commencement of construction works. The CEMP should outline the following:

- Environmental management and responsibilities;
- Monitoring and auditing processes;
- Procedures that will be used to complete different construction activities;
- Complaints response procedures; and
- Community and stakeholder liaison processes.

6.5.3. The contractor may also be able to submit a Section 61 application under the Control of Pollution Act 1974 for some construction works, especially if night-time working is proposed.

6.5.4. The contractor should also be encouraged to join (if not already a member) the Considerate Contractors Scheme that is recognised by industry and the Government for encouraging firms to be sensitive to the environment.

6.5.5. Good stakeholder relations are often the most effective way to manage potential noise impacts on site. Therefore, the contractor should keep local residents and other affected parties informed of the progress of the works, including when and where the noisiest activities will be taking place and how long they are expected to last. All noise complaints should be effectively recorded, investigated and addressed.

6.5.6. In addition, the contractor should use the following good working practices that will minimise impacts to local residents and ecological receptors:

- All vehicles and plant should be fitted with effective exhaust silencers which should be maintained in good and efficient working order;
- All compressors and generators should be 'sound reduced' models fitted with properly lined and sealed acoustic covers which should be kept closed whenever the machines are in use;

- All ancillary pneumatic percussive tools should be fitted with mufflers or suppressors as recommended by the manufacturers which should be kept in a good state of repair;
- Machines in intermittent use should be shut down when not in use or where this is impracticable, throttled down to a minimum;
- The site compound and static machines should be sited as far as is practicable from noise sensitive buildings;
- Where practicable, plant with directional noise characteristics should be orientated to minimise noise at nearby properties;
- Plant should be certified to meet the current EU legislation and should be not be louder than the noise levels provided in Annex C and D of BS5228-1;
- Where appropriate, temporary noise barriers or other noise containment measures should be installed to minimise construction noise levels;
- The loading or unloading of vehicles and the movement of equipment or materials should be undertaken in a manner that minimises noise generation;
- Concrete mixers should not be cleaned by hammering the drums; and
- When handling materials, care should be shown not to drop materials from excessive heights.

6.5.7. In addition to the above good working practices, if piling is required, the piling method should be selected carefully to minimise noise and vibration impacts at receptors. Where practicable, piling methods that result in low levels of vibration, such as rotary bored piling should be used. Methods that cause much higher levels of vibration, such as percussive piling, can cause cosmetic damage to buildings within 50 m of the construction works and should be avoided wherever possible.

6.5.8. Even with appropriate mitigation in place, it may not be possible to eliminate all noise impacts. However, best practice, considerate working hours as well as frequent and open communications with stakeholders will help to reduce the residual impact of construction noise and vibration.

Operation

6.5.9. The assessment of the Scheme indicated that minor impacts are predicted at up to 4 properties across the study area, with the majority being located in southern Bean. Although negligible impacts are generally expected as a result of the Scheme

6.5.10. Generally, a minor impact is not considered significant, however, the significance of the minor impacts cannot be determined until an assessment of the SOAEL has been carried out. An impact of 1dB or more at properties that exceed the SOAEL, as well as at NIAs, is considered significant.

6.5.11. Noise mitigation with regard to road traffic noise can consist of noise barriers, earth bunds, or low noise road surfacing, and may include any existing noise mitigation in situ that will be retained by the Scheme options.

6.5.12. It is understood that all new or modified roads proposed by the Scheme will be resurfaced with a low noise road surface. According to the DMRB, usage of a low noise road surface can reduce road traffic noise levels by up to 3.5dB $L_{A10,18h}$.

6.5.13. There are a number of existing noise barriers at the Bean end of the scheme which Highways England aim to retain or replace if disturbed during construction. Further assessment of potential mitigation requirements and options will be undertaken during the current design phase, once the scheme design, and the traffic model upon which the noise impact calculations are undertaken, are both suitably further developed. This will permit a robust appraisal of the suitability and viability of different mitigation options, if subsequently shown to be necessary.

6.6. Residual impacts

Construction

6.6.1. Using best practicable means and general good working practices during the construction phase will also reduce the occurrence of transient 'maximum' noise levels that can cause disturbance to local residents and ecological receptors.

6.6.2. Frequent and open communication with local residents will reduce the potential for impacts to occur and complaints to arise during the construction phase.

6.6.3. Temporary environmental noise barriers can reduce noise levels by up to 10dB, however, this depends on the barrier's dimensions and the position of the nearest receptors relative to the construction site. Once baseline noise monitoring results and construction phase information are available, further comments can be made as to whether temporary environmental noise barriers will sufficiently mitigate against significant adverse effects from construction noise and vibration.

Operation

6.6.4. Where necessary, the use of mitigation measures will reduce noise at locations already experiencing high road traffic noise levels, such as Important Areas, and locations predicted road traffic noise levels above the SOAEL due to the Scheme's proposals. This will reduce the number of properties where significant effects are predicted.

6.6.5. As mentioned above, the use of low noise road surfacing can reduce noise levels by up to 3.5 dB $L_{A10,18h}$. Usage of low noise road surfacing has been included in the design of the Scheme for new and modified roads as indicated in paragraph 6.5.12 above.

6.6.6. Environmental noise barriers can also achieve reductions in noise of up to 10dB depending on the length and height of the barrier and its position relative to the receptors and the Scheme. The benefits of environmental noise barriers will be investigated further during the Preliminary Design Stage upon receipt of updated traffic data for the Scheme.

6.7. Cumulative effects

6.7.1. The traffic model used as the basis of the noise assessment, takes into account the effects of major residential and employment developments proposed in the wider area, as these will affect traffic volumes. The impact of these developments is therefore considered in the operation phase assessment.

6.8. NPS compliance

6.8.1. In line with the national policy guidance included in Table 6.1 of the Planning and Policy Context section in the PEIR Volume 2 Appendix E, the Scheme aims to avoid significant adverse effects from noise and vibration as far as possible and to use mitigation measures to reduce significant adverse and adverse impacts. To date, this has been achieved by noise modelling different option variants of the Scheme in previous assessment stages to determine what impacts may occur and where, and which areas may require mitigation.

6.8.2. As the design of the preferred option progresses, the following activities will be undertaken in order to meet the national policy objectives:

- Further examination of locations where significant adverse impacts are predicted to determine the feasibility of noise mitigation options for these areas,
- Incorporation of mitigation measures to improve road traffic noise levels at Important Areas wherever possible,
- Replacement of existing noise barriers to maximise their efficacy when the Scheme is operational, and
- Investigation of noise mitigation measures for the ecological receptors.

6.9. Assumptions and limitations

6.9.1. At the Options Selections Stage, all impacts were considered to be minor as no properties experienced an increase in noise of 3dB or more in the short term, and 5dB or more in the long term. These were not considered significant, and did not take into consideration existing noise levels. In the ES, any increases in NIAs and increases of more than 1dB for properties already exceeding the daytime threshold, will be considered significant in the short and long term. This change in threshold may identify additional properties where these smaller increases in noise are now considered significant. If this is the case, and where feasible, additional noise mitigation will be included in the Scheme.

6.9.2. The noise assessment will be carried out for a study area which is at least 600 m, and no more than 1 km, from the Scheme.

6.9.3. The existing road surfaces and existing noise barriers will be modelled based on the data available from Highways England.

6.10. Summary

6.10.1. In order to meet the requirements for a Preliminary Design Stage noise and vibration assessment, baseline noise surveys will be undertaken at several locations within the study area to establish the prevailing noise climate. A construction noise and vibration assessment, using the BS 5228 methodology, will be completed to identify any impacts arising from the construction phase.

6.10.2. A "simple" DMRB noise assessment undertaken during the previous design phase highlighted the requirement for the project to proceed to a "detailed" DMRB assessment during the Preliminary Design Stage to confirm the level of operational noise impact for the preferred option. The detailed noise modelling

will incorporate new traffic data obtained from a strategic traffic model and any new mitigation measures incorporated into the design.

6.10.3. The results of the Option Selection Stage assessment showed that, in the short term, 4 receptors were predicted to suffer from an adverse increase in Road Traffic Noise of more than 1dB, this is classed as Minor Adverse. The dwellings are spread across the study area. There are 6 receptors predicted to benefit from a decrease in Road Traffic Noise in excess of 1dB, this is classed as a Minor Beneficial.

6.10.4. In the long term 3 receptors were predicted to suffer from an adverse increase in Road Traffic Noise of more than 3dB, this is classed as Minor Adverse. There are 28 receptors predicted to benefit from a decrease in Road Traffic Noise in excess of 3dB, this is classed as a Minor Beneficial.

6.10.5. When the detailed noise modelling has been undertaken for the latest Scheme design, the results from the detailed noise modelling will be assessed against the impact magnitude thresholds stated in the DMRB, and significance criteria for impacts to human health. Existing noise mitigation measures incorporated into the Scheme design and the need for additional mitigation measures will be reviewed based on these results.

Chapter 7 - Biodiversity

7.1. Introduction

7.1.1. This chapter provides a qualitative assessment as to whether there are likely to be any significant adverse ecological effects on nature conservation resources resulting from the implementation of the Scheme. In addition, this chapter identifies proposed mitigation and compensation options, some of which may lead to beneficial effects on nature conservation resources.

7.1.2. The Scheme design is described in detail in the PEIR Volume 1 Chapter 2 of this report.

7.1.3. This chapter provides details of the assessment undertaken to date, including the identification of potential mitigation measures that could reduce any adverse ecological impacts. It should be read in conjunction with the ecological information provided in the PEIR Volume 2 Appendix F, which lists the key legislation and policy, study area, methodology and tables for the biodiversity assessment and Figure 7.1 in the PEIR Volume 3.

7.1.4. This assessment is based on preliminary information available at the time of writing the report, and may change as a result of design changes, consultation and further ecological survey(s).

7.2. Consultation

7.2.1. To date the following environmental organisations have been consulted with regards to aspects of the Scheme such as option selection and design, potential mitigation and compensation features, and species survey methodologies:

- Natural England (option selection and design, potential mitigation and compensation features, and species survey methodologies);
- Environment Agency (option selection and design); and
- Kent Wildlife Trust (option selection and design, potential mitigation and compensation features).

7.2.2. Consultation will continue with these organisations throughout the Preliminary Design Stage, in order to ensure their input is incorporated into the impact assessment, the final design of the Scheme and its associated mitigation and compensation.

7.2.3. In addition to these organisations, consultation has commenced with the Forestry Commission and it is proposed that Kent County Council, Dartford Borough Council and Gravesham Borough Council will also be consulted during the Preliminary Design Stage regarding survey design and potential mitigation and compensation features.

7.3. Baseline conditions

Designated sites

7.3.1. There is one statutory site designated for its importance to nature conservation, located within the study area: Darenth Wood SSSI[1] (refer the PEIR Volume 2 Appendix D for relevant legislation). A summary of the site is provided in Table 7.4 in the PEIR Volume 2 Appendix F and the site is shown on the environmental constraints Map Figure 2.1 in the PEIR Volume 3. There are two further designated sites located within the study area: Baker's Hole SSSI located approximately 500 m north of the survey area and Swanscombe Skull Site SSSI and NNR located approximately 900 m north of the survey area. However, these sites are designated for their geological interest only and are not considered further in this chapter.

7.3.2. There are no special areas of conservation (SACs) located within the study area listing bats as one of the qualifying features. There are no internationally designated sites within the study area or located downstream from any watercourses connected to the survey area.

7.3.3. Two non-statutory LWSs were identified within the study area. A summary of these sites is provided in Table 7.5 in the PEIR Volume 2 Appendix F. There are no non-statutory designated RNRs located within study area.

7.3.4. Due to the location of Beacon Wood Country Park LWS and its distance, approximately 370 m south from the Scheme (at Bean Junction), it is not anticipated that there is any risk the site will be subject to any adverse effects as a result of the Scheme. Therefore, Beacon Wood Country Park LWS has been scoped out of further assessment.

Ancient Woodland (and veteran trees outside of ancient woodland)

7.3.5. There are six parcels of ancient woodland recorded as ancient semi-natural woodland (ASNW) on the Ancient Woodland Inventory within the study area. A summary of these is provided in Table 7.6 in the PEIR Volume 2 Appendix F and they are shown on the environmental constraints Figure 2.1 in the PEIR Volume 3.

7.3.6. The ancient woodland inventory mapped boundary indicates that The Thrift ancient woodland extends into the existing A2 westbound carriageway. However, this does not reflect the current situation. The road verge is the side of a cutting where all original vegetation and the original soil structure was removed, and the verge and carriageway do not support ancient woodland. The situation is subject to ongoing consultation with Natural England and the Forestry Commission. It is intended that for the purposes of this assessment, the ancient woodland boundary is treated as the noise barrier, at the actual woodland edge, so that the actual physical area of The Thrift ancient woodland is slightly smaller than the area listed in Table 7.6 in the PEIR Volume 2 Appendix F.

7.3.7. Beacon Wood ancient woodland is a small area of ancient woodland, located within Beacon Wood Country Park LWS. Due to the location of Beacon Wood ancient woodland and its distance, approximately 700 m south from the Scheme (at Bean Junction), it is not anticipated that there is any risk that the site will be

[1] Sites of Special Scientific Interest (SSSIs) are protected under the Wildlife and Countryside Act 1981 (as amended) and The Countryside and Rights of Way Act 2000.

subject to any adverse effects as a result of the Scheme. Therefore, Beacon Wood ancient woodland has been scoped out of further assessment.

7.3.8. The ancient woodlands identified in Table 7.6 in the PEIR Volume 2 Appendix F that are relevant to the Scheme also qualify as 'lowland mixed deciduous woodland' Habitats of Principal Importance (HPI). 'Mixed broad-leaved woodland [and plantations on ancient woodland sites]' is also Kent Biodiversity Action Plan (KBAP) priority habitat.

7.3.9. The Woodland Trust website identified no veteran trees located within 50 m of the survey area. However, an arboricultural assessment of the survey area has not yet been conducted. This survey, or a specific veteran tree survey may identify veteran trees located within the survey area.

Habitats

7.3.10. The habitats within the survey area mainly comprise of young plantation woodland (i.e. landscape planting resulting from previous road improvements) and semi-natural broadleaved woodland, with smaller areas of unimproved neutral grassland, species-rich semi-improved grassland, improved grassland and scrub along the road verges.

7.3.11. Young plantation woodland surrounds the A2, Bean and Ebbsfleet Junctions and is comprised of species such as hawthorn (*Crataegus monogyna*), wayfaring tree (*Viburnum lantana*), wild cherry (*Prunus avium*), blackthorn (*Prunus spinosa*), damson (*Prunus domesticus subs. insititia*), ash (*Fraxinus excelsior*) and horse-chestnut (*Aesculus hippocastanum*) interspersed with rough grassland.

7.3.12. Semi-natural broadleaved woodland is primarily located around Bean Interchange and comprised of a sycamore (*Acer pseudoplatanus*), scattered sessile oak (*Quercus petraea*) and hornbeam (*Carpinus betulus*) canopy with ivy (*Hedera helix)*-dominated ground flora. Other tree species found include ash, beech, silver birch, wild cherry and hazel. Areas of semi-natural broadleaved woodland qualify as ‘lowland mixed deciduous woodland’ HPI and ‘mixed broad-leaved woodland and plantations on ancient woodland sites’ KBAP priority habitat.

7.3.13. An area of wet woodland is present along the River Ebbsfleet, adjacent to the Scheme, north-west of Ebbsfleet Junction. The canopy comprised crack-willow (*Salix fragilis*) and grey willow (*Salix cinerea*) with a ground flora including watercress (*Nasturtium officinale*). Wet woodland is a HPI and a KBAP priority habitat.

7.3.14. An area of unimproved neutral grassland was recorded on the road verge adjacent to the A292 and Eastern Quarry Land, which supported a colony of man orchid. Unimproved neutral grassland is classified as ‘lowland meadows’ HPI and is also a KBAP priority habitat.

7.3.15. Two narrow bands of species-rich semi-improved grassland containing species such as annual meadow-grass (*Poa annua*), red fescue (*Festuca rubra*), common knapweed (*Centaurea nigra*), ox-eye daisy (*Leucanthemum vulgare*), common broomrape (*Orabanche minor*) and back medick (*Medicago lupulina*) are present within the survey area on Bean Lane and adjacent to the Scheme near Ebbsfleet Junction.

7.3.16. Semi-improved calcareous grassland containing species such as yellow-wort (*Blackstonia perfoliata*), marjoram (*Origanum vulgare*), wild basil (*Clinopodium vulgare*) and yellow oat-grass (*Trisetum flavescens*) is present adjacent to the Scheme west of, and on road verges within the survey area at, Bean Interchange. These areas qualify as 'lowland calcareous grassland' HPI, and are also KBAP priority habitat.

7.3.17. There are smaller areas of arable, improved, amenity and semi-improved (species poor) grassland, along with dense or continuous scrub, ephemeral/short perennial vegetation and hedgerows located within and adjacent to the survey area surrounding Ebbsfleet Junction and to the south of the A2 at Bean Junction. All native hedgerows within and adjacent to the Scheme are HPI.

7.3.18. The River Ebbsfleet is culverted beneath the A2 east of Ebbsfleet Junction and there are several ponds, ditches and lakes surrounding the survey area. 'Rivers' and 'ponds' are HPI and 'chalk rivers' and 'standing open water' are KBAP priority habitat. A small area of reedbed adjacent to River Ebbsfleet, within Ebbsfleet Marshes LWS adjacent to the Scheme qualifies as 'reedbed' HPI and KBAP priority habitat.

Notable and protected species

Notable plants

7.3.19. The desk study returned numerous records of notable plant species within the study area. These included two species, field eryngo and ground-pine, that are protected under Schedule 8 of the Wildlife and Countryside Act (as amended) and listed as species of principal importance (SPI)[2], which are considered unlikely to be present due to a lack of suitable habitat within the Scheme.

7.3.20. Recent records were also returned from the desk study for four orchid species; man orchid (*Orchis italica)*, common spotted-orchid (*Dactylorhiza fuchsia*), pyramidal orchid (*Anacamptis pyramidalis*) and bird's-nest orchid (*Neottia nidus-avis*). All except the latter were recorded within the survey area during the extended Phase 1 habitat surveys undertaken in May 2014, June 2015 and updated in June 2017. Man orchid, an SPI and KBAP priority species, was recorded at three locations within the survey area.

7.3.21. Further NVC surveys may be necessary during the Preliminary Design Stage in areas of high botanical interest (i.e. ancient woodland and species rich grassland) in order to update existing data and inform Detailed Design.

Invertebrates - Terrestrial

7.3.22. The desk study provided records of a number of invertebrate species within study area, the majority of which were records of notable moths, but also included records of four butterfly species: grizzled skipper (*Pyrgus malvae*), small heath (*Coenonympha pamphilus*), grayling (*Hipparchia semele*), and wall (*Lasiommata megera*). These, along with the following: Duffey's bell-head spider (*Baryphyma duffeyi*); stag beetle (*Lucanus cervus*); phoenix fly (*Dorycera graminum*); brown-banded carder-bee (*Bombus humilis*); moss carder-bee (*Bombus (T.) muscorum*); red-shanked carder-bee (*Bombus (T.*) *ruderarius*); five-banded

[2] Species of Principal Importance for the Conservation of Biological Diversity in England are notified under Section 41 of the NERC Act 2006

weevil-wasp (*Cerceris quinquefasciata*) and black-headed mason wasp (*Odynerus melanocephalus*), are all SPI.

7.3.23. Habitats of potential value for terrestrial invertebrates include species-rich grassland within the survey area and the area of mature coppice woodland within Darenth Wood SSSI, which lies adjacent to the survey area west of Bean Junction. Ancient woodland and semi-natural broadleaved woodland HPI within the survey area also offer potentially suitable habitat for notable terrestrial invertebrates, such as stag beetle. However, this will be confirmed upon the results of further surveys during the Preliminary Design Stage.

7.3.24. Relatively young plantation woodland, scrub and regularly-mown grassland within the survey area are only likely to support limited assemblages of common terrestrial invertebrate species and none of these habitats are considered sufficiently large or diverse to support assemblages of notable invertebrates.

Invertebrates - Aquatic

7.3.25. The desk study provided no records of notable aquatic invertebrates within the study area.

7.3.26. A desk review of survey reports found that no notable aquatic species were recorded as part of the Ebbsfleet Valley Joint Monitoring Strategy (Middlemarch, 2014b) during aquatic macro-invertebrate surveys of the Ebbsfleet and two nearby waterbodies, one of which is located near the survey area (Middlemarch, 2014). The stream samples were generally dominated by taxa such as molluscs, worms and chironomids; species that are relatively pollution-tolerant or characteristic of slow-flowing, anaerobic water conditions. The water body samples indicated poor water quality.

7.3.27. Considering the hard-engineered nature of the River Ebbsfleet corridor, which is culverted beneath the A2 and High Speed 1 for over 700 m, within and adjacent to the survey area, it is considered unlikely to support diverse or notable assemblages of aquatic invertebrates. However, this will be confirmed during the Preliminary Design Stage.

Amphibians

7.3.28. The desk study returned records of great crested newts within the study area. The Kent Wildlife Trust citation for Ebbsfleet Marshes LWS confirms that great crested newts have been observed within the site. There were also historical records (maximum 67 adults in 1996) from Beacon Wood Country Park, which is located 370 m south of Bean and the A2.

7.3.29. Records of common toad (*Bufo bufo*), an SPI, and three other species of amphibian: smooth newt (*Lissotriton vulgaris*), palmate newt (*Lissotriton helveticus*) and common frog (*Rana temporaria*) were also returned from the desk study.

7.3.30. A desk review of survey reports from adjacent developments found that one great crested newt was recorded during a translocation operation on Eastern Quarry Land in 2005 and was moved to ponds in the north-west part of the quarry site. No great crested newts have been recorded since this date during annual monitoring of the quarry ponds (Middlemarch 2016a). Surveys undertaken at Bluewater Retail Park in 2013 for great crested newts and other amphibians confirmed absence of these species in ponds around the retail park (Wildthing

Wildlife Consultants, 2013 - see PEIR Volume 1 Chapter 17 References). Finally, an eDNA survey undertaken in 2013 for pond 16, located 195 m south from the survey area confirmed the likely absence of great crested newts (Landscape Planning Limited, 2013 - see PEIR Volume 1 Chapter 17 References).

7.3.31. The desk study identified potentially suitable terrestrial and aquatic habitat that could be used by great crested newts[3], including 17 waterbodies within 500 m of the survey area[4], three of which were identified during the extended Phase 1 habitat survey.

7.3.32. During May 2015, a total of seven waterbodies achieved a total score of 0.6 ('average' suitability) or above using the HSI assessment method and were subject to presence / likely absence surveys using the great crested newt eDNA survey method in June 2015, which confirmed that two ponds (22a and 24a, located 305 m and 960 m east from the Scheme, respectively) contained great crested newts. However, after a review of the Scheme design in spring 2017, it was determined that pond 24a was located more than 1 km from the Scheme boundary, and any population contained in this pond was considered unlikely to be affected by the Scheme.

7.3.33. In May 2017, one additional pond (13) was subject to presence / likely absence surveys using the eDNA survey method and one re-sample was taken from pond 22a due to previously limited access. Standard survey techniques were used concurrently with the eDNA survey method during four presence / likely absence surveys of these two ponds. The results determined that great crested newts were absent from ponds 13 and 22a in 2017.

7.3.34. The survey results combined with the desk study data indicate that great crested newts may be present in aquatic and terrestrial habitats surrounding the A2, Bean and Ebbsfleet Junctions. However, further surveys will be required during the Preliminary Design Stage to update existing data. It is also possible that suitable aquatic and terrestrial habitats support other species of amphibians (e.g. common toad, common frog, palmate and smooth newt) within and adjacent to the survey area.

Reptiles

7.3.35. The desk study identified records of common lizard (*Zootoca vivipara*), grass snake (*Natrix natrix*), slow worm (*Anguis fragilis*), and adder (*Vipera berus*) within the study area. The Kent Wildlife Trust citation for Ebbsfleet Marshes LWS states that slow-worms and grass snakes have been observed within the LWS, and this was confirmed by the records provided by the Kent and Medway Biological Records Centre (KMBRC). There were also four records of adder from locations within Beacon Wood Country Park LWS and Darenth Wood SSSI.

7.3.36. A review of previous survey reports from adjacent developments found that slow-worms, common lizards and grass snakes have been recorded consistently during annual monitoring surveys undertaken between 2006 and 2016 within Eastern Quarry Land (Middlemarch, 2016b - see PEIR Volume 1 Chapter 17 References).

[3] Excluding waterbodies where there would be a major barrier to the movement of newts (e.g. major roads, residential areas) between the waterbody and the Scheme.
[4] This review excluded the seven lakes at Bluewater Retail Park and the ponds within Eastern Quarry because recent great crested newt survey information was already available for these waterbodies.

7.3.37. During the extended Phase 1 habitat survey carried out in 2014 and 2017, slow-worms and common lizards were recorded several times within the survey area. These records comprised of slow-worms to the west and east of Bean Lane within semi-improved grassland, young plantation woodland, bare ground and dense scrub mosaic habitats, and records of slow-worms and common lizards east of Ebbsfleet Junction and in Eastern Quarry Land within grassland/scrub habitats. Suitable reptile habitats, such as grassland, scrub, woodland and bare ground, have been recorded within the survey area.

7.3.38. Reptile presence / likely absence surveys were carried out during August and September 2017 by HHJV to identify the distribution and indicate a population size estimate for these species within the survey area. During the 2017 surveys, a total of three reptile species: slow-worm, common lizard and grass snake were recorded in relatively low numbers surrounding Bean and Ebbsfleet Junctions. Anecdotal (unconfirmed) evidence of adder was reported near Bean Junction. However, none were recorded during the surveys. This species is therefore considered to be present in individual or low numbers, or possibly absent from the survey area.

7.3.39. The desk study combined with the survey results confirm that low numbers of slow-worm, common lizard and grass snake (and possibly adder), all SPI, are present in areas of suitable habitat surrounding Bean and Ebbsfleet Junctions, which extend north and south of the A2 adjacent to the carriageway.

Birds

7.3.40. The desk study identified a number of protected and rare species of bird within the study area, including those mainly associated with wetlands and the quarries to the north of the A2. Records included peregrine falcon (*Falco peregrinus*), hobby (*Falco subbuteo*), black redstart (*Phoenicurus ochruros*) and kingfisher (*Alcedo atthis*), which are listed on Schedule 1 of the Wildlife and Countryside Act 1981 (as amended).

7.3.41. A breeding bird survey undertaken on Eastern Quarry Land in 2014 and 2016 for the site's BAP Monitoring and Management Plan (Middlemarch 2016c - see PEIR Volume 1 Chapter 17 References) recorded a diverse range of breeding bird species. A total of 57 bird species were recorded, of which 47 were thought to have bred within the Eastern Quarry Land survey area, based on breeding behaviour observed and/or habitats present. Of the species recorded, four are SPI: dunnock (*Prunella modularis*), linnet (*Carduelis cannabina*), skylark (*Alauda arvensis*) and song thrush (*Turdus philomelos*). Linnet, pochard (*Aythya ferina*), skylark and song thrush are also Red Listed Birds of Conservation Concern (BoCC) (British Trust for Ornithology, BTO, 2015 - see PEIR Volume 1 Chapter 17 References). The mosaic of habitats within Eastern Quarry Land are outside of the survey area and do not extend within the survey area. Therefore, it is considered unlikely that important assemblages of notable bird species would be present in habitats located within the survey area. This will be confirmed during the Preliminary Design Stage.

7.3.42. The banks of the River Ebbsfleet within Ebbsfleet Marshes LWS may have the potential to support nesting kingfisher. However, due to the hard-engineered nature of the River Ebbsfleet, adjacent to the Scheme, which is culverted under the A2 and High Speed 1 for over 700 m, no nesting habitat is present within or

adjacent to the survey area. This will be confirmed during the Preliminary Design Stage.

7.3.43. Suitable nesting habitat, such as grassland, scrub and woodland, has been recorded within the survey area during extended Phase 1 habitat surveys. These areas have the potential to support common and widespread species including individual/small numbers of notable species such as dunnock and song thrush.

Bats

7.3.44. The desk study returned records for 11 bat species within the study area, comprised of, serotine (*Eptesicus serotinus*), Brandt's (*Myotis brandtii*), Daubenton's bat (*Myotis daubentonii*), whiskered bat (*Myotis mystacinus*), Natterer's bat (*Myotis nattereri*), Leislers (*Nyctalus leisleri*), noctule (*Nyctalus noctula*), Nathusius' pipistrelle (*Pipistrellus nathusii*), common pipistrelle (*P. pipistrellus*), soprano pipistrelle (*P. pygmaeus*) and brown long-eared bat (*Plecotus auritus*).

7.3.45. No records of bat roosts were provided from within the survey area. However, 12 records of bat roosts were identified from within 5 km of the survey area including two roosts in Darenth Wood SSSI, one supporting 21 Myotis sp. bats, and another supporting a hibernation roost where Daubenton's bat, Natterer's bat, Brandt's / whiskered bat, brown long-eared bat and common and soprano pipistrelle have all been recorded. In addition, a pipistrelle maternity roost supporting at least 76 bats was identified from the Swanscombe residential area to the north of the survey area. Roosts were also identified to the south-west of the Ebbsfleet Junction and at the far eastern end of the survey area. Smaller roosts (typically of a single bat) were identified at Darenth Country Park on the eastern edge of Bean, in Gravesend and at two locations in Northfleet. No bat roosts have so far been identified within Eastern Quarry during the annual bat monitoring surveys, which have been undertaken since 2006 (Middlemarch, 2014a - see PEIR Volume 1 Chapter 17 References).

7.3.46. The extended Phase 1 habitat survey identified 11 buildings within or adjacent to the survey area with potential to support roosting bats: Ightham Cottages, one stable block and three outbuildings. A daytime internal and external building inspection carried out in May and June 2017 found that three of the cottages had negligible potential and three had low potential to support roosting bats. The stables also had low potential and the outbuildings had negligible potential to support roosting bats. A presence / likely absence dawn re-entry survey undertaken in June 2017 recorded no bat roosts within the buildings. During the survey, a small number of common species (common and soprano pipistrelles) and two Myotis sp. calls were heard in the woodland to the north-east of Ightham Cottages and occasional bats were heard commuting along Bean Lane. To date, no bat roosts have been found in buildings within the survey area. However, further presence/likely absence bat surveys will need to be carried out during the Preliminary Design Stage for structures with low to high potential to support roosting bats in order to obtain a complete data set.

7.3.47. The extended Phase 1 habitat survey identified 11 trees within or adjacent to the survey area with features suitable to support roosting bats. Four trees were assessed as having features with moderate roosting potential (trees BT4, BT5, BT6 and BT11), six as having low roosting potential (trees BT2, BT3, BT7, BT8, BT9 and BT10) and one as having negligible potential (tree BT1). Three of the

trees (trees BT1, BT2 and BT3) were located within the survey area. Tree BT1 was found to be unsuitable for roosting bats and BT 2 and BT3 had low potential to support roosting bats. One tree (BT11) located immediately adjacent to the survey area had moderate potential to support roosting bats. Further presence/likely absence surveys will need to be carried out during the Preliminary Design Stage for trees with moderate or high potential to support roosting bats.

7.3.48. Two wooden bat boxes on semi-mature trees, approx. 1.5 m above ground level in the horse sanctuary paddock, within the survey area, were inspected in June 2017 for evidence of use by roosting bats. No evidence was found. An update inspection of these boxes will be carried out during the Preliminary Design Stage.

7.3.49. Bat activity transect surveys were carried out in June and September 2017 within the survey area at the Bean Interchange, close to Ightham Cottages and the adjacent horse sanctuary, which recorded low levels of bat activity from common and soprano pipistrelle bats. Individual noctule and *Myotis* sp. were recorded during the September 2017 survey. One final transect survey will need to be undertaken during the Preliminary Design Stage (in spring) to complete the data set.

Hazel Dormouse

7.3.50. The desk study returned records of hazel dormice on both the north and south sides of the A2 with good connectivity to habitats within the study area. A hazel dormouse monitoring report provided by Bluewater Retail Park (Wildthing Wildlife Consultants, 2012 - see PEIR 1 Chapter 17 References) gave evidence that hazel dormouse had been recorded within the strip of woodland north of the A296 in 2010, 2011 and 2014. Historical records from 2001 and 2002 show hazel dormouse as being present within Darenth Wood SSSI, adjacent to the survey area. The latest hazel dormouse monitoring report for Eastern Quarry Land (Middlemarch, 2016d – see PEIR 1 Chapter 17 References) revealed that hazel dormice are present within the south of the Eastern Quarry Land site, which borders the A2 adjacent to the survey area.

7.3.51. The extended Phase 1 habitat survey identified habitats within and adjacent to the survey area that were considered suitable to support hazel dormice. These include ancient, broadleaved and young plantation woodland and scrub.

7.3.52. Hazel dormouse surveys carried out within and adjacent to the survey area in 2014 found evidence of hazel dormice (e.g. individuals or hazel dormouse nests) in three locations: two within landscape planting to the north of the A2, and one on the northern edge of the woodland within the Bean Interchange (i.e. Bean Triangle). Further hazel dormouse surveys carried out in 2017 found the presence of hazel dormice in The Thrift ancient woodland and the road verge between the westbound A2 carriageway and Bean Lane.

7.3.53. The survey results combined with the desk study data indicate that hazel dormice are widespread in the areas surrounding the A2, Bean and Ebbsfleet Junctions and are present in suitable habitats (e.g. woodland and scrub) within and adjacent to the survey area. This includes confirmed presence in the relatively young landscape planting surrounding the road network.

7.3.54. Further hazel dormouse surveys may be required during the Preliminary Design Stage to update existing data (to be confirmed by consultation with Natural England).

Otter and Water Vole

7.3.55. The desk study returned no records of otters or water vole within the study area. However, a desk review of previous survey reports found that numerous and regular signs of water vole have been recorded in the Ebbsfleet Development Area (adjacent to the survey area) in 2004 then annually between 2006 and 2014 (Middlemarch, 2014b see PEIR 1 Chapter 17 References). It was reported that, based upon the total number of field signs, the population of water voles associated with the entire Ebbsfleet stream corridor is considered to be approximately 17 individuals.

7.3.56. It was identified during the extended Phase 1 habitat survey that the Ebbsfleet runs through Ebbsfleet Marshes LWS and is culverted for over 700 m beneath the A2 and High Speed 1 east of Ebbsfleet Junction. The River Ebbsfleet offers suitable commuting habitat for otter and water vole, which has been confirmed by records of water vole reported in Ebbsfleet Marshes LWS. However, suitable habitat for foraging and commuting otters is limited along the culvert and south of the A2 where the source of the River Ebbsfleet is a series of field drains located across agricultural land. Similarly, due to its culverted nature, the section of the River Ebbsfleet immediately adjacent to the A2 is hard-engineered and not considered suitable to support otter holts or lay-ups and/or water vole burrows.

7.3.57. No signs of otter or water vole were identified through incidental observation during the extended Phase 1 habitat survey within and adjacent to the survey area. However, a full survey was not undertaken. It was noted that there is no suitable habitat for otter holts or water vole burrows within the section of watercourse within and immediately adjacent to the survey area. This will be confirmed during the Preliminary Design Stage.

Badger

7.3.58. The desk study returned five records of badgers and 11 records of dead badgers within the study area.

7.3.59. A total of seven badger setts were identified within and adjacent to the survey area during the extended Phase 1 habitat surveys carried out in 2014 and 2017. These included two active setts, a partially-used outlier sett, one disused outlier sett, two outlier setts and one small main or subsidiary sett, and one disused sett.

7.3.60. Further badger surveys will be undertaken during the Preliminary Design Stage to update existing data.

Non-native invasive plant species

7.3.61. The desk study returned a number of records for non-native invasive plant species listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended)[5] within the study area. The most recent records include Canadian waterweed (*Elodea canadensis*), Virginia creeper (*Parthenocissus quinquefolia*),

[5] It is illegal to plant or otherwise cause these species to grow in the wild.

New Zealand pygmyweed (*Crassula helmsii*) and yellow archangel (*Lamiastrum galeobdolon subsp. argentatum*).

7.3.62. The following species were recorded during the extended Phase 1 habitat survey: Japanese knotweed (*Fallopia japonica*), Japanese rose (*Rosa rugosa*), and Giant-rhubarb (*Gunnera tinctoria*). Of the non-native invasive plant species recorded during the extended Phase 1 habitat surveys, only Japanese rose is located within the survey area.

7.3.63. Further invasive plant species surveys may be required during the Preliminary Design Stage in order to update existing data and inform Detailed Design.

7.4. Potential impacts

Valuation of resources

7.4.1. A preliminary valuation of nature conservation resources relevant to the Scheme is provided below. This will be further informed by the results of ecological surveys to be carried out during the Preliminary Design Stage and will be confirmed in consultation with Natural England.

Designated sites

7.4.2. Darenth Wood SSSI, located adjacent to the survey area, west of Bean Junction, has *National* value and Ebbsfleet Marshes LWS, located adjacent to the survey area, east of Ebbsfleet Junction has *County* value, in line with their statutory and non-statutory designations, respectively.

Ancient woodland[6]

7.4.3. Darenth Wood ancient woodland, located adjacent to the Survey Area north and south of the A2, west of Bean Junction, covers the same area as Darenth Wood SSSI and is considered to be of *National* value, in line with its statutory designation.

7.4.4. Other ancient woodlands in close proximity to the A2 include The Thrift, two small unnamed woods north of the A2 in Bean Triangle, and Parkhill Wood. None of these are within designated sites. Where ancient woodland is relatively common, as in Kent, there are often examples that are of SSSI quality (and therefore National value) or of LWS quality (and therefore County value) that are not covered by a designation. Therefore, as required by IAN 130/10, as inclusion on the Ancient Woodland Inventory does not itself indicate a specific level of value, the examples present in close proximity to the Scheme will be valued based on the Joint Nature Conservation Committee (JNCC) SSSI and Kent County LWS criteria for site selection, ecological survey data, and in consultation with Natural England.

7.4.5. Ancient woodland is an irreplaceable habitat, and whatever nature conservation valuation is placed on an individual ancient woodland, whether an ASNW or a plantation on an ancient woodland site (PAWS), it has that ASNW or PAWS status and the resultant strong policy protection.

[6] All ancient woodland is irreplaceable habitat.

Notable habitats

7.4.6. Lowland mixed deciduous woodland HPI (most of which is ancient woodland) adjacent to the survey area west of Bean Junction, that falls within Darenth Wood SSSI, is the main reason for the sites designation, and is therefore of *National* value for nature conservation in line with the site's statutory designation.

7.4.7. The parcels of lowland mixed deciduous woodland HPI that fall within ancient woodland sites within and adjacent to the Scheme, where not designated, are considered to be of nature conservation value according to the levels assigned for ancient woodland sites above.

7.4.8. Lowland mixed deciduous woodland HPI where not designated and/or ancient woodland, is considered to be of *Local* value.

7.4.9. Other notable habitats identified during the extended Phase 1 habitat surveys within and adjacent to the survey area were: rivers (River Ebbsfleet), ponds, arable field margins, hedgerows, lowland meadows and lowland calcareous grassland, which are all HPI (or potential HPI) and are considered to be of *Local* value.

7.4.10. The remaining habitats within and adjacent to the survey area, including species-poor grassland, often forming a mosaic with tall ruderal, scrub vegetation and young plantation woodland, are considered to be of less than *Local* value for nature conservation.

Notable and legally protected species

7.4.11. Notable and legally protected species recorded within the survey area, such as widespread reptile species, noctule bat, soprano pipistrelle bat, brown long-eared bat, hazel dormice and man orchid are SPI. Other notable and legally protected species confirmed or considered likely to be present within and adjacent to the survey area include the following wider groups: terrestrial invertebrates, bats, nesting birds and badgers, some species of which are SPI. The potential presence of great crested newts (SPI), otter (SPI), water vole (SPI), aquatic invertebrates, and other notable plant species will be confirmed upon the results of further surveys to be undertaken during the Preliminary Design Stage. However, based on desk study data, ecological surveys undertaken to date and initial assessments, it is considered that the survey area and its immediate surrounds only supports populations of notable and/or legally protected species valued at up to the *Local* scale. Valuation of notable and legally protected species will be confirmed upon receipt of results from completed further surveys to be undertaken during the Preliminary Design Stage and will be used to inform the assessment in the ES.

7.4.12. Invasive non-native plant species will not have a nature conservation value. However, they are considered in this report due to the legal requirements to avoid the spread of such species.

Characterisation of impacts (change)

7.4.13. Potential impacts relating to nature conservation resources are detailed below prior to mitigation.

Designated sites

7.4.14. A Habitats Regulations Assessment (HRA)- Screening is being undertaken for this Scheme, to ensure that any potential impacts on European designated sites are identified and assessed, in consultation with Natural England. Initial findings indicate that no likely significant effects are anticipated as a result of the Scheme. This is based on the absence of European designated sites within the study area, which was set out according to DMRB standard guidance (DfT, 2009). The results of further air quality assessment to be undertaken during the Preliminary Design Stage will be reviewed to determine potential impacts on European designated sites located further afield, and the HRA – Screening will be updated, if required.

7.4.15. There will be no direct habitat loss from Darenth Wood SSSI. However, some very limited localised vegetation clearance may be required within the highways boundary to the north and south of the A2, adjacent to Darenth Wood SSSI, which could increase the sensitivity of the ancient woodland plant communities close to the highway, particularly where the existing vegetative buffer is narrow between the A2 and Darenth Wood SSSI.

7.4.16. Initial air quality assessment indicates that improved traffic flow near Darenth Wood SSSI will improve air quality adjacent to the designated site during operation (see the PEIR Volume 1 Chapter 5 Air Quality for further information). Due to the objective of the Scheme, which is to manage and improve existing traffic flow, rather than increase traffic volume, it is not anticipated that there will be indirect impacts on designated sites located at a further distance from the Scheme. However, further air quality assessment is required during the Preliminary Design Stage to identify and assess impacts to any other designated sites that may be affected during construction and operation of the Scheme.

7.4.17. The Scheme has potential to cause indirect impacts to Darenth Wood SSSI resulting from air and/or groundwater pollution during construction and operation of the Scheme.

7.4.18. There will be no direct habitat loss from Ebbsfleet Marshes LWS. However, the Scheme has potential to cause indirect impacts resulting from air and/or water pollution during construction and operation. Further air quality assessment is required during the Preliminary Design Stage to inform potential impacts and assessment.

7.4.19. See Chapter 8 Water and Drainage regarding potential indirect impacts to designated sites resulting from groundwater pollution during operation of the Scheme.

Ancient woodland

7.4.20. The Scheme has potential to directly impact two small unnamed parcels of ancient woodland adjacent the A2 to the north, by a small amount of land take at the edge of the woodlands to accommodate a new eastbound on-slip from the Bean northern roundabout. All ancient woodland is irreplaceable habitat which, once lost, cannot be recreated. Therefore, options to avoid ancient woodland loss

are being explored during the Preliminary Design Stage, including a departure from standard for narrow lanes at this location.

7.4.21. Based on existing data, it is anticipated that loss of ancient woodland in these two areas can be avoided. However, until this can be confirmed through the results of surveys to be undertaken during the Preliminary Design Stage, potential loss is reported.

7.4.22. As noted above, some very limited localised vegetation clearance may be required within the highways boundary to the north and south of the A2, adjacent to Darenth Wood SSSI and ancient woodland, and adjacent to the other ancient woodlands, which could increase the sensitivity of the plant communities close to the highway, particularly where the existing vegetative buffer is narrow between the A2 and ancient woodland.

7.4.23. The Scheme is located adjacent to Darenth Wood ancient woodland (also Darenth Wood SSSI), The Thrift ancient woodland and Parkhill Wood ancient woodland. Therefore, the Scheme has the potential to cause indirect impacts to these ancient woodlands and the two unnamed ancient woodlands, resulting from air and/or groundwater pollution during construction and operation of the Scheme.

7.4.24. As noted above, initial air quality assessments indicate that improved traffic flow near Darenth Wood SSSI and ancient woodland will improve air quality adjacent to the site during operation. However, further air quality assessment is required during the Preliminary Design Stage to assess potential impacts on ancient woodland during construction and operation of the Scheme.

7.4.25. See the PEIR Volume 1 Chapter 8 Water and Drainage regarding potential impacts on ancient woodland resulting from ground water pollution during operation of the Scheme.

Notable habitats

7.4.26. The Scheme will cause the direct loss of notable habitats including HPI (lowland mixed deciduous woodland) and potential HPIs (lowland meadows, lowland calcareous grassland and ponds) through permanent and temporary habitat clearance during construction.

7.4.27. The Scheme is located adjacent to lowland mixed deciduous woodland HPI and potential HPIs, such as lowland meadows, lowland calcareous grassland, arable field margins, hedgerows and River Ebbsfleet, and has potential to cause indirect impacts resulting from air and/or water pollution during construction.

7.4.28. See the PEIR Volume 1 Chapter 5 Air Quality and Chapter 8 Water and Drainage for further details.

Notable and legally protected species

7.4.29. There is potential for the Scheme to cause direct and indirect impacts on notable species through permanent and temporary loss and/or fragmentation of habitats and increased disturbance (e.g. noise/visual) to habitats located adjacent to the Scheme during construction. However, all habitat loss will occur directly adjacent to the road network and the majority of habitats supporting notable and protected species will be retained in the adjacent landscape. There is potential for the Scheme to have direct and indirect impacts on legally protected species

(including European Protected Species), including killing, injury or disturbance, and permanent or temporary habitat loss during construction.

7.4.30. There is potential for the Scheme to cause indirect impacts on notable species as a result of disturbance (e.g. from noise / light) during operation.

7.5. Potential mitigation measures

7.5.1. Based on the current understanding of the potential impacts of the Scheme, mitigation measures have been considered for incorporation into the Scheme design in order to avoid and/or reduce the significance of any adverse impacts on valued nature conservation resources:

- The design will consider existing valued nature conservation resources including designated sites, ancient woodland and notable habitats (in particular broadleaved and plantation woodland, species-rich hedgerows and species-rich semi-improved grassland). Wherever possible the Scheme will be designed to avoid these resources, and where there is permanent loss or fragmentation of notable habitats, this will be kept to the minimum as far as possible;
- Location of access tracks/haul roads and site compound/material storage areas will be sited outside of ancient woodland and notable habitats;
- Advanced planting will be considered in collaboration with Landscape to provide habitats suitable to support notable and legally protected species to mitigate for temporary habitat clearance during construction;
- Maintenance and, where possible, enhancement of habitat connectivity and commuting routes for notable species and other wildlife, including underpasses, sensitive culvert design, and maintaining habitat connections where possible;
- Consideration will be given to the potential translocation of turfs containing populations of notable plant species (e.g. man orchid) to suitable habitat adjacent to the Scheme;
- Replanting of temporarily cleared areas with native woodland and species-rich grassland to mitigate for the loss of similar habitats, which will also provide suitable habitat for notable terrestrial invertebrates;
- Replanting of temporarily cleared areas with new grassland and scrub planting, including installation of log piles from trees felled during construction, to mitigate for the loss of reptile habitat adjacent to the road network;
- Replanting of temporarily cleared areas with new tree and scrub planting, including bird and bat boxes to mitigate for the loss of potential features within buildings and cleared areas of woodland vegetation adjacent to the road network;
- Replanting of temporarily cleared areas with new native tree planting with understorey shrubs to mitigate for the loss of habitat suitable for hazel dormouse adjacent to the road network;
- New road lighting to be designed sensitively taking into consideration the presence of commuting and/or foraging bats and other wildlife, including

measures to avoid and/or minimise light spill onto adjacent vegetation, particularly Darenth Wood SSSI; and ancient woodland; and

- Mitigation measures will be implemented as set out in Chapter's 5-8 to avoid and/or reduce the significance of any potential effects caused by air, water and/or noise pollution.

7.5.2. In order to avoid or minimise any potential habitat damage, loss and disturbance to notable and legally protected species caused by the construction works, good practice methodology, including a Construction Environmental Management Plan (CEMP), would be followed for all construction operations. The CEMP is likely to include the following measures:

- Protection of designated sites, ancient woodland, and other notable habitats outside the working area from accidental incursion;
- Protection of retained trees following standard practice;
- Use of mitigation measures under licence if habitats or features afforded legal protection due to their use by protected species (such as badger, bat roosts, or hazel dormouse habitat) would be damaged during the works;
- Use of precautionary method of working during construction to minimise risk to individual animals of protected species where licences would not be required; such as avoiding sensitive seasons for notable or legally protected species (i.e. bird breeding season); and
- Provision of an Ecological Clerk of Works to advise on the above measures during construction.

7.5.3. This assessment, and consultation with Natural England, will identify requirements for ecological monitoring during and after construction. This may include monitoring for individual species, particularly if any European Protected Species mitigation licences are required, and will include monitoring of newly created habitats to inform decisions on their ongoing maintenance.

Significant effects

7.5.4. Initial noise assessments indicate that the Scheme will be largely beneficial and noise levels within the surrounding areas may be reduced as a result of the Scheme. However, the effect of these changes on the adjacent designated sites will be assessed during the Preliminary Design Stage (refer to the PEIR Volume 1 Chapter 6 Noise for further details).

7.5.5. Initial air quality assessments indicate that emissions may decrease adjacent to Darenth Wood SSSI and ancient woodland as a result of the Scheme, due to a reduction in traffic flow near this site. A decrease in NOx concentrations and nitrogen deposition rates at Darenth Wood SSSI and ancient woodland would not cause an adverse impact and could be beneficial for ancient woodland plant species and notable terrestrial invertebrates present within this site. However, the effect of these changes on the adjacent designated sites and ancient woodland will be assessed during the Preliminary Design Stage (refer to the PEIR Volume 1 Chapter 5 Air Quality for further details).

7.5.6. A precautionary approach has been taken to identifying the residual significance of effects of the Scheme and it is likely that some may be reduced through mitigation by design (as described in section 7.5 above) or other measures. The

potential significance of effects of the Scheme on each nature conservation resource (with mitigation) are detailed in Table 7.7 in the PEIR Volume 2 Appendix F.

7.6. Residual impacts

7.6.1. Whilst the potential mitigation measures described above will help to reduce the impacts of the Scheme on valued nature conservation resources (i.e. designated sites, ancient woodland, notable habitats and notable and legally protected species), it appears that the Scheme may involve unavoidable land take from the edge of two small unnamed areas of ancient woodland located adjacent the A2 to the north, east of Bean Junction. Ancient woodland is an irreplaceable habitat, and whatever nature conservation valuation is placed on an individual ancient woodland, whether an ASNW or a PAWS, it has that status and the resultant strong policy protection. Existing data indicates that ancient woodland loss in these two areas can be avoided. However, until this can be confirmed through the results of surveys to be undertaken during the Preliminary Design Stage, potential loss is reported.

7.6.2. If design cannot avoid the loss of land within ancient woodland, the residual impacts of the Scheme will include loss of irreplaceable habitat. During the Preliminary Design Stage, efforts will continue to avoid this loss completely or reduce it. However, due to the potential residual loss of irreplaceable habitat, it is acknowledged that compensation measures will be required in the event that permanent loss of ancient woodland cannot be avoided.

7.6.3. Consultation with Natural England and the Forestry Commission will inform proposals for a compensation package, if required, which is likely to involve the creation of newly planted broadleaved woodland and an ongoing management regime to ensure the successful establishment of new woodland. The establishment of new broadleaved woodland will aim to increase the area of continuous woodland habitat surrounding Bean Junction and provide additional suitable continuous habitat for hazel dormice (a European Protected Species).

7.6.4. Providing mitigation measures are put in place to protect the designated sites (Darenth Wood SSSI and Ebbsfleet Marshes LWS) from pollution and accidental incursion, and habitat clearance within the highways boundary is kept to the minimum where adjacent to designated sites and ancient woodland, no significant adverse effects are anticipated on these designated sites as a result of the Scheme.

7.6.5. Providing mitigation and habitat protection measures are put in place, the Scheme has the potential to have a slight adverse effect on notable habitats and populations of notable and legally protected species. However, it is anticipated that this will reduce over time and be neutral in the long-term once replacement habitats have been established and vegetation matures adjacent to the Scheme.

7.7. Cumulative effects

7.7.1. It understood that there are a number of projects and plans that could potentially lead to cumulative effects when combined with the Scheme.

Highways projects

7.7.2. The following proposed highway interventions are proposed within the study area:

- Lower Thames Crossing - new road crossing connecting Essex and Kent. Located east of Gravesend and Tilbury.

7.7.3. Lower Thames Crossing is likely to add to habitat loss within Kent, particularly through the additional loss of ancient woodland. It is assumed that mitigation and compensation measures would be incorporated into the detailed design in order to avoid and/or minimise impacts to ancient woodland, notable habitats, notable and legally protected species.

Development projects

7.7.4. A total of eight approved developments have been identified that are of a sufficient scale to be considered as cumulative developments. Of these, three of the proposed developments within/adjacent to the Scheme have been considered with regards to potential cumulative effects on biodiversity:

- DA/12/01451/EQVAR - Eastern Quarry Watling Street Swanscombe Kent (DA12/00758/EQVAR approval of condition variations October 2012). A mixed-use development of up to 6,250 dwellings & in addition up to 231,000 square metres of built floorspace. The development will include open space (including parks, play spaces, playing fields, allotments, lakes and water features, community woodland & formal and informal open space); landscaping; works to create ecological & nature reserves & refuge areas;
- 15/00887/CPO - Eastern Quarry Wastewater Treatment Works (approved November 2015). Wastewater treatment works and ancillary infrastructure to serve the development at Eastern Quarry; and
- 20150155 - Land at Ebbsfleet Bounded by A2 (application permitted February 2016). The development of land at Ebbsfleet for mixed use up to 789,550m2 gross floorspace comprising employment, residential, hotel and leisure uses, supporting retail and community facilities and provision of car parking, open space, roads and infrastructure.

7.7.5. DA/12/01451/EQVAR - Eastern Quarry Watling Street Swanscombe Kent could add to habitat loss within the local area. However, mitigation and compensation measures have been incorporated into the development plans, including extensive habitat creation for bats, reptiles and amphibians. Suitable habitats adjacent to the A2 that support dormice are largely unaffected by the development.

7.7.6. 15/00887/CPO - Eastern Quarry Wastewater Treatment Works is located within the footprint of the above development and is not anticipated to contribute any potential cumulative effects other than those detailed for Eastern Quarry Watling Street Swanscombe Kent.

7.7.7. 20150155 - Land at Ebbsfleet Bounded by A2 is located adjacent to Ebbsfleet Marsh LWS. However, no cumulative effect is expected as the designated features of the LWS would not be affected by the Scheme. The development could add to habitat loss within the local area. However, habitat creation and landscape planting within and around Ebbsfleet Junction could have an overall

positive impact on reptiles, amphibians and hazel dormice by strengthening habitat connectivity around the local road network.

7.8. NPS compliance

7.8.1. The assessment for this Scheme has considered potential impacts set out in the Biodiversity and Ecological Conservation section (paragraphs 5.20 – 5.38) of the NN NPS. Relevant paragraphs are highlighted below and in paragraph 7.1.2 of the PEIR Volume 2 Appendix F.

7.8.2. This report provides a preliminary assessment of the significance of effects of the Scheme on nature conservation resources (i.e. internationally, nationally and locally designated sites of nature conservation importance, legally protected species, notable habitats and other notable species identified as being of principle importance for the conservation of biodiversity).

7.8.3. It is considered that the potential mitigation and compensation options being proposed for this Scheme demonstrate a positive effort to take opportunities to conserve and advance biodiversity. This is in line with the Government's biodiversity strategy, as set out in Biodiversity Strategy 2020: A Strategy for England's Wildlife and Ecosystem Services and referenced in the NPS.

7.8.4. In addition, it is considered that the potential mitigation and compensation options being proposed for this Scheme comply with the bullet points listed in paragraph 5.36 of the NPS:

- "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; and
- 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 and the habitat improvement of the network verge."

7.8.5. Arboricultural surveys of the survey area will be carried out during the Preliminary Design Stage. In accordance with the NPS (paragraph 5.32), any loss of ancient woodland and veteran trees will be avoided and minimised as far as possible.

7.9. Assumptions and limitations

7.9.1. Ecological survey work is seasonally constrained and subject to land and environmental conditions, as well as permitted and safe access. Therefore, further surveys are required in 2018 to update and complete existing data for the Scheme and to inform the assessment in the ES.

7.10. Summary

7.10.1. The information gathered to date has provided the baseline conditions within the EZoI for the Scheme. However, further data collection is proposed during the Preliminary Design Stage to update existing data and to complete data sets for notable habitats, notable and legally protected species.

7.10.2. Based on the preliminary environmental assessment carried out for this report, it has been established that the Scheme has the potential to have a moderate significant adverse effect on two small areas of ancient woodland located adjacent the A2 to the north. However, design work is ongoing with the aim of avoiding loss of ancient woodland if possible due to its status as an irreplaceable habitat. Existing data indicates that ancient woodland loss in these two areas can be avoided. However, until this can be confirmed through the results of surveys to be undertaken during the Preliminary Design Stage, potential loss is reported. If loss of ancient woodland cannot be avoided, this loss will necessitate compensation, potentially involving the creation of newly planted broadleaved woodland and an ongoing management regime to ensure the successful establishment of new woodland.

7.10.3. Darenth Wood SSSI and Ebbsfleet Marshes LWS are located adjacent to the Scheme. Providing mitigation measures are put in place to protect the designated sites from pollution and accidental incursion, and habitat clearance within the highways boundary is kept to the minimum where adjacent to designated sites and ancient woodland, no significant adverse effects are anticipated as a result of the Scheme.

7.10.4. In addition, the Scheme supports notable habitats and populations of notable and legally protected species. Providing mitigation and habitat protection measures are put in place, the Scheme has the potential to have a slight adverse effect on these valued nature conservation resources. However, it is anticipated that this will reduce over time and be neutral in the long-term once replacement habitats have been established and vegetation matures adjacent to the Scheme.

7.10.5. It is considered that the mitigation and compensation proposals that have been provided in this report have taken into account the requirements of the NPS (set out in Section 7.5 above and in the PEIR Volume 2 Appendix F), by providing green corridors, minimising habitat fragmentation, enhancing existing habitats and creating new, linked habitats to expand the range of existing notable and legally protected species populations. However, consultation with stakeholders will continue, and will guide the final mitigation and compensation strategy for the Scheme.

Chapter 8 - Road Drainage and the Water Environment

8.1. Introduction

8.1.1. This chapter of the PEIR presents the preliminary environmental information for the Road Drainage and the Water Environment. It identifies the study area, methodology, baseline conditions, identifies receptors potentially affected (and their value), regulatory / policy framework, design mitigation and enhancement measures (where relevant), monitoring requirements, the magnitude of impacts and significance of effects (including cumulative). The chapter is based on readily available information that has previously been presented in the scoping report and the Environmental Assessment Report prepared at the Option Selection Stage.

8.1.2. Based on IAN 125/15 and the need for proportionate and appropriate assessment, the scope and level of assessment produced in this chapter has been maintained at the same level as for Option Selection Stage. As no new information has become available this chapter largely echoes that of Option Selection Stage. However, the baseline reported in Option Selection Stage was revisited during the pre-application EIA scoping, in order to confirm any updates to baseline / existing conditions.

8.1.3. Previous assessments of the Scheme have been undertaken. This includes (but not limited to):

- A2 Bean to Ebbsfleet Junction Improvements Environmental Scoping Report Highways England, December 2017; and
- Option Selection Stage Environmental Assessment Report: Volume 1. A2 Bean to Ebbsfleet Junction Improvements, Highways England, August 2017.

8.1.4. These reports will be used as a basis for the preliminary environmental impacts.

8.1.5. The assessment has been prepared in accordance with the Design Manual for Roads and Bridges (DMRB).

8.1.6. This section should be read in conjunction with the water environment information provided in the PEIR Volume 2 Appendix G, which lists the key legislation and policy, study area, methodology and tables for the water assessment and Figures 8.1 to 8.4 in the PEIR Volume 3.

8.2. Consultation

8.2.1. Consultation with regulators (principally the Environment Agency) should continue regularly throughout the design process to ensure that the Scheme is designed to be compliant with the objectives of the Water Framework Directive (WFD) and flood risk and that feasible opportunities for improvements to the water environment are integrated into the scheme.

8.3. Baseline conditions

Surface water

8.3.1. Waterbodies within the study area fall within the Thames River Basin District (RBD) as set out within the Thames River Basin Management Plan (RBMP) (Environment Agency, February 2016).

8.3.2. The River Ebbsfleet is the only designated Main River within the site boundary. The River Ebbsfleet is not designated under the WFD.

8.3.3. The River Thames is located approximately 1.2km north of the site boundary (WFD waterbody 'Thames Middle'). The River Thames is designated under the WFD and is a heavily modified waterbody that has a 'Moderate' ecological status and a 'Good' chemical status.

8.3.4. The study area also contains a series of un-named surface water drains and ditches that are likely to receive local drainage and form tributaries to these Main Rivers.

8.3.5. Further details of local surface water features from features from the Option Selection Stage study are shown in Table 8.2 in the PEIR Volume 2 Appendix G.

WFD compliance assessment / channel morphology

8.3.6. A WFD compliance assessment is required for new developments and schemes to demonstrate that scheme will not result in a deterioration in status (or potential) of any water body, or prevent the water body from meeting good status (or potential) in the future.

8.3.7. The Environment Agency is the competent authority for WFD. However, as the Scheme has the potential to also affect other waterbodies not designated under the WFD, Dartford Borough Council and Gravesham Borough Council (the lead local flood authorities) have a duty to ensure the scheme complies with WFD legislation.

Flood risk

8.3.8. The Environment Agency flood map illustrates the majority of the study area is located in Flood Zone 1. There is a narrow area of Flood Zone 3 along the upstream reach of the River Ebbsfleet, which intersects with the Scheme approximately 500m east of the A2 Ebbsfleet Junction.

8.3.9. No parts of the Scheme or wider study area are within the medium (Flood Zone 2) or high (Flood Zone 3) flood risk zones associated with the River Thames. However, flooding within the River Thames may interact with the River Ebbsfleet, via backwater effects for example, and this may contribute to the predicted flood likelihood and extent for the River Ebbsfleet and the Ebbsfleet Junction area of the Scheme.

8.3.10. The Environment Agency flood map also indicates that much of the flood risk areas described above benefit from protection by flood defences, however the standard of these defences has not been confirmed.

8.3.11. The Environment Agency risk of flooding from surface water map shows that land within the Scheme limits generally has a very low risk of surface water flooding. However, there are some areas of low, medium and high risk; the distribution of

these areas is synonymous to the existence of current surface water features and areas of low-lying topography. Areas of high risk, including the highway corridor, are located around the River Ebbsfleet crossing of the A2, toward the eastern boundary of the Proposed Scheme.

Groundwater

8.3.12. The junctions are underlain by a Principal Aquifer and there are also several SPZs 1's, 2 and 3 (Source Protection Zones) present.

8.3.13. Groundwater flow is considered to flow generally to the north and towards the River Thames. Near the Ebbsfleet Junction, groundwater is likely to flow towards the River Ebbsfleet.

8.3.14. Further details of local geology and groundwater from the Option Selection Stage study are shown in Table 8.3 in Volume 2 Appendix G.

Aquatic ecology

8.3.15. Aquatic ecology is considered within the PEIR Volume 1 Chapter 7 Biodiversity.

8.4. Potential impacts

8.4.1. Pre-mitigation potential temporary effects during the construction phase for the Scheme include, but not limited to the following:

- Risks to the surface water environment due to excavation, and the subsequent deposition of soils, sediment, or other construction materials to accommodate new watercourse crossings; spillage of fuels or other contaminating liquids; and through uncontrolled site runoff;
- Risks to the groundwater environment, principally associated with cuttings and the spillage of fuels or other contaminating liquids; and
- Risk of an increase in flood risk arising from the storage of materials and temporary impermeable areas at site compounds and discharge of abstracted water during construction giving rise to increased flood risk, especially if discharged to smaller watercourses.

8.4.2. Risks of pollution associated with the release of pollutants (e.g. hydrocarbons, cement, fine sediment, mobilised contaminants) due to existing ground contamination are considered within the PEIR Volume 1 Chapter 10 Geology and Soils and will not be considered here.

8.4.3. Potential permanent effects during the operational phase for the Scheme include, but not limited to the following. As above, risks of pollution associated with the release of pollutants (e.g. hydrocarbons, cement, fine sediment, mobilised contaminants) due to existing ground contamination are considered within the PEIR Volume 1 Chapter 10 Geology and Soils and will not be considered here:

- There are two main types of pollution risk from roads during the operational phase, the first associated with routine runoff and the second from accidental spillages. Road runoff can contain hydrocarbons, heavy metals, chemicals and de-icing agents. These pollutants when combined with rainfall can run-off into the drainage system and have an adverse effect on the receiving watercourses. The pollutants may also find their way into groundwater through filter drains and overland flows during heavy rainfall events. During operation

there is a risk that polluting materials may be accidentally spilt onto the road surface, as a result of a road accident, these pollutants have the potential to enter surface and ground waters;

- Alterations to the drainage network which could provide a pollutant linkage between road runoff to surface water and groundwater receptors. Alteration to the drainage could also increase the risk from groundwater flooding and result in other changes to existing flow patterns, rates and volumes of surface water runoff. Changes in the pollution linkages and hydraulic regime of the site may also alter the risk to ecological features; and
- New impermeable areas would induce higher rates and volumes of rainfall runoff, with the potential for increased surface water flood risk. Drainage of cuttings may increase receiving stream flows and impact on flow conveyance and the capacity of surface water receptors and flood risk from these sources.

8.5. Potential mitigation measures

8.5.1. Should the assessment carried out using the above methodology identify any significant adverse effects, mitigation measures would to be implemented. These proposed mitigation measures would be in addition to the embedded mitigation within the project's design, such as sustainable drainage systems (SuDs) pollution control measures on outfalls (if appropriate) and measures within the CEMP to control and prevent polluted run-off.

8.5.2. More detailed and some scheme specific mitigation was included in the Option Selection Stage study and is included below.

Design

8.5.3. At Ebbsfleet Junction, no drainage outfalls to ground (i.e. no infiltration features or soakaways) are proposed in order to minimise the risk of causing groundwater flooding and inundation of the drainage system due to the shallow groundwater table (Scheme specific mitigation measure).

8.5.4. At Bean Junction, re-use of existing highway drainage soakaway infiltration features are proposed, where possible, as this is an area where the water table is deep. Replacement of structures will be required where the development causes removal of an outfall structure (to be detailed at Preliminary Design Stage) (Scheme specific mitigation measure).

8.5.5. Adverse impacts on human health would be avoided wherever possible. Detailed design of the Scheme would aim to prevent a pollutant linkage between contamination sources such as contaminated soils and groundwater from filling stations and other industrial land uses and humans (Standard Practice).

8.5.6. Highways England has a proprietary approach to drainage design as detailed in DMRB Volume 4, Section 2, Part 9 (HA 119/06) which would be used to inform the Drainage Strategy for the Scheme. In accordance with HA 119/06 and the NN NPS the Drainage Strategy would incorporate appropriate forms of SuDS within the drainage design (where appropriate).

8.5.7. When considering road runoff, discharges from roads must not lead to deterioration in the WFD classification status of the receiving surface or groundwater as determined in the relevant River Basin Management Plan (Defra, 2015). A quantitative appraisal of Spillage Risk will be carried out during the

Preliminary Design Stage using the Water Risk Assessment Tool ("HAWRAT"). This assessment will be undertaken for all new outfalls and any existing outfalls that are affected by the Scheme. This assessment will confirm the environmental risk as a result of the Scheme which will then be dealt with through the design to ensure that water quality will not deteriorate compared to the background situation. The assessment will consider existing contamination sources such as contaminated soils and groundwater from brownfield land uses and incorporate any necessary work to reduce risk to controlled waters to acceptable standards. The design which could include pre-construction methods such as remediation of soils and permanent operational features such as cut off valves and sediment traps would be applied to new and existing drainage features (Standard Practice).

8.5.8. There will be an increase in impermeable area cover associated with the Scheme, so there will be changes to existing patterns, rates and volumes of surface water runoff. The drainage design will be such that operation of the drainage system will result in minimum adverse impacts to the receiving water environment, whether through pollution, development of sink holes or increased flood risk. This will be achieved by the design including for the provision of attenuation and treatment/spillage control devices (Scheme Specific).

8.5.9. The proposed drainage for the Scheme at both Bean and Ebbsfleet Junction shall be designed to have a neutral impact on groundwater levels and existing surface water drainage flow rates and volumes. At Bean Junction the water table is tens of metres deep so would not affect any shallow archaeological remains (Scheme Specific).

8.5.10. At Ebbsfleet Junction there are no major cuttings below the existing ground level so lowering of groundwater levels significantly below the existing water levels is not expected. Drainage outfalls at Ebbsfleet Junction will be to surface water (e.g. the River Ebbsfleet) and use of appropriate sustainable drainage design will mitigate any potential for increased surface water flood risk (Scheme Specific).

Construction

8.5.11. To ensure the quality of the water environment does not deteriorate during construction, a CEMP will document all construction phase mitigation measures. These will include a pollution control plan, standard best practices, relevant CIRIA pollution prevention guidance and a site waste management plan (Standard Practice).

8.5.12. Pursuant to the CEMP, method statements and management plans will be prepared by the successful Contractor(s) detailing their approach to construction. Best practice pollution prevention and control measures will be adopted to ensure that water resources are not adversely affected by storm water runoff or accidental spillages from construction sites. The CEMP will also include an emergency preparedness and response plan. This will provide a full list of protocols and communication channels with the Environment Agency in the event of a pollution incident (Standard Practice).

8.5.13. The Contractor will comply with BS 6031 'Code of Practice for earthworks' (British Standards, 2009) regarding the general control of site drainage including, for example, all washings, abstractions and surface water runoff, unless otherwise agreed by the employer's representative (Standard Practice).

8.5.14. If any water abstraction is required as part of the construction process, the Environment Agency will be contacted and the appropriate licenses will be obtained. Any abstraction practices will be in accordance with the guidelines and requirements of these licences (Scheme Specific).

8.5.15. Consultation with the Environment Agency or Lead Local Flood Authority is required where any of the Scheme lies within 9 m of a designated main river or ordinary watercourse respectively. Such watercourses are ordinarily subject to byelaw control and consent would also be required under the Water Resources Act 1991 for works on, over or within the river channel, including temporary works required for construction purposes and the construction of surface water outfalls (Standard Practice).

8.5.16. The risk of disturbing contamination within and outside the immediate road construction site will depend on a number of factors including the actual presence and type of contamination, site-specific ground conditions such as permeability and the depth of excavations/cuttings below the water table. This will be investigated at a later stage of the Scheme design. Specific assessment of potentially contaminated ground would include assessment of the two former petrol stations (former Watling Road Services and Springhead Services) as necessary (Scheme Specific). During stripping excavation / construction works, a watching brief would be adopted with site workers remaining vigilant so any visual or olfactory signs of contamination are noted and that any contaminated soil is kept separate from other materials. Any suspected contaminated material would be analysed to determine if it is suitable for re-use on site or requires disposal off-site to an appropriate soil recycling or disposal facility (Standard Practice).

8.5.17. Suitable Personal Protective Equipment (PPE) including Respiratory Protective Equipment (RPE) (if necessary) would be available to all site workers. Appropriate site hygiene protocols would be adopted during the construction phase (Standard Practice).

Operation

8.5.18. The road surface will restrict the exposure to the geology and soils beneath the road and therefore potential pollutant linkages (e.g. dermal contact from contaminated soils) would be broken should contaminated soils be present. The impacts to future site users such as maintenance workers will also be mitigated by the remedial measures that are implemented during the construction phase. Any residual risks to Maintenance Workers will be further reduced by the use of appropriate PPE during works and compliance with Health and Safety legislation and CDM Regulations (Standard Practice).

8.5.19. There is a risk to shallow soils and the water environment from road spray and pollution incidents associated with the road usage (e.g. fuel / oil spillages). These risks will be mitigated within the design of the drainage system that is installed during the construction of the road (Scheme Specific).

8.5.20. The highway drainage attenuation and treatment/spillage control devices will require appropriate operational and maintenance procedures for continued avoidance of pollution of the receiving controlled waters (Standard Practice).

8.5.21. The highway drainage in the Ebbsfleet Junction will be designed to take account of potentially shallow groundwater levels. Consideration will include the potential

to ingress into surface water drainage and potential for local groundwater flooding during prolonged wet weather periods. Assessment will include site investigation and water level monitoring. Drainage will be designed to separate collection and conveyance of surface water from any potential ingress of groundwater, as necessary, in later design stages (Scheme Specific).

Enhancement measures

8.5.22. The current drainage network has not been designed with an allowance for climate change. The risk of surface water flooding from the Scheme itself will therefore be alleviated by the provision of a drainage design that accommodates a 1 in 5 year storm event, inclusive of an appropriate allowance for climate change, in accordance with the guidance in Section 6.2 of HD 33/06, Volume 4, Section 2 (DfT, 2006 – see PEIR Volume 1 Chapter 17 References). The climate change allowance would be determined with reference to the most recent Environment Agency guidance, published in February 2016 (Scheme Specific).

Monitoring requirements

8.5.23. During the construction phase of the Scheme a surface water and groundwater monitoring plan would be implemented, in terms of both water quality and quantity, if required. This will also include groundwater level monitoring where relevant, including at Ebbsfleet Junction (Scheme Specific).

8.5.24. During the earthworks, a watching brief would be adopted with site workers remaining vigilant to any visual or olfactory signs of contamination and any contaminated soil will be kept separate from other materials. Any suspected contaminated material would be analysed to determine if it is suitable for re-use on site or requires disposal off-site to an appropriate disposal facility (Standard Practice).

8.6. Residual impacts

8.6.1. The residual magnitude of impacts and significance of their effects on the water environment were assessed as part of the Option Selection Stage study and are shown below. The magnitude and characterisation of impacts is based on the baseline data and assumes all necessary mitigation, outlined above, is applied.

8.6.2. Impacts and their significance relating to Ebbsfleet Option 1 are discussed first within Table 8.5 in the PEIR Volume 2 Appendix G. Table 8.6 in the PEIR Volume 2 Appendix G identifies the controlled water and geology and soils receptors where construction or operational impacts could arise from Bean Option 5.

8.6.3. In summary, no construction or operational impacts have been identified (assuming post mitigation).

8.7. Cumulative effects

8.7.1. Table 8.7 in the PEIR Volume 2 Appendix G lists the nearby (within 1 km) developments to the Scheme that were identified in the Option Selection Stage study. The potential cumulative impacts to the water environment are outlined although it is anticipated that there would be a neutral effect from other developments, as each development will be subject to compliance with legislation

and best practice guidance that should prevent pollution and safeguard the water environment.

8.8. NPS compliance

8.8.1. The scheme assessment will be undertaken in compliance with NN NPS.

8.8.2. For flood risk a Flood Risk Assessment will be undertaken as prescribed in the NPS and the drainage design will include sustainable features. The necessary sequential and exception tests will be followed in the decision making.

8.8.3. For water quality, as outlined in the sections above, appropriate assessment of the impacts on water quality, water resources and physical characteristics of the water bodies affected by the scheme will be undertaken as outlined in the NPS. The scheme is not likely to affect the environmental objectives of the WFD, and with enhancement measures the impacts are likely to be neutral or slightly beneficial. Mitigation measures will include sustainable drainage systems as promoted by the NPS.

8.9. Assumptions and limitations

8.9.1. The assessment has relied upon the accuracy and level of detail of the documented data sources.

8.9.2. A qualitative assessment has been undertaken. Quantitative assessments will be undertaken when the data are available. Impacts are therefore not yet quantified and the potential mitigation is still being developed.

8.9.3. Although the preliminary environmental information currently excludes the assessment of groundwater level and flow direction, a groundwater WFD assessment and a FRA these assessments will be available and referred to in the ES.

8.9.4. The balance of surface water and groundwater influence on standing water bodies, such as ponds is not certain. Therefore, indirect impacts as a result of changes to hydrological catchments, such as drainage of ponds is not fully known.

8.9.5. The study area is 1 km. This is assumed to be large enough to capture water receptors that could be affected by the scheme. Should the design change, then the study area could change.

8.10. Summary

8.10.1. In summary, it is considered that it is unlikely that the proposed design will lead to a significant impact on the water environment. The proposed design will incorporate SuDS as part of the ongoing design development. As a result, there would be no increase in flood risk or impact on water quality.

Chapter 9 - Landscape

9.1. Introduction

9.1.1. A simple Landscape and Visual Assessment (in accordance with IAN 135/10) has been carried out, based on the preliminary geometric layout of the Highways design, to inform the preliminary environmental information discussed below. This will be developed further as a detailed Landscape and Visual Assessment is prepared for inclusion in the ES.

9.1.2. This section should be read in conjunction with the landscape information provided the PEIR Volume 2 in Appendix H, which lists the key legislation and policy, study area, methodology and tables for the landscape assessment and Figures 9.1 to 9.6 in the PEIR Volume 3.

9.2. Consultation

9.2.1. Stakeholder consultation will be required to agree the location of viewpoints to be photographed, the location and number of photomontages and the extent of the visual envelope. Consultation will be required with the relevant Local Planning Authorities Dartford Borough Council and Gravesham Borough Council. The environmental design measures would also be consulted on across the topics.

9.3. Baseline conditions

Existing landscape character

Overview

9.3.1. The land use to the south of the A2 is predominantly agricultural and horticultural, including some old orchards. The field pattern is regular with sparse or overgrown hedgerows and some windbreaks. The villages of Bean and Betsham are the main settlements. Woodland blocks, some of which are ancient woodland dominate the landscape around the Bean Junction, whilst the landscape around the Ebbsfleet Junction is more open and has long range views east of the scheme. Electricity pylons are a discordant element in the view.

9.3.2. The land use to the north of the A2 consists of former quarries, agricultural land and a garden nursery. The main settlement pattern is urban fringe and includes Swanscombe and the edges of Northfleet, Greenhithe and Dartford as well as new developments which form part of the Ebbsfleet Garden City. The area is in transition and future development is planned for Eastern Quarry and land around the Ebbsfleet Junction. The Ebbsfleet Junction is a key gateway to the Ebbsfleet Garden City.

9.3.3. The roundabouts at both Bean and Ebbsfleet Junctions and the A2 between the two have existing lighting.

Landscape character assessment

9.3.4. The study area lies within National Character Area (NCA) 113 North Kent Plain as defined by Natural England.

9.3.5. At a regional level, the study area lies with four Landscape Character Areas (LCAs) identified by Kent County Council in their Landscape Assessment of Kent (LAK). These LCAs also form part of the Dartford Borough Council Local Development Framework:

- Dartford and Gravesend Fringes (LCA);
- Southfleet Arable Lands (LCA); and
- Darenth Downs (LCA).

9.3.6. The Gravesend Southern Fringe LCA within the study area has also been identified in the Gravesham Landscape Character Assessment 2009.

9.3.7. The extents of the NCA and LCAs are shown on Figure 9.2 in the PEIR Volume 3 Appendix H.

9.3.8. Local Landscape Character Areas (LLCAs) have been identified based on a more detailed analysis of the study area. These character areas will form the baseline for the landscape assessment and will be reviewed and a full landscape character assessment in accordance with the guidance in IAN 135/10 will be undertaken for the ES.

- A: Former Eastern Quarry;
- B: Bluewater Retail Park;
- C: C1 to C3: Darenth Wood and Bean Wood;
- D: Urban Fringe of Dartford, Greenhithe and Swanscombe;
- E: Southfleet Downland;
- F: Urban Fringe of Gravesend and Northfleet; and
- G: A2 Corridor North (Open and Closed).

9.3.9. The location and extent of these LLCAs are shown on Figure 9.3 in the PEIR Volume 3 Appendix H.

9.3.10. B: Bluewater Retail Park and D: Urban fringe of Dartford, Greenhithe and Swanscombe have been scoped out of further assessment. These LLCAs were considered not to be susceptible to any to any changes arising from the Scheme. Bluewater Retail Park is surrounded by approximately 50m (AOD) high vegetated chalk cliffs with carparks and the existing road network dominating the surroundings, and no intervisibility with the Scheme. Whilst D: Urban fringe of Dartford, Greenhithe and Swanscombe is dominated by residential land-use, mixed pattern of houses, streets and open spaces with outward views generally constrained by the built environment and undulating topography so there is no intervisibility with the Scheme.

9.3.11. Whilst A: Former Eastern Quarry is currently considered to be of low sensitivity in relation to any changes arising from the Scheme. This area is in a state of transformation with limited views in and out of the site. This LLCA has been included in the assessment so that the potential effects of the Scheme on permitted development can be considered.

Visual

Overview

9.3.12. Views of the Scheme are restricted predominantly by the undulating topography and woodland, particularly in the vicinity of Bean Interchange and to the east and west adjoining the A2. The views around the Ebbsfleet Junction are more open.

Visual receptors

9.3.13. Visual receptors are the people who live or visit the landscape and who will experience views of the Scheme. The main receptors include residential properties and the users of PRoW.

9.3.14. The main visual receptors identified in the Scoping Report for further assessment are identified below. It is considered that most of these receptors are susceptible to any to any changes arising from the Scheme:

- Local communities including: residents of Hope Cottages, residents of Bean and residents of rural farms and cottages, and the new communities of Ebbsfleet Garden City;
- People using PRoW, including bridleways and cycle routes;
- People in their place of work; and
- Road users (e.g. users of the A2, and local roads).

9.3.15. The location of key visual receptors is shown on Figures 9.1 and 9.6 in the PEIR Volume 3 Appendix H. Representative viewpoints will be identified in the ES. It is noted that these will be agreed with representatives of Dartford and Gravesham Borough Councils.

9.4. Potential impacts

9.4.1. Without mitigation, the Scheme has the potential to have an impact on the landscape, townscape and visual amenity due to the following:

Construction

- Vegetation removal;
- Temporary introduction of construction compounds, batching plants, storage areas and haul routes, temporary lighting and traffic management, presence of construction machinery including cranes and increased vehicular movement;
- Drainage;
- Land re-profiling; and
- New structures.

9.4.2. At the time of assessing the potential impacts of the locations of the construction compounds were not available. The construction compounds are likely to have significant effects on the landscape and visual receptors during the construction period.

Operation

- Large scale changes to infrastructure features including roundabouts, earthworks, on and off-slip roads and widening of existing links;
- Changes to street lighting;
- New signage and gantries, and;
- Introduction of environmental design measures including planting, seeding, potential noise barriers and others.

9.4.3. Additional information will be available to inform the assessment in the ES. This includes:

- Accurate topographic information to determine the full extent of earthworks and therefore full extent of vegetation loss; and
- Scheme details of lighting and drainage design, the location of any proposed environmental barriers, construction compounds and soil storage areas,

Potential landscape impacts

9.4.4. Potential landscape impacts at Bean Junction and the Bean Triangle include the loss of existing vegetation. The A2 corridor is narrow corresponding with this part of the Scheme and immediately adjacent to the road boundary there is a mixture of mature woodland, ancient woodland and maturing roadside planting, all of which contribute to the landscape character. Changes to earthworks alongside the road due to the increased size of roundabouts, new slip road, amendments to slip roads and earthworks associated with re-located gantries, will all result in a loss of existing vegetation. To the west of Bean Junction, the Scheme is within the existing highway boundary and would not impact on the ancient woodland at Darenth and Bean Woods. To the east of Bean Junction, based on existing data, it is anticipated that loss of ancient woodland in the Bean Triangle can be avoided and options to avoid any loss are being explored during the Preliminary Design Stage, including a departure from standard for narrow lanes at this location.

9.4.5. There is an intensification of the highway at the Ebbsfleet Junction, but the existing character of the junction will be retained by replacing the existing amenity planting.

9.4.6. During construction, traffic and construction activity would be visible in the landscape local to the junctions, as well as to visual receptors. However, the potential effects of construction activities would be temporary, short term and reversible.

Potential visual impacts

9.4.7. The visual assessment determined that there would be potential impacts to Hope Cottages. The existing baseline conditions for the northern most cottages are already impacted by the existing road and overbridge but the road will be widened at this point to four lanes with a central reserve from the current three to four lanes. The southernmost cottages are currently well screened from the junction by roadside vegetation. This screening vegetation would be lost resulting in full and uninterrupted views of the junction.

9.4.8. There are also potential impacts to the residents of Bean, topography within the village means that some of the properties within the village have high level views across the countryside towards Bean Junction. Loss of the existing screening vegetation to the junction would open up views of the junction. The loss of screening vegetation would also impact PRoW DR19.

9.4.9. The new on-slip eastbound onto the A2 would have an impact on the embankments and screening vegetation to the Bean Triangle and open up views of the A2 to residential and commercial properties. The proposed new gantry would impact on the cottage to the east of the Merry Chest Café. Screening vegetation would be lost due to works to construct the gantry base, allowing views of the elevated gantry.

9.4.10. The potential for visual impacts around the Ebbsfleet Junction is low due to the nature of the changes and the distance of the receptors from the Scheme. There are existing views from receptors at Springhead Park, but the A2 is already a dominant element in these views and changes to the junction are not expected to result in a change to the view.

9.4.11. There is a good network of PRoW across the study area and there is a potential for visual impacts on a number of these, including DR19 and DR312 due to loss of roadside screening vegetation. As for the landscape assessment above, the full extent of vegetation removal was not established at the time of the preliminary survey.

9.4.12. Visual impacts will occur to Ightham Cottages due to the increase in size of the Bean northern roundabout. The cottages will be demolished as part of the Scheme.

9.4.13. There are a number of planning applications on the north side of the A2 which form part of the Ebbsfleet Garden City. Where there is sufficient information provided in the application to carry out an assessment, they will be assessed as part of the visual assessment in the ES and will include the following applications which would have some visibility according to the Zone of Theoretical Visibility (ZTV) shown on Figures 9.4 and 9.5 in the PEIR Volume 3 Appendix H:

- St Clements Valley - 14/01344/FUL;
- Ebbsfleet Green - 05/00308/OUT and 16/01271/EDCON;
- Eastern Quarry - 12/01451/EQVAR; and
- Springhead Park and adjacent application – 20150155.

9.5. Potential mitigation measures

9.5.1. The following potential mitigation measures have been identified from the initial assessment and would be developed further going forward:

- Retain and protect existing mature trees and hedges wherever possible, the Bean Junction is currently well screened with vegetation and losses to this vegetation could expose visual receptors to views of the junction or the A2. Therefore, as much existing vegetation should be retained as possible;
- Retain natural character and enhance with local species and replant woodland edges, replacing any screening lost;

- Provide advanced planting in the field between the Bean northern roundabout and Bean Village to mitigate the loss of screening;
- Retain screening vegetation to provide advanced planting with land owner agreement to screen views of the gantry from the cottage east of the Merry Chest Café;
- Provide screening to Hope Cottages by using environmental barriers or planting, maximising the screening potential in the area to minimise the impact of the bridge embankments; and
- Reinstate and recreate the high-quality standard of horticulture at the Ebbsfleet roundabouts.

9.5.2. Alongside the potential mitigation measures several enhancement measures have been identified and will be taken forward and developed further as part of the iterative design:

- Consider a design solution that moves the road in front of Hope Cottages to the east to allow the retention of the existing screening vegetation;
- Explore opportunities for ecological enhancements based on findings in PEIR Volume 1 Chapter 7 Biodiversity, maximising the overall net ecological gain; and
- Work with the lighting designers to reduce the impact of lighting on the area and ensure there is no new lighting impacts on the residents of Hope Cottages.

9.5.3. Only mitigation measures and enhancement measures which are buildable within the scheme boundary have been taken into consideration during the assessment of effects and would be considered going forward. Any potential off-site planting which would require landowner agreement would not form part of the assessment.

9.6. Residual impacts

9.6.1. There are potential residual impacts at Hope Cottages. The existing vegetative screening to the southernmost cottages would be lost and replaced with a fence. The existing baseline situation for the northernmost cottages is already severely affected by the existing junction layout and bridge across the A2. There may be possibilities to look at mitigation if amendments to the current footprint are feasible.

9.6.2. Any existing screening vegetation beneath pylons lost to the scheme would be replaced with small trees or shrubs only.

9.7. Cumulative effects

9.7.1. Five approved developments within a 1 km study area have been identified that are of a sufficient scale to be considered as cumulative developments:

- Eastern Quarry Watling Street Swanscombe Kent;
- Eastern Quarry KCC/EDC waste water treatment works and ancillary;
- Bluewater West Village;

- Land at St Clements Way; and
- Land at Ebbsfleet.

9.7.2. Of these five, three of the proposed developments have been considered with regards to potential cumulative effects on environmental designations, landscape and townscape, and visual amenity as they are located within or adjacent to the Scheme. These are summarised in the Table 9.7 in the PEIR Volume 2 Appendix H.

9.8. NPS compliance

9.8.1. The assessment complies with and going forward will continue to comply with the NN NPS, Generic Impacts: Landscape and Visual Impacts as quoted below:

'*Where the development is subject to EIA the applicant should undertake an assessment of any likely significant landscape and visual impacts in the environmental impact assessment and describe these in the environmental assessment. … The landscape and visual assessment should include reference to any landscape character assessment and associated studies, as a means of assessing landscape impacts relevant to the proposed project. The applicant's assessment should also take account of any relevant policies based on these assessments in local development documents in England.*

The applicant's assessment should include any significant effects during construction of the project and/or the significant effects of the completed development and its operation on landscape components and landscape character (including historic landscape characterisation).

The assessment should include the visibility and conspicuousness of the project during construction and of the presence and operation of the project and potential impacts on views and visual amenity. This should include any noise and light pollution effects, including on local amenity, tranquillity and nature conservation.'

9.8.2. Relevant policies from the NPS are also included in the Planning and Policy Context in the PEIR Volume 2 Appendix H.

9.9. Assumptions and limitations

9.9.1. Further investigations and surveys, which are being carried out in the coming months, are required to complete the earthworks design. The assessment in the ES will consider the impact that changes to the existing slopes would have on the vegetation loss. Although it is currently assumed that any design refinements would not affect the ancient woodland either side of the A2. It will also consider the design development, including drainage and lighting, and construction information such as soil storage areas and haul routes as this information becomes available.

9.9.2. The landscape and visual assessments will be carried out late winter and early summer 2018.

9.10. Summary

9.10.1. The results of the initial Landscape and Visual Impact assessment identified the potential impacts on the landscape and visual receptors. A more detailed

Landscape and Visual Impact Assessment would be carried out as part of the EIA for the scheme, forming part of an iterative design process, with the final assessment based on the fixed engineering design. The assessment would also consider impacts during construction, the winter of year 1 and summer of year 15 after opening.

9.10.2. Minimising vegetation loss to the existing road corridor and any adjacent ancient woodland, particularly around the Bean Junction would be key to minimising the impact of the scheme on adjacent visual and landscape receptors. At the time of the initial assessment the location of drainage, haul roads and construction compounds was not known and haven't been included in the assessment. These all have the potential to impact existing vegetation within the scheme boundary.

9.10.3. It is expected that there will be residual effects on Hope Cottages and mitigation and enhancement opportunities would be taken where practical to minimise the impacts on these residents.

9.10.4. It is anticipated that significant effects due to the proposed Ebbsfleet Junction will be limited but this will be confirmed as part of the detailed landscape and visual assessment in the ES.

Chapter 10 - Geology and Soils

10.1. Introduction

10.1.1. This chapter has been prepared to provide the preliminary environmental information with respect to geology and soils resulting from the construction and operation of the A2 Bean and Ebbsfleet Junction improvements (herein defined as 'the Scheme').

10.1.2. This geology and soils chapter assesses the following topics:

- Direct impacts on mineral resource sterilisation;
- Direct impacts on controlled waters from land or groundwater contamination;
- Effects associated with pre-existing soil and groundwater contamination, for example mobilising contamination, introducing new or changing existing contamination migration pathways, or changing the types of contamination receptors;
- Physical effects such as changes in topography, aggressive ground, ground stability and soil availability and quality in the study area; and
- The expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters relevant to the Scheme.

10.1.3. The main legislation and policies considered in the context of geology and soils assessment include the National Planning Policy Framework Chapter 11 (2012 – see PEIR Volume 1 Chapter 17 References), National Networks National Policy Statement paragraph 5.23, Technical Information Note 049, Environmental Protection Act part 2a (1990 – see PEIR Volume 1 Chapter 17 References) and the Model Procedures for the Management of Land Contamination. Local guidance documents include Dartford Borough Council Core Strategy (2014 – see PEIR Volume 1 Chapter 17 References) and Gravesham Borough Council Local Plan Core Strategy (2014 – see PEIR Volume 1 Chapter 17 References).

10.1.4. This section should be read in conjunction with the geology and soils information provided in the PEIR Volume 2 Appendix I, which lists the key legislation and policy, study area, methodology and tables for the geology and soils assessment and Figure 10.1 in the PEIR Volume 3.

10.1.5. This chapter discusses hydrology and hydrogeology with respect to the potential contamination impacts of the Scheme on the water environment. The PEIR Volume 1 Chapter 8 Road Drainage and Water Environment discusses the potential impacts of the Scheme on the water environment as a resource and considers the risks associated with potential flooding from groundwater and surface water. Chapter 8 also discusses impacts associated with the potential for polluting substances to reach the water environment during the operational phase such as accidental loss/spillage of fuels during operational phase.

10.1.6. For consideration of the re-use of soils and generation of waste soils see the PEIR Volume 1 Chapter 12 Materials and Waste.

10.1.7. For direct impacts on agricultural land, including the loss of Best and Most Versatile (BMV), see the PEIR Volume 1 Chapter 13 People and Communities.

10.1.8. Direct impacts from the Scheme on Swanscombe Skull SSSI and Baker's Hole Sites of Special Scientific Interest (SSSIs) of geological interest were discounted from the assessment at scoping stage and have not been considered further.

10.2. Consultation

10.2.1. Consultation with the relevant statutory authorities (notably the Environment Agency and local authorities) is being undertaken. Each relevant body is being consulted separately to discuss specific information, issues and concerns.

10.2.2. The Environment Agency will be consulted prior to undertaking the proposed ground investigation and following the development of relevant risk assessments to agree the most appropriate construction method to protect controlled waters.

10.3. Baseline conditions

10.3.1. This section provides a summary of the baseline geology and soil characteristics of the Scheme and study area.

10.3.2. It should be noted that all distances within this chapter are relative to the centre of either Bean Junction or Ebbsfleet Junction (whichever is closest), assumed to be located at National Grid references TQ 58635 72717 (Bean Junction) and TQ 61353 72703 (Ebbsfleet Junction). Items are listed in order of their proximity to Bean Junction followed by Ebbsfleet Junction.

Scheme extent

10.3.3. A description of the Scheme extent is provided in the PEIR Volume 1 Section 2.4.

Study area

10.3.4. The study area comprises historical chalk and clay quarries, open space, agricultural fields, woodland (including ancient woodland), and mixed use developments including residential and commercial / industrial land uses.

10.3.5. Historical quarries and pits, are located to the north of the Scheme. These sites are currently undergoing redevelopment, with mixed use development clusters under construction or planned. Residential and commercial properties and small areas of woodland are located within the Bean Triangle.

10.3.6. A mixture of agricultural land, open space and woodland is located to the south of the Scheme, along the length of the A2, with Darenth Wood Ecological SSSI situated to the west and south-west of Bean Junction and ancient woodland namely the Thrift, Parkhill Wood and Beacon Wood all located within the study area. Farmland is present to the south of Bean Junction and to the south of Ebbsfleet Junction.

10.3.7. Multiple villages and residential properties are located within the study area, with Bean village, Stone, Greenhithe and Northfleet all situated close to the Scheme. Permanent caravan sites are located to the south of the A2 and in Northfleet to the east of Ebbsfleet Junction.

10.3.8. Nearby schools include Painters Ash Primary School and Northfleet School for Girls which are situated in Northfleet and Bean Village pre-school, which is located in the village of Bean.

10.3.9. Current commercial activities within the study area include: Bluewater Retail Park (on the site of a former quarry which is situated to the north-west of A296/Bean Lane roundabout), Springhead Nurseries, Sainsbury's supermarket and fuel station located to the east of Ebbsfleet Junction; and Millbrook Garden Centre located to the south-east of Ebbsfleet Junction. Several commercial premises are located along the A296 Watling Street (Roman Road), which include a carwash, timber and fencing merchants, air-conditioning re-gassing services and a cafe.

10.3.10. Public utilities within the study area include: A water works to the south-west of Ebbsfleet Junction on Park Corner Road; an electrical substation to the south-east of Ebbsfleet Junction; and a pumping station to the north of Ebbsfleet Junction.

10.3.11. The River Ebbsfleet is located to the east of Ebbsfleet Junction and flows in a south to north direction from the A2 towards the River Thames. Other surface water features present within the study area include: a series of lakes to the north of the A2 and within the Bluewater Retail Park, which are associated with historical quarries and pits; and various small drainage ditches and attenuation ponds.

10.3.12. Roman remains have been identified across the Scheme and study area, including a Roman Road (Watling Street) and Roman settlement (Vagniacae) to the south of Ebbsfleet Junction and a Roman burial site to the north of the eastern extent of the Scheme. These sites are discussed in more detail in the PEIR Volume 1 Chapter 11 Cultural Heritage.

Topography

10.3.13. The topography of the Scheme has a general decline to the east. The A2 western extent of the Scheme is approximately 80 m above Ordnance Datum (AOD) and the A2 eastern extent is at approximately 15 m AOD. The A296/Bean Lane roundabout is 53 m AOD which inclines to the Bean northern roundabout at 69 m AOD. Bean House to the south of Bean southern roundabout lies at 55 m AOD. The A296 on-slip to the A2 is approximately 85 m AOD and the A2260 on-slip to the A2 is approximately 35m AOD. Ebbsfleet western roundabout is at 25 m AOD and 215 m to the south-east at Ebbsfleet eastern roundabout, the elevation is 10 m AOD.

10.3.14. According to MAGIC mapping (Natural England, 2017), topography over the study area for the Scheme ranges from approximately 5 m to 95 m AOD. Topographical lows of approximately 5 m AOD are observed along the River Ebbsfleet and topographical highs of 95 m are observed at the caravan site to the south of the A2. The A2 slopes downwards towards both the Bean and Ebbsfleet Junctions from a high point at the mid-section. Due to historical excavations elevations to the north of the A296 and A2 drop rapidly. Elevations decrease more gradually to the south of the A2.

Site history

10.3.15. A review of historical maps within the Envirocheck report (Landmark 2017 – see PEIR Volume 1 Chapter 17 References) and other historical land use information has been undertaken. The historical maps within the Envirocheck report date from 1869 to 2017. A summary of the findings is detailed below and a full review of the site history is presented in Table 10.13 in the PEIR Volume 2 Appendix I. It

should be noted that locations of any military camps, strategic sites or security sites were either removed or replaced by fake fields or clouds between 1878 and 1981. Therefore, these features, typically associated with the presence of UXO, are generally not available on publicly sourced maps and aerial photographs. Section 10.3.17 to 10.3.26 is structured as observations through time, for geographical sections of the Scheme from west to east.

Scheme extent

10.3.16. The earliest available maps (1869) show an unnamed road mapped in a generally south to north orientation in the same location as the existing Bean Lane. Watling Street (Roman Road) is also present and runs in a north-west to south-east direction, in the same location as the present day A296, intersecting Bean Lane. No road is present between Bean and Ebbsfleet Junctions, with a narrow track in a similar location to the current day A2. By 1931, Watling Street (Roman Road) is shown to have been widened and extended to connect the western section of the Scheme extent with Ebbsfleet.

10.3.17. The 1909/1910 map shows Ightham Cottages in their present location, along with a brickworks and associated sand pit immediately south-east of the Bean Lane-Watling Street intersection. The brickworks and sand pit are labelled as disused on the 1938 map.

10.3.18. By 1973/1974, the A2 is shown to be in its present day position, with Bean Lane crossing the A2 as a flyover. A pond is shown to the north-east of Bean Junction in the present-day Bean Triangle and a roundabout has been constructed at the intersection between Bean Lane and Watling Street. By 2006 the road alignments at Bean Junction match the present-day alignments.

10.3.19. A road which crosses the Scheme boundary immediately south of Ebbsfleet Junction is shown on the 1869 map running south-west to north-east in a similar orientation and location to the present day Park Corner Road. A pumping station is shown to occupy part of the Scheme immediately south of Ebbsfleet Junction, along Park Corner Road. The pumping station is shown as a water works on the 1961-1962 map.

10.3.20. From 1898, a railway line runs through cuttings, crossing the present-day A2 to the east of Ebbsfleet Junction. By 1973 the line is marked as disused, later dismantled (prior to 1991). By 2006, the Channel Tunnel Rail Link (HS1) is mapped east of Ebbsfleet Junction, running through a tunnel under the A2 in a north-west to south-east direction and the road configurations at Ebbsfleet Junction, match those of the present day.

Study area

10.3.21. The 1869 to 1995 mapping shows the study area to predominantly comprise a mix of agriculture, chalk and clay quarrying activities and woodland, fields and farm tracks present within the study area. The eastern portion of the study area becomes progressively more residential and commercial from the 1960s onward.

10.3.22. To the north of the A2, along the length of the study area (and a small area to the south of the present-day A296-A2 merge), land use has historically been dominated by quarrying activities. The first available maps, from 1869, show isolated chalk and clay pits. By the 1930s large areas are marked on the maps as quarry pits, and these continue to expand until the 1990s and the quarry

boundaries cross the northern Scheme boundary. Developments, including a Works mapped to the north of the present-day A296 (1973-74), and a tramway (1951) mapped to the north-east of Ebbsfleet Junction, are assumed to be associated with the historical quarrying activities. By 2006, the quarried areas are mapped as disused, associated infrastructure is no longer shown, and the quarry to the north-west of Bean Junction has been developed and is mapped as Bluewater Retail Park.

10.3.23. The towns of Stone and Greenhithe (north of Bean Junction) gradually expand into the study area from 1898 to 2017, primarily with the construction of residential developments. The village of Bean expands gradually between 1898 and 1967, before a large expansion in 1974, when it reaches its current size.

10.3.24. In the location of the present-day Bean Triangle, Thrift Cottages are mapped from 1898. Later (1967), Brickfield Nursery and Watling Street Nursery are also mapped in this area. Along Claywood Lane, to the south of the present-day A296-A2 merge, a caravan park is indicated from 1980 onwards.

10.3.25. To the east of the Scheme, Northfleet residential areas start to expand into the study area in 1938, with steady growth between 1938 and 1973 to its current extent. Two electrical substations, Northfleet West (1967) and Northfleet East (1973) were mapped during this period, with Northfleet West known to be decommissioned and the land remediated.

Unexploded ordnance (UXO)

10.3.26. An unexploded ordnance (UXO) Pre-Desk Study Assessment (PDSA) (2017– see PEIR Volume 1 Chapter 17 References) has been carried out by Zetica. The PDSA identified that at least ten World War II bombs fell in close proximity to study area.

10.3.27. In addition, the Zetica (n.d) map classifies the Scheme extents as holding a high risk of encountering unexploded bombs.

10.3.28. A detailed UXO desk study will be carried out for the site, by UXO specialists, prior to the breaking of any ground.

Geology

Historical exploratory hole records

10.3.29. Over 100 historical exploratory hole records are located within, and in close proximity to, the Scheme extents. The historical exploratory hole records from the British Geological Society (BGS) Borehole Scans and Highways Agency Geotechnical Data Management System (HAGDMS) reports (Highways England, 2017– see PEIR Volume 1 Chapter 17 References) were reviewed and the information has been used to confirm the anticipated geological sequence within the Scheme extents, including locations, persistence and descriptions of the anticipated geology.

Artificial Ground

10.3.30. Published 1:50,000 BGS (1996) geological mapping (Dartford, Sheet 271, 1:50 000 Scale, Solid and Drift Map, 1998) shows the Scheme to be directly underlain by artificial ground comprising localised areas of Worked Ground and Made Ground separately.

10.3.31. Worked Ground is defined as areas where the pre-existing land surface is known to have been excavated by man and is thought to be limited to areas of chalk, sand and gravel, or clay pits with little or no infill.

10.3.32. Made Ground is anticipated to be present across the Scheme extent associated with the construction of embankments for the A2, B255, A296, A2260, local access roads, and the dismantled railway as well as areas of residential and commercial development. Embankments associated with the Bean Lane/A2 Junction are up to 15 m above natural ground (typically 8 m above natural ground), therefore a considerable thickness of Made Ground is expected to be present in these areas.

10.3.33. Anthropogenic deposits across the Scheme and study area are also likely to be found in some areas including, but not limited to, landfill sites (discussed in section 10.6.31), disused quarries and pits, infilled ponds/pits/quarry's and structures associated with the highway infrastructure.

10.3.34. Envirocheck datasheets (Landmark, 2017– see PEIR Volume 1 Chapter 17 References) indicated that 18 locations of potentially infilled land are present within the study area. Eight listings are located within the Scheme: One within the Bean Triangle adjacent to Bean Lane; one north of the A296; three to the north and in the vicinity of Ebbsfleet West roundabout; one located close to Stonewood; one close to the water works to the south-west of Ebbsfleet West roundabout; and one adjacent to the dismantled railway. All locations of infilled ground are recorded as pits or quarries; the material with which they are potentially filled is not known.

10.3.35. One potentially infilled water body (ponds, lakes, etc.) was identified within the study area in the Envirocheck report (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References), adjacent to the west of the River Ebbsfleet.

10.3.36. The sources of Made Ground / infill materials are unknown and it is therefore considered that contamination may be encountered within these materials and/or in the vicinity.

Superficial deposits

10.3.37. Superficial deposits comprising Head, Alluvium and River Terrace Deposits (undifferentiated) are anticipated to be present in localised pockets across the study area.

10.3.38. Alluvium is mapped locally to the east of Ebbsfleet Junction, in the vicinity of the River Ebbsfleet.

10.3.39. Discrete deposits of both Head Deposits and River Terrace Deposits are mapped within the Scheme boundary and within the study area. The BGS geology map of the area (2013a) records Landslip Deposits to the west of Ebbsfleet western roundabout, which are expected to underlie the A2 and slip roads. The parent material is expected to be as clay. No information pertaining to the age or type of landslide is given by BGS geology map. Further localised areas of Landslip Deposits are identified within the study area on the BGS Geoindex (BGS, 1996) and in the Envirocheck report (Landmark, 2017). These are shown to be present approximately 180 m to the south of Swanscombe Cutting Footbridge and approximately 350 m to the north of Ebbsfleet western roundabout.

Bedrock geology

10.3.40. Bedrock geology, at both Bean and Ebbsfleet Junctions generally comprises Thanet Formation over Chalk Group. The London Clay Formation and Lambeth Group are mapped in the centre of the Scheme between the two junctions. The extents of the London Clay Formation and Lambeth Group are limited to an area of higher topography to the east of the A296 east bound on-slip.

10.3.41. It should be noted that the Thanet Formation has been observed to be absent in some historical boreholes at both Bean Junction and Ebbsfleet Junction.

10.3.42. The Seaford Chalk Formation outcrops at the A296/Bean Lane roundabout and adjacent to the west of Bean northern roundabout on the east bound off-slip road.

10.3.43. The Seaford Chalk Formation outcrops adjacent to the River Ebbsfleet and at Ebbsfleet western roundabout. The Thanet Formation is expected to overlie the Seaford Chalk across the remainder of Ebbsfleet Junction. Generally, the Thanet Formation can be expected to be absent in areas of low lying ground due to erosion.

Structural geology

10.3.44. The Scheme is located on the northern extremity of the North Downs, a ridge of chalk hills, which define the south-eastern periphery of the London Basin Syncline. The strata of the North Downs generally dips towards the London Basin, north or north-west. The north-east to south-west trending axial trace of the London Basin Syncline is located approximately 20 km to the northwest of the A2 Bean Junction (Royse et al, 2012 – see PEIR Volume 1 Chapter 17 References).

10.3.45. Information taken from the BGS GeoIndex (BGS, 2017 – see PEIR Volume 1 Chapter 17 References) suggests the closest inferred faulting to the Scheme is 0.75 km to the south of Bean Junction within Beacon Wood Country park just south of the village of Bean. The fault runs north-south.

10.3.46. Research by Royse et al (2012 – see PEIR Volume 1 Chapter 17 References) suggests faulting is more extensive than shown on previous BGS data and maps, and that the bedrock is likely to be more structurally complex than originally thought; this theory is now widely accepted within the UK. This should be taken into consideration when determining if faulting is present within the Scheme extents, and the near vicinity, during ground investigation and during construction.

Mining activity and quarrying

10.3.47. The Onshore Mineral Resources Map for Kent (BGS, 2017– see PEIR Volume 1 Chapter 17 References) identifies three former chalk pits to the north of the A2: Blue Water, Swanscombe and Eastern Quarry. All pits are classified as 'inactive, worked-out and / or restored sites'. These areas, and localised pockets of River Terrace Deposits to the east and west of Bean Junction along the A2, have all been identified as mineral resources.

10.3.48. In addition to these, the Envirocheck report (Landmark, 2017– see PEIR Volume 1 Chapter 17 References) identified two deneholes within the Scheme Extent at Bean Junction, one approximately 300 m to the west of the Bean Junction overbridge and another 570 m to the south-west of Ebbsfleet western

roundabout. The deneholes are recorded as ceased and comprised underground workings (usually 6-8 chambers) into the White Chalk Subgroup. A further 43 recorded mineral sites and man-made mining cavities comprising deneholes, pits and quarries are located within 500 m of the study area. All the mineral sites are recorded to have ceased works.

10.3.49. Two shaft/crown hole collapses have been recorded within 500 m of Bean Junction. The collapses are located approximately 125 m to the north-east and 400 m to the west of Bean Junction.

10.3.50. Mineral safeguard zones (Kent County Council, 2013 – see PEIR Volume 1 Chapter 17 References) to the west and east of Bean Junction are located within the study area and partially within the Scheme.

10.3.51. Further to the information above, there is a potential for unrecorded workings (deneholes, quarries and pits) within the study area. The standard structure of a denehole is that is spreads laterally at the base of the shaft, giving risk to the probability of the feature being closer to the Scheme that the shaft location.

Soils

10.3.52. There is no published detailed soil map of the land in the vicinity of the Bean and Ebbsfleet Junctions. The only available map is the 1:250,000 soil map of South East England published by the Soil Survey of England and Wales in 1983. This shows the land affected by the Scheme to be within the Fyfield association of deep, well drained, often stoneless, coarse loamy and sandy soils. Therefore, the soils within the Scheme limits are graded as Grade 2 (good quality agricultural land).

10.3.53. Google Earth imagery of December 2003 shows heavy disturbance to Land north of the Ebbsfleet Junction during the construction of the roundabouts associated with Ebbsfleet Junction, with the underlying chalk having been brought to the surface. The restored soils are unlikely to be of their original quality as evidenced by the fact that in 1999 images they are under arable crops, but are now under scrub and rough grass.

Local Geological Sites

10.3.54. One Local Geological Site (LGS) (formerly known as a Regionally Important Geological Site (RIG)), Beacon Wood Country Park, is present within the study area.

Ground stability hazards

10.3.55. The potential for ground stability hazards to be present within the Scheme extent, as taken from the BGS Geosure GIS dataset detailed in the Envirocheck report (Landmark, 2017– see PEIR Volume 1 Chapter 17 References) is as follows:

- Compressible ground: High where Alluvium is anticipated east of Ebbsfleet Junction and where Infilled Ground is recorded at Ebbsfleet western roundabout. A Very Low to Low hazard is expected across the remainder of the Scheme extent;
- Collapsible ground: Very Low throughout the Scheme extent. However, it should be noted that there is a risk of collapse from historical mining activities;

- Landslide: Moderate to High adjacent to the west of Ebbsfleet Junction where Landslip Deposits are recorded, and Low to Moderate throughout the remainder of the Scheme extent;
- Running sands: Moderate to High where the Thanet Formation is anticipated across the Scheme extent. The remainder of the study area, where the Thanet Formation is absent, is classed as presenting a Very Low to Low hazard;
- Shrinking or swelling clay: Very low across the majority of the Scheme extent. Moderate in locations where London Clay Formation is anticipated adjacent to the east of the A296 on-slip to the A2; and
- Dissolution: High to Very High at locations where the White Chalk Subgroup outcrops at the surface and where Head is anticipated to be encountered directly overlying the White Chalk Subgroup. A Moderate hazard is expected where the Thanet Formation overlies the White Chalk Subgroup. A Very Low to Low hazard is expected where Chalk is present at depth underlying a top down sequence of London Clay Formation, Lambeth Group and Thanet Formation, adjacent to the east of the A296 on-slip to the A2. The Envirocheck report (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References) identifies 10 natural cavities within 500 m of the Scheme extents, none of which are recorded within the Scheme boundary.

Chemical attack on concrete

10.3.56. Made Ground, Alluvium, and London Clay Formation have the potential to contain sulphates and sulphides which can have detrimental impacts on concrete structures. The London Clay Formation is one of the principal sulphate and sulphide bearing strata in England. Chemical testing will therefore be undertaken during the ground investigation and an assessment of the aggressivity of the ground and groundwater conditions will be undertaken, in accordance with British Research Establishment (BRE) Special Digest 1 (2005 – see PEIR Volume 1 Chapter 17 References).

Hydrogeology

Aquifer designations

10.3.57. The Environment Agency (2017 – see PEIR Volume 1 Chapter 17 References) aquifer designations for superficial deposits and bedrock formations/groups are presented in Table 10.6 in the PEIR Volume 2 Appendix I.

Source protection and groundwater vulnerability zones

10.3.58. Source Protection Zones 1, 2 and 3 and Groundwater Vulnerability Zones are present within the Scheme extent and across the study area associated with bedrock Principal Aquifer mentioned in Table 10.8 in the PEIR Volume 2 Appendix I. These have been described in detail in the PEIR Chapter 8 Road Drainage and Water Environment.

Groundwater

10.3.59. As detailed in the PEIR Chapter 8 Road Drainage and Water Environment, groundwater is considered to flow generally to the north and towards the River Thames. There are likely to be localised groundwater flow variations caused by

dewatering/abstraction actives occurring in the vicinity of the Scheme. The superficial deposits and Made Ground may have shallow groundwater/perched water, which may follow localised flow directions.

Groundwater abstraction licences

10.3.60. Active groundwater abstraction licences have been identified within the study area (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References). These are detailed in Table 8.3 in Volume 2 Appendix G.

Hydrology

Surface water

10.3.61. The River Ebbsfleet, flows in a south-north direction from the A2 (spring) towards the River Thames, starting within the Scheme extent immediately south-east of Springhead Nurseries to the east of Ebbsfleet Junction.

10.3.62. A number of other surface water features are present within the study area. These include:

- A series of ponds and lakes to the north of the A2, between Bean and Ebbsfleet Junctions associated with historical quarrying activities;
- A series of lakes at the Bluewater Retail Park, also associated with historical mining activities; and
- Various unnamed drainage ditches, soakaways and attenuation ponds adjacent to the A2 and roads at Bean and Ebbsfleet Junctions.

10.3.63. A more detailed summary, covering surface water features outside of the Geology and Soils study area, is provided in the PEIR Chapter 8 Road Drainage and Water Environment.

Landfill sites

10.3.64. The Envirocheck report (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References) identifies five historical landfill sites and one active landfill within the study area. A summary of the identified records is presented in Table 10.9 in the PEIR Volume 2 Appendix I.

Fuel stations

10.3.65. According to the Envirocheck report (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References) one active fuel station, Sainsbury's Pepper Hill Petrol Station, was identified within the study area. The fuel station is located 900 m to the north-east of Ebbsfleet Junction, at Wingfield Bank.

10.3.66. Additionally, 'Springhead services', a historical fuel station was identified within the Scheme, approximately 100 m to the east of Ebbsfleet Junction (Landmark, 2017). This fuel station has been decommissioned (dates to be confirmed).

10.3.67. A suspected historical fuel station was also identified on Google Maps (2017– see PEIR Volume 1 Chapter 17 References) midway along the A296 Watling Street (Roman Road), between the A296/Bean Lane roundabout and the A2 on-slip, however this requires verification. The location is currently used as a car wash.

Industrial and commercial land uses

10.3.68. A number of trade directory entries (active/inactive) with potentially contaminative land uses historically operated or currently operate in the study area (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References). These include: a car breakers, a haulage company, three timber suppliers, a concrete manufacturer, a clay pigeon shooting centre, two garden centres, a National Grid electricity substation, a waterworks, a pumping station and a supermarket (with vehicle cleaning services).

10.3.69. A list of trade directories (both active and inactive) within the study area which involve or have involved potentially contaminative activities is included in Table 10.14 in the PEIR Volume 2 Appendix I.

Pollution incidents

10.3.70. According to the Envirocheck report (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References), there have been 15 pollution incidents within the study area, including two major incidents. One major incident occurred on the boundary of the Scheme extent, to the south-west of Bean Junction in January 1999, involving a spillage of pesticides due to containment failure. The second major incident occurred outside of the Scheme extent in February 1993, involving a spill of oils into a nearby stream adjacent to Springhead Nursery.

10.3.71. The other 13 recorded pollution incidents were designated as minor or significant associated with septic tank effluent, oils, soluble antifreeze, construction demolition materials, foam, fire water/ foam, crude sewage and red gas oil.

10.3.72. A summary of the incidents is provided in Table 10.15 in the PEIR Volume 2 Appendix I.

Potential sources of contamination

10.3.73. Potentially contaminative current and historical activities in the study area were identified in the Envirocheck report (Landmark, 2017– see PEIR Volume 1 Chapter 17 References) and through assessment of freely available information.

10.3.74. One active and four historical landfills are located within the study area. The closest landfill (Northfleet Landfill extension) is located approximately 700 m north of Ebbsfleet Junction, which accepted commercial, industrial and household waste (Landmark, 2017 – see PEIR Volume 1 Chapter 17 References).

10.3.75. Other sources of potential contamination include the presence of infilled land across the Scheme and study area and Made Ground associated with the construction of the A2, B255, B259, A2260 and A296 carriageways (including embankments), and in particular, Bean/A2 Junction and local access roads. Deneholes and other historical mineral extraction sites also have the potential to have once been infilled. The sources of Made Ground and infill material are unknown and it is therefore considered that contamination may be encountered within and in proximity to these areas.

10.3.76. Potentially contaminative land uses (current and historical) within the study area include: car breakers, a haulage company, three timber suppliers, a concrete manufacturer, a clay pigeon shooting centre, two garden centres, a National Grid electricity substation, a waterworks, a pumping station and a supermarket (with

vehicle cleaning services). Two fuel stations, one active and one historical (removed), have been identified within the study area within the Envirocheck Report (Landmark, 2017– see PEIR Volume 1 Chapter 17 References), a potential fuel station has been identified using google maps along the A296 Watling Street (Roman Road). Potentially unknown land use within the Bean Triangle could also be a source of contamination.

10.3.77. Additional contaminative land uses identified in historical mapping include several historical chalk, clay, and sand pits associated with quarrying / brickworks located throughout the Scheme extent and study area, a dismantled railway line transecting eastern portion of the Scheme, Northfleet West Grid Substation, a historical 'Works' with eight tanks and two historical nurseries.

Potential receptors

10.3.78. Potential contamination receptors have been categorised as relating to human health, controlled waters, ecology and property. The receptors identified as part of the baseline assessment relate to the current use of the study area only.

10.3.79. Potential human health receptors include:

- On-site construction workers and site workers;
- On-site local residents[7];
- Off-site local residents;
- On-site and off-site members of the public using public rights of way (non-motorised users);
- Off-site school children and staff (Painters Ash Primary School, Northfleet School for Girls and Jumping Beans Village Pre-School); and
- Off-site workers and visitors at commercial / industrial premises and recreational facilities (future) in the study area.

10.3.80. It is considered that exposure to members of the public using the highways from potential sources of contamination will be of limited frequency and duration. As such, they have not been considered further as receptors in identified potential contaminant linkages (PCLs).

10.3.81. Potential controlled waters receptors include:

- Groundwater within the bedrock Principal and Secondary 'A' Aquifers and the localised superficial Secondary 'A' and Secondary (Undifferentiated) Aquifers across the study area; with groundwater abstractions and SPZs (1, 2 and 3) within the Scheme extent and study area; and
- Surface waters, including the River Ebbsfleet, lakes and ponds associated with historical quarrying activities to the north of the A2, and various unnamed ditches and balancing ponds.

10.3.82. Potential property receptors include:

- Piles and other foundations in the proposed works areas;
- Underground services (within Scheme extent);

[7] Residential properties extend into the redline boundary of the scheme, however controls will be implemented to ensure that during construction members of the public will not have access to active construction areas

- Historical features, including Roman remains and listed buildings;
- On-site property (residential); and
- Off-site property (including residential, commercial and industrial).

10.3.83. Potential ecological receptors include:

- Ancient Woodland at Darenth Wood, The Thrift and small areas within Bean Triangle, Parkhill Wood and Beacon Wood;
- Darenth Wood SSSI; and
- Beacon Wood Country Park LGS.

Potential pathways

10.3.84. Subject to the findings of a ground investigation and based on the identified potential sources and human receptors, plausible exposure pathways for the identified human receptors may include but are not limited to:

- Inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres;
- Inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater;
- Migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion; and
- Inhalation of vapours.

10.3.85. Again, subject to the findings of a ground investigation, potential pathways to the identified controlled waters receptors may include but are not limited to:

- Leaching / vertical migration of contaminants in soils to underlying groundwater;
- Vertical migration of contaminants to deeper groundwater;
- Lateral migration of contamination in groundwater;
- Migration of contamination in entrained in surface water run-off; and,
- Migration of contamination via surface waters.

10.3.86. It should also be noted that the vertical movement of contamination into the underlying aquifers can be exacerbated by piling or penetrative ground improvement activities and the presence of soakaways. Similarly, lateral migration of contamination in groundwater may be exacerbated as a result of any dewatering processes should they be implemented.

10.3.87. Potential pathways to the identified ecological receptors include but are not limited to:

- Lateral migration of contamination in shallow groundwater; and
- Migration of contaminants entrained in surface water run-off.

10.3.88. Potential pathways to the identified structural receptors include but are not limited to:

- Chemical attack from direct contact of aggressive chemical constituents in soil or groundwater; and
- Migration of ground gases or vapours along preferential pathways including permeable ground, services trenches and service entry points and accumulation in enclosed spaces such as services ducts or access points, followed by ignition causing an explosion.

10.4. Potential impacts

Description of works

10.4.1. Works will include but are not limited to construction of embankments, retaining structures, upgrading of soakaways, installation and upgrading of gantries.

Bean Junction

10.4.2. The proposed option retains the existing junction layout but with the existing roundabouts enlarged and converted to full traffic signal control. This results in the demolition of Ightham Cottages. A new overbridge will be constructed for southbound traffic only with the existing overbridge retained for northbound traffic only. An additional on-slip road from the Bean northern roundabout to the A2 eastbound is to be constructed. On the B255 southbound carriageway the slip road between the B255 and the A296 is to be closed. A NMU route will traverse the junction from south to north approximate.

A2 Carriageway

10.4.3. The eastbound carriageway of the A2 is to be converted to four lanes by removing the existing hard shoulder and using narrow lanes from the end of the new slip road to the existing eastbound on-slip at the A296. Swanscombe footbridge is retained.

Ebbsfleet Junction

10.4.4. The proposed option retains the existing junction layout but with the existing roundabouts enlarged to provide for full traffic signal control. Access to the proposed Station Quarter South and Ebbsfleet Green developments are provided at Ebbsfleet eastern and western roundabouts. The link road between the roundabouts is widened from the existing single carriageway to a dual two lane carriageway with additional widening to three lanes on the approach to the roundabouts. The existing eastbound and westbound off-slips are retained, with the westbound off-slip converted to two lanes along its full length. The current eastbound on-slip is to be separated from the one-way link road to the Pepper Hill Junction. The new eastbound on-slip is realigned across the old service area. Bike paths are located within the proposed design.

Stage 1: Land contamination risk assessment

10.4.5. A desk study review of available documentary information has been undertaken to develop a Preliminary Conceptual Site Model (PCSM). The PCLs and assessed risks have been identified for each development phase to inform the Stage 2 land contamination impact assessment (See Paragraphs 10.4.11 to 10.4.27 below).

10.4.6. The construction phase will potentially introduce new sources of contamination and disturb and mobilise existing sources of contamination. Construction activities may also introduce new pathways for migration of existing contamination such as excavation and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off, groundwater and ground gas. The following construction phase activities may contribute to the creation of new PCLs:

- Potential introduction of new sources of contamination associated with the accidental loss/spillage of fuels and oils;
- Potential disturbance and mobilisation of existing sources of contamination;
- Introduction of additional receptors on site including construction workers, future site workers and foundations;
- Creation of confined spaces, such as manholes and service chambers/ducts, within which ground gas has the potential to accumulate;
- Piling or excavation during construction could create new pathways between any contaminated soils and the underlying groundwater; and
- Any dewatering activities have the potential to mobilise contaminated groundwater and enhance lateral migration of contamination within the superficial and bedrock aquifers and potentially into surface watercourses.

10.4.7. During the operational phase, it is anticipated that no new pathways will be created however accidents / incidents have the potential to introduce new sources. It is anticipated that the CEMP and the subsequent Handover Environmental Management Plan (HEMP) for the Scheme will address how these incidents will be managed and detail the emergency management procedures to be implemented in such an event.

10.4.8. As PCLs have been identified, there are theoretical risks to receptors from contamination which require further consideration and assessment. The ground investigation will be undertaken to characterise ground conditions and to provide data to inform a generic quantitative risk assessment (GQRA) and any further assessments as necessary to assess these PCLs.

10.4.9. At this stage, there has been no opportunity for an intrusive investigation, and historical reports lack sufficient data to inform a GQRA. The assessment undertaken for the purposes of this report, were therefore qualitative in nature.

10.4.10. The PCSM, which also presents the assessed classification of risk for each development phase, is presented in Table 10.16 in the PEIR Volume 2 Appendix I and is summarised in Table 10.10 in the PEIR Volume 2 Appendix I.

Stage 2: Impact assessment

Land contamination

10.4.11. The land contamination impact assessment is based on comparison of the baseline risk classification with the anticipated construction phase and the operational phase risk classifications, as assessed in Table 10.16 and summarised in Table 10.10 in the PEIR Volume 2 Appendix I and discussed in Sections 10.5.12 to 10.5.16. This approach has enabled the changes in the risks

to the identified receptors during the construction and operational phases to be captured and an assessment made of the potential impacts of the Scheme. The land contamination impact assessment is presented in Table 10.16 in the PEIR Volume 2 Appendix I and summarised below.

Construction phase

10.4.12. As noted in section 10.4.6, construction phase activities may contribute to the creation of new PCLs, involving the potential introduction of new sources of contamination and potentially disturbing and mobilising existing sources of contamination. Construction activities may introduce new pathways for the migration of existing contamination, such as excavation and exposure of contaminated soil, remobilisation of contaminants through soil disturbance and the creation of preferential pathways for surface water run-off, ground gas migration pathways and the vertical migration of contamination.

10.4.13. If no mitigation measures are implemented the construction phase impacts associated with potential on-site sources have been typically assessed as minor to moderate adverse. The assessment has also identified negligible effects which are typically associated with on-site and off-site human health receptors from on-site sources associated with potential risks from the migration of ground gas and vapours and contact/ingestion of contaminated groundwater. The exceptions where more significant effects have been identified include on-site construction / site workers in direct contact with contaminants from on-site sources in perched water or shallow groundwater. Risks to on-site controlled waters and property receptors from off-site sources have also been assessed as negligible. All of the assessed effects are considered likely to be permanent. The anticipated minor adverse or negligible effects are not considered to be significant. However, the predicted moderate adverse effects are considered significant. Consequently, mitigation measures are required to reduce the assessed impacts associated the Scheme.

With the implementation of mitigation measures through design and through the construction phase, as set out in the CEMP, risks identified to human health, controlled waters, ecological and property receptors during construction have been assessed as very low to moderate. Compared to the existing baseline, the level of risk to receptors is expected to remain generally the same or improve due to the mitigation measures for the prevention of impacts from contamination. The effect is therefore negligible to minor beneficial. The predicted effects are considered likely to be permanent. The overall negligible to minor beneficial effects of the construction phase of the Scheme with the implementation of mitigation measures are not considered to be significant.

Operational phase

10.4.14. The operational phase will potentially introduce new sources of contamination. Spillages and leaks may occur along the Scheme. In addition, below ground services could create additional potential pathways for the migration of potential contamination which were not present at baseline. However, it is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

10.4.15. With mitigation measures incorporated within the design, there will be an overall betterment of the land during the operational phase. An overall negligible to moderate beneficial effect is anticipated, associated with the removal / mitigation of on-site contamination sources and mitigation of off-site contamination sources, if quantitative risk assessments undertaken as part of detailed design determine this to be necessary. All effects are considered permanent. The anticipated negligible and minor beneficial effects are not considered to be significant whilst the predicted moderate beneficial effects are considered significant.

Geology and geomorphology

10.4.16. A qualitative approach has been taken to assess the potential effects of the Scheme on topography, physical properties / ground stability and mineral resources which have all been assigned a low value based on the rationale presented in Table 10.4 in the PEIR Volume 2 Appendix I. This assessment is summarised in Table 10.10 in the PEIR Volume 2 Appendix I and further discussed in Sections 10.4.17 to 10.5.24.

Construction phase

10.4.17. The Scheme is likely to impact the topography of the study area as it will involve earthworks and the construction of new infrastructure associated with a bridge crossing, new slip roads, widening of embankments and roads, and enlarging of roundabouts.

10.4.18. Topography is considered to be of low value as the "attribute within the study area only possesses characteristics which are locally significant" and "has tolerance for change". The mitigation measures proposed for the construction works will reduce potential impacts to topography. Further, the magnitude of impact that construction will have on topography is considered low as there will be only minor topographical changes compared to baseline. The effects on topography as a result of the development are considered to be permanent, although temporary effects are anticipated associated with the creation of temporary stockpiles, which will likely be required for waste and materials management through the construction phase. The effect on topography is considered to be minor adverse and not significant.

10.4.19. Changes in physical properties or ground stability as a result of the Scheme have been assessed and are discussed below. Physical geological features have been assessed as having a low value as the attributes only possess characteristics which are locally significant.

10.4.20. Soil erosion and quality - there is likely to be an increase in soil erosion and there is potential for the soil quality to be degraded as a result of the stripping of topsoil, vegetation clearance, earthworks, temporary stockpiling and the movement of heavy plant. There is also potential for increased runoff during earthworks with a high sediment load to impact surface water receptors. However, mitigation measures such as outlined in Section 10.5 will reduce the potential for soil erosion and degradation of the quality of surface water receptors. Areas required for temporary works will be reinstated. Consequently, the effect on soil erosion quality is considered to be temporary minor adverse and not significant.

10.4.21. Identified ground stability hazards within the Scheme are compressible ground associated with alluvium and infilled ground, landslide where land slip deposits

are recorded, running sands where the Thanet Sands. Formation is anticipated and dissolution where the chalk outcrops. It is anticipated that the ground investigation will assess all identified ground stability hazards where they pose a risk to the Scheme and risks to proposed engineered structures will be mitigated by design (likely to be through either excavation and replacement with more competent material or the use of foundations). Should ground instability be identified as a geotechnical hazard beneath existing structures following the ground investigation as a result of changes in horizontal or vertical forces through the construction phase, risk will be mitigated by design. Consequently, the effect on compressible ground, landslide, running sands and dissolution are considered permanent minor adverse and not significant.

10.4.22. The Envirocheck report (Landmark, 2017– see PEIR Volume 1 Chapter 17 References) indicates a very low potential for collapsible ground and shrinking or swelling clays. Consequently, the potential physical change to these features has been considered negligible, the significance of the effect is also considered to be negligible and not significant.

10.4.23. There is potential that a number of geological deposits identified within the area have the potential to form aggressive ground. However, if present this will be mitigated against through the detailed design. Therefore, the sensitivity of aggressive ground has been assessed as low, and consequently the potential physical change to aggressive ground has been considered as negligible, the significant of the effect is considered negligible and not significant.

10.4.24. Mineral resources and mineral safeguard zones are located within the study area, both below and adjacent to the Scheme. The mineral resource areas and mineral safeguard zones have been assigned a medium value as they have a moderately economic value. The effect on the identified mineral resources during construction is considered to be low as the characteristics of the mineral resource will largely still be present but unavailable during construction, and where below the active carriageway during operation. The effect on the majority of the identified mineral resource areas within the Scheme area considered temporary. Where mineral deposits or safeguard zones are present below the A2 or side roads the development is considered to not have an effect. The impact on identified mineral resources and mineral safeguard zones is considered to be minor / moderately adverse. However, as the mineral resource will be largely unchanged and accessible following the development the effect is considered not significant.

Operational phase

10.4.25. Potential effects associated with the operation of the Scheme compared to baseline have been assessed. Suitable design and subsequent construction works will minimise soil erosion and it is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques. This will therefore further reduce soil erosion, and any further impacts to physical properties and ground instability. Mineral resources and mineral safeguard zones are located beneath and adjacent to the Scheme. During operation the effect on the identified mineral resources is considered to be negligible as very limited land take is proposed within the vicinity of the safeguard zones resulting in very minor to no loss of the resource compared to baseline. Therefore, the impact on identified mineral

resources and mineral safeguard zones is considered to be minor adverse and not significant.

10.4.26. Consequently, the overall effect of the Scheme during the operational phase is considered permanent, minor adverse to negligible and not significant.

10.4.27. Further assessment will be informed by other topics, as assessing the adverse effects of a major accident or disaster will require interaction with other sections of the ES.

10.5. Potential mitigation measures

Geology and contaminated land

10.5.1. Based on information available to date, assessment of potential risks / impacts / effects the Scheme has been largely qualitative, with only limited ground investigation data to assess ground conditions on site. It is therefore required that a phase of pre-construction intrusive ground investigation is undertaken to inform the design and confirm the appropriate mitigation measures. At this stage, it is envisaged that the ground investigation will include:

- Targeting areas of identified potential contamination or junction reconfigurations (including but not limited to bridges and earthworks);
- Providing an assessment of geological boundaries and thickness of stratum;
- Providing an assessment of the groundwater regime at the site;
- Determining the nature and potential contamination of Made Ground associated with the construction of the A2, B255, A296 and A2260 carriageways (including embankments), and local access roads, the infilling of ponds, pits and quarries within the Scheme extent;
- Determining the aggressivity of the ground towards buried concrete;
- Monitoring of soil and landfill gas; and
- Analysing surface water samples from identified potential surface water receptors for hardness, pH, calcium, and dissolved organic carbon concentrations to enable determination of pragmatic environmental quality standards.

10.5.2. The data gathered from the ground investigation on the condition of soils at the site will also help inform an appropriate Materials Management Plan (MMP) and Site Waste Management Plan (SWMP). Further information can be found in the PEIR Volume 1 Chapter 12 Materials and Waste.

10.5.3. Piling risk assessments will likely be required, particularly where structures are to be piled and are located in the vicinity of Secondary A and Principal aquifers to assess where preferential pathways might be created that allow the migration of landfill/soil gas or vapours or risks to controlled waters. Piling risk assessments will be subject to agreement by the Environment Agency.

10.5.4. Geotechnical risk will be managed in accordance with HD 22/08 and sufficient ground investigation will be carried out to ensure that the potential for ground collapse or settlement is understood, and that adequate foundation solutions can be designed. Following ground investigation, a Ground Investigation Report (GIR) will be produced and used to inform the Geotechnical Design Report

(GDR). The GDR will include stability analyses and design calculations for new and modified earthworks and structures, ensuring their short and long-term stability.

Mitigation measures

10.5.5. Beyond completion of the ground investigation and those risk assessments appropriate to the Scheme, such as human health, controlled waters, piling and ground gas risk, Mitigation measures to be incorporated into the construction process are likely to include (but are not limited to):

- Health and safety risk assessments, method statements and appropriate PPE for the protection of construction workers in accordance with the Control of Substances Hazardous to Health (COSHH) Regulations (Health and Safety Executive, 2013 – see PEIR Volume 1 Chapter 17 References);
- Implementation of appropriate dust suppression measures to prevent migration of contaminated dust and fibres as appropriate, as set out in the PEIR Volume 1 Chapter 5 Air Quality;
- Working methods during construction to manage groundwater and surface water appropriately and ensure that there is no run-off from the works, any material / waste stockpiles, and storage containers into adjacent surface watercourses; in accordance with Pollution Prevention Guideline (PPG): Working at Construction and Demolition Sites (Environment Agency, 2016 – see PEIR Volume 1 Chapter 17 References);
- Stockpile management (such as water spraying and avoiding over stockpiling to reduce compaction of soil and loss of integrity) and timely removal of stockpiled soil to prevent windblown dust and surface water run-off;
- Implementation of an appropriate MMP and SWMP. Further information can be found in the PEIR Volume 1 Chapter 12 Materials and Waste;
- Limiting the area of earthworks at any one time to reduce temporary effects on topography, soil compaction and erosion;
- Limiting the duration of soil exposure and timely reinstatement of vegetation or hardstanding to prevent soil erosion;
- Prioritising the reuse of mineral resources (sand and gravel) within the Scheme;
- Implementing appropriate pollution incident control e.g. plant drip trays and spill kits;
- Implementing appropriate and safe storage of fuel, oils and equipment during construction;
- If unexpected contamination is encountered during proposed earthworks, further assessment will be required. Following assessment further mitigation measures may be required;
- Implementation of measures in the CEMP such as good management of stockpiles in accordance with Defra and the Environment Agency's PPG, implementation of pollution incident control e.g. plant drip trays and spill kits;

- Further monitoring to inform risk assessments and to further define mitigation measures which may need to be incorporated into design; and,
- Completion of a detailed desk study undertaken by UXO specialists to further assess the UXO hazard level within the Scheme, and the completion of a UXO survey prior to any intrusive ground investigation works if required.

10.5.6. It has also been assumed that hardstanding will be placed across the majority of the proposed works associated with the carriageway, except for soft landscaping along embankments and cuttings, which will minimise the generation of dust, direct contact and ingestion pathways and minimise infiltration after construction is complete. If soil contamination is identified, laying of a clean capping layer may be required in areas of proposed soft landscaping. Drainage design will consider the risks from any residual contamination and designers may be required to use lined drainage systems in areas of contamination that may be left in situ. If soil and / or groundwater contamination is identified during the ground investigation which poses a risk to sensitive receptors, appropriate remediation will be undertaken.

10.5.7. It is assumed that the Scheme will be operated in accordance with the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

10.5.8. Furthermore, pollution prevention measures incorporated within drainage design will mitigate the risk of contamination to controlled waters. The principles of drainage design for the proposed development are summarised in the PEIR Volume 1 Chapter 8 Road Drainage and Water Environment.

Monitoring

10.5.9. Limited ground investigation information is currently available for the Scheme and assessment of potential impacts associated with the Scheme to date have been qualitative.

10.5.10. A ground investigation is required for the Scheme to inform the Scheme design and appropriate mitigation measures. A ground investigation specification has been drafted which allows for the installation of groundwater and ground gas monitoring wells and a subsequent preliminary monitoring programme to establish baseline conditions. The requirement for further monitoring will be reviewed upon completion of the assessments detailed in Section 10.3 in Volume 2 Appendix I.

10.6. Residual impacts

10.6.1. Residual impacts typically refer to the long-term effects of the Scheme and relate to the completed, operational development. Impacts are assessed taking into account any mitigation measures and a consideration of their positive or negative influence.

10.6.2. With the effective application of mitigation and design measures, temporary negligible and minor adverse and permanent negligible and minor beneficial effects are mainly anticipated during construction. These effects are assessed as not significant. Temporary minor / moderately adverse effects are anticipated with respect to mineral safeguard zones. As these deposits are unlikely to be

degraded and will only be temporarily unavailable during the development this effect is not considered to be significant.

10.6.3. Permanent minor adverse, negligible, minor beneficial and moderately beneficial effects are mainly anticipated during operation with implementation of the mitigation and design measures. Moderately beneficial effects are considered significant. All other effects are assessed as not significant.

10.6.4. Consequently, allowing for the proposed mitigation measures, positive residual impacts are anticipated associated with the moderately beneficial effects identified during operation.

10.7. Cumulative effects

10.7.1. Cumulative impacts may occur from interaction with other committed and planned developments in the vicinity of the Scheme.

10.7.2. The cumulative impact of soils and geology material resources and waste will be assessed as part of the ES process.

10.7.3. Development that has been identified within the study area, and will be considered as part of the cumulative assessment are summarised in Table 10.10 in the PEIR Volume 2 Appendix I.

Cumulative construction effects

10.7.4. The developments have been subject to the NPPF, with some receiving consent, and have been / will be required to ensure that the planned development is suitable for its intended use and that mitigation and control measures will be adopted during the construction phase to reduce impacts to the environment. Therefore, a low potential for cumulative impacts is predicted during the construction phase.

Cumulative operational effects

10.7.5. It is assumed that the developments will be operated in accordance with granted consents and the relevant regulations and best practice guidance in applying Best Available Techniques and pollution prevention.

10.7.6. Therefore, a low potential for cumulative impacts is predicted during operation.

10.8. NPS compliance

10.8.1. The Scheme aims to comply with the NPS by leaving the Scheme area in better condition than prior to development, where possible. The Planning and Policy Context in Section 10.1 in the PEIR Volume 2 Appendix I presents the NPS compliance requirements related to hydrogeology and ground conditions.

10.8.2. As per the NPS the development will aim to adhere to the following:

- The Scheme will be designed to minimise environmental impacts and to improve quality of life, as well as aim to identify opportunities to deliver environmental benefits; and
- The new and existing development should be prevented from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution.

10.8.3. The mitigation measures outlined in Section 10.5 above including further ground investigation should be adhered to and considered throughout all stages of the Scheme to ensure compliance with NPS guidance.

10.9. Assumptions and limitations

10.9.1. The assessment of baseline ground conditions and potential impacts has been assessed to date through desk-based means only. This means that the assessment has considered the reasonable worst-case, the real risks and consequently the impacts that the Scheme has on soils and geology will be assessed through the ground investigation work that is currently being planned.

10.10. Summary

10.10.1. This chapter has considered the effects of the Scheme on geology and soils in accordance with the regulatory policy framework set out in the Planning and Policy Context in Section 10.1 in the PEIR Volume 2 Appendix I .

10.10.2. With respect to land contamination, the assessment of baseline conditions, and the magnitude of the potential impact (change) of the Scheme has been assessed as significant. However, with the application of appropriate mitigation measures, this classification becomes not significant (negligible to minor beneficial). The operational phase has been assessed as having a moderately beneficial to negligible effect and has therefore been assessed as being significant (beneficial).

10.10.3. With respect to geology / geomorphology and soils, the assessment indicated that the construction phase will have a minor / moderate adverse to negligible effect and the operational phase will have a minor adverse to negligible effect. These effects have been assessed as not significant.

10.10.4. Events constituting potential major accident or natural disaster have been identified during both the construction and operational phases of the Scheme. However, the embedded mitigation through construction and operation is considered sufficient to address the potential risks arising from such events and reduce the risks as low as reasonably practicable (ALARP).

Chapter 11 - Cultural Heritage

11.1. Introduction

11.1.1. This chapter presents the preliminary environmental information on the known historic environment baseline within the Scheme boundary and its wider study area. An assessment of potential impacts on heritage assets, both designated and non-designated, is presented in Sections 11.4 to 11.7 of this chapter.

11.1.2. This PEIR has been undertaken as part of the Preliminary Design and will contribute towards the EIA.

11.1.3. This section should be read in conjunction with the historical information provided in the PEIR Volume 2 Appendix J, which lists the key legislation and policy, study area, methodology and tables for the historic assessment and Figures 11.1 to 11.5 in the PEIR Volume 3.

11.2. Consultation

11.2.1. Preliminary consultation has been undertaken with the statutory consultees:

- Kent County Council's Heritage Conservation Team (KHCT); and
- Historic England.

11.2.2. The Historic England Principal Inspector of Ancient Monuments responded to requests to comment on two areas of proposed archaeological investigations. The following comments were received:

- Proposed geophysical survey area at Bean Junction: the proposed survey does not affect any known or suspected nationally important archaeology, hence, Historic England would be content for Highways England to agree the scope directly with KHCT; and
- Proposed archaeological evaluation area at Ebbsfleet Junction: the proposed survey is within an area with confirmed nationally important, but non-designated, archaeological remains and has high potential for unknown buried remains. Such high potential largely relates to the Roman town at Springhead itself, but also considers Palaeolithic potential and perhaps that of other periods, including early medieval. Further investigations within the area should be targeted on locations for which current understanding of archaeological potential is poor.

11.2.3. The Kent Heritage Conservation Team Manager was contacted on 23rd January 2018. The following comments were received:

- No concerns with current design at Bean if it avoids direct impacts on Darenth Wood and Thrift Ancient Woodland;
- Advised site walkover survey assess setting impacts on ancient woods along Scheme to determine whether at threat and to inform any design change needs;
- Geophysical survey area at Bean Junction is appropriate and need for any further field investigations (trial trenching) can be discuss following published results;

- There is potential for Pleistocene deposits around the edges of Eastern Quarry. If the works go outside beyond the existing highway surrounding the quarry, this will have an impact on such remains;
- There is a preserved Roman temple site underneath the slip road adjacent to the A2 at Ebbsfleet (adjacent to the Springhead Nursery site). Any works in this are likely to affect schedulable quality archaeology and will need to be discussed with KHCT and Historic England;
- The Roman road (Watling Street) may survive along the verges of the A2, south of Northfleet Substation (now part of Ebbsfleet Green development);
- The proposed evaluation area should be reviewed against previous excavation and trial trenching investigations in order to target remaining areas appropriately. Further areas of evaluation may be needed where the Scheme has the potential to disturb Roman remains associated with Springhead Roman Site (Scheduled Monument), early prehistoric activity sites and palaeoenvironmental evidence. Ebbsfleet area is particularly sensitive in this regard with good preservation found across the area;
- There is potential for Pleistocene deposits around the edges of Eastern Quarry. Any proposed construction works outside of the existing highway, surrounding the quarry, should be assessed to determine whether mitigation is required;
- There are likely to be significant cumulative effects from both the Ebbsfleet housing developments and the London Resort Development upon preserved archaeological and palaeoenvironmental remains surrounding the Scheme; and
- There are three new reports on recent investigations in the Ebbsfleet area either just received or pending receipt.

11.2.4. Scoping Opinions containing heritage specific comments have been received from:

- Kent County Council;
- Historic England;
- Gravesham Borough Council;
- Ebbsfleet Development Corporation; and
- Dartford Borough Council.

11.2.5. Comments raised in the Scoping Opinion have either been taken into account in this PEIR or where they are to be addressed in the ES, are set out below.

11.2.6. A Public Consultation was carried out between 18th January to 1st March 2017, the outcomes of which can be found in the consultation report. Heritage specific comments raised in the consultation report included the following:

- When considering mitigation measures it is not always appropriate to block the view of infrastructure from heritage sites with the use of soft landscaping. Consideration should be given as to whether the unobstructed view is part of the significance of the setting when mitigating;

- Harm to heritage sites has largely been avoided in the proposals. Historic England agreed that impacts to Darenth Wood Scheduled Monument [1013378] will be minor. This was also acknowledged by Kent County Council. However, Kent County Council also noted that unknown buried archaeological remains could be present that may be uncovered during construction works or that construction may lead to a change in condition in which the remains are preserved;
- Kent County Council welcomes the avoidance of physical impacts to Vagniacae [1004226] but challenges the assessment of non-designated heritage assets such as a Roman temple [MKE99355]. They proposed a further desk-based assessment of the area including a detailed assessment of historic landscape; and
- Kent County Council asks for an expansion of the study area for the Environmental Assessment Report for wider context.

11.2.7. Appendix 4-1 in the Option Selection Stage Environmental Assessment Report (EAR) summarises the consultations undertaken prior to public consultation. Historic Environment specific stakeholders include Historic England, Kent Historic Environment Record (HER), Kent County Council Heritage Conservation Group and Kent Archaeological Society.

11.3. Baseline conditions

Topographical & geological conditions

11.3.1. The archaeological desk-based assessment (AOC, 2017 – see PEIR Volume 1 Chapter 17 References) provides a brief summary of topographical and geological conditions, some of which shall be presented below.

11.3.2. Topographically, the Bean Junction is located on a ridge in the landscape, but south of the A296/A2 the topography undulates from Darenth Wood towards the Ebbsfleet Junction. The Bean southern roundabout is located on higher ground than Darenth Wood, thus affording views towards Darenth Wood. These views are lost once crossing the current bridge on Bean Lane towards Bean to the south of the A2 due to the gently sloping landscape towards Beacon Wood to the south of the study area. Due to its densely wooded character, and the rising topography towards Bean Junction, there are likely very limited seasonal views from inside of the Scheduled Monument at Darenth Wood [1013378] towards Bean Junction; only from the outskirts of the monuments can views be glimpsed.

11.3.3. Although the two roundabouts at Ebbsfleet Junction, which are to be expanded as part of the Scheme, are located on higher ground to the scheduled Springhead Roman settlement [1005140], there is limited visibility to the monument from the junctions due to current landscaping until the approach towards the A2 and A2260 sliproad. Due to the undulating landscape at Springhead Scheduled Monument [1005140], views from the monument towards the junctions are limited. In contrast, views from the southern of the two scheduled Neolithic sites at Ebbsfleet [1004206] are relatively open towards Ebbsfleet roundabouts.

11.3.4. The BGS maps available through their website shows the Site as being dominated by White Chalk and the Thanet Formation. The Palaeogene and Late

Cretaceous deposits are overlain in places by Quaternary deposits mainly consisting of alluvium, head and terrace gravel. Such deposits have the potential to preserve significant palaeoenvironmental and geoarchaeological remains.

11.3.5. There is evidence for sand, gravel, chalk and clay extractions, particularly within the northern extent of the study area.

Designated Heritage Assets

11.3.6. There are no World Heritage Sites, Registered Parks and Gardens, Conservation Areas or Registered Battlefields within the Scheme or study area.

11.3.7. The archaeological desk-based assessment (AOC, 2017– see PEIR Volume 1 Chapter 17 References) contains a comprehensive chapter on the archaeological and palaeoenvironmental evidence of the Scheme corridor, including the history of the area and geoarchaeological potential.

Scheduled Monuments

11.3.8. There are 4 Scheduled Monuments within the Scheme or study area. From west to east (from Bean to Ebbsfleet), these are as follows:

- Medieval woodland boundary in Darenth Wood [1013378];
- Springhead Roman Site (Vagniacae) [1005140];
- Neolithic sites near Ebbsfleet [1004206]; and
- Roman enclosure SE of Vagniacae [1004226].

11.3.9. Two Scheduled Monuments are located within the Site [1013378, 1005140, whilst the remaining 2 are either located to the east of the A2260 [1004206] or to the south of Watling Street on New Barn Road [1004226].

11.3.10. Apart from the medieval woodland boundary [1013378] located within Darenth Wood towards the west of the Site, the remaining 3 Scheduled Monuments can be found at Ebbsfleet to the east of the Scheme [1005140, 1004226, 1004206].

11.3.11. Both the medieval boundary [10013378] and Springhead Roman site [1005140] have previously been partially truncated during construction works of the A2. The medieval boundary is irregularly shaped and survives as an earthwork, enclosing a wood of around 35.5 hectares managed during the medieval period. Historic England does not currently provide a listing entry summary or summary of the extent, survival, character or significance of the other 4 Scheduled Monuments; however, by virtue of their designated status they are considered to be of high value. Vagniacae [1005140] is considered to be of high value due to its rich archaeological remains which includes a mix of domestic, commercial, industrial and ritual evidence (AOC 2017: 9 – see PEIR Volume 1 Chapter 17 References).

11.3.12. As works are currently planned to stay within the footprint of the existing A2 in the areas where the road borders these Scheduled Monuments, no further physical impacts within the designated area are anticipated. However, important non-designated remains associated with the Scheduled Monuments could exist outside of these formal designations. In addition, as no detailed construction elements are known at this stage, this will require further assessment in the next stages of the EIA process.

11.3.13. The number and extent of Scheduled Monuments in the study area suggest an area of extensive usage and good survival of remains dating to the Prehistoric, Roman and medieval periods.

Listed buildings

11.3.14. There are 5 Listed Buildings within the Scheme and study area. All are Grade II listed. From east to west (Bean to Ebbsfleet), these assets include:

- Lower Bean Farmhouse [1099940];
- Barn to south east of Lower Bean Farmhouse [1085808];
- Stone Castle [1099902];
- Blue House [1336457]; and
- Swanscombe Cutting Footbridge crossing A2 east of A296 Junction [1119762].

11.3.15. Apart from the footbridge crossing the A2 [1119762], all other remaining Listed Buildings are located outside of the Site itself, but within the study area.

11.3.16. Two buildings are located north-west of Bean [1099940 & 1085808] within the western portion of the study area, whilst the footbridge [1119762] and the Blue House [1336457] are located within the approximate centre of the study area. Stone Castle [1099902] is located at the north-western part of the study area within a mixed use residential and commercial setting north of Bluewater Retail Park. Apart from the footbridge [1119762] there are no other Listed Buildings within the Site and it is not currently anticipated that the bridge will be physically affected as part of the Scheme.

11.3.17. Aside from the footbridge [1119762] there is likely to be limited intervisibility to and from the Scheme to any other Listed Buildings referred to above. Following a site visit, any changes to the setting of the 4 Listed Buildings [1099940, 1085808, 1099902, 1336457] will be assessed, though it is not anticipated that these impacts will be significant. This follows on from the Option Selection Stage Environmental Assessment Report which concluded the magnitude of impact due to Scheme Option 1 and Option 5, which now form part of the Scheme, would lead to no change. This will be confirmed in the subsequent Environmental Impact Assessment, following the site visit and assessment of other environmental data produced for the Scheme.

Non-designated heritage assets

11.3.18. The KHER records 643 non-designated heritage assets within the Site study area. Five of these are associated with the Listed Building entries above, and 2 with the Scheduled Monuments at Darenth Wood [1013378] and the Neolithic sites near Ebbsfleet [1004206]. As these would have already been discussed in their designated heritage context above, they shall not be repeated here. Where non-designated heritage assets are copies of designated entries, both, the NHLE and KHER reference will be provided in the gazetteer.

11.3.19. Four hundred and thirty-two entries are findspots with the clear majority of these dating from the Iron Age to the Romano-British period. Whilst findspots are not heritage assets themselves, having been removed at the time of their discovery, they indicate the usage of the wider landscape during past periods. The

remaining 204 non-designated heritage assets are monuments, once again primarily dating from the Romano-British period. Forty-eight of these are present within the Site. The full list of non-designated heritage assets, excluding find spots, can be seen in Table 11.7 in the PEIR Volume 2 Appendix J.

11.3.20. In the west of the study area a small amount of Palaeolithic non-designated heritage assets have been recorded, and numerous flints and hand axes of similar dates, along with a tool manufacturing and elephant butchery site of the 'Ebbsfleet Elephant' [MKE43400] are located. At Springhead, an Upper Palaeolithic flint knapping site [MKE20294] has been uncovered during excavations of the Channel Tunnel Rail Link (CTRL). The Palaeolithic remains and sites are of high value, especially the butchery site and are particularly unusual survivals from a period where little is known.

11.3.21. In general, the area surrounding Ebbsfleet is rich in nationally significant Palaeolithic evidence, some in undisturbed context, and has been subject to extensive investigations. Such an intensity of investigations is not mirrored in the western extent of the Site. The evidence uncovered is mostly associated with the early Middle Pleistocene and is present at Swanscombe to the west of the Site and at Northfleet to the northeast.

11.3.22. Although there is no distinct geographical pattern in the dispersion of non-designated heritage assets, that is, all time periods are represented within both areas of the Scheme, there is a strong prevalence of Iron Age and Romano-British remains surrounding the Scheduled Monument of Vagniacae [1005140], and the majority of findspots and non-designated heritage assets are associated with this Scheduled Monument. Due to their association with the Scheduled Monument [1005140] and the wider Iron Age and Romano-British activity in the study area, non-designated heritage assets of the same date are considered to be of high value.

11.3.23. A Roman Temple [MKE99355] which has partially been excavated but was subsequently re-buried allowing some preservation in situ preserved in situ under the A2 slip road north of Watling Street, has been singled out in the consultation report as requiring further assessment. Coin finds indicate that the temple was constructed in c. AD 180/190 and demolished a century or so later. Due to this asset's association with the Scheduled Monument, it is considered to be of high significance; however, further detailed assessment of it, and other non-designated heritage assets in the area, should be undertaken following consultation with Kent County Council.

11.3.24. The presence of further non-designated Romano-British assets surrounding Vagniacae further cements this area as one of strengthens the position of the area as being of high significance in relation to the Romano-British period. To name a few, These important assets include a Roman Road [MKE4004], a ritual settlement [MKE1632], a selection of features including a kiln [MKE20569], a courtyard feature [MKE20564], two further Roman temples [MKE99370; MKE99355], a possible bath house [MKE99390] and six early Roman burials [MKE99368], which only present a fraction of the non-designated Roman heritage assets surrounding or placed within the Scheduled Monument. The potential for further archaeological remains associated with the Romano-British activity in the area is considered to be very high where previous construction or development has not disturbed original ground levels of this period and earlier. therefore high.

11.3.25. The non-designated heritage assets, along with the associated Scheduled Monuments provide a clear picture of a heavily utilised landscape from the early prehistoric period, a particularly intense area of settlement during Iron Age and Roman periods with continued occupation into the medieval period. Therefore, considering the density of known non-designated heritage assets, further detailed assessment of these is recommended for the following EIA stages that is likely to include elements of non-intrusive and intrusive archaeological fieldwork. The scope and methods of any archaeological fieldwork will be agreed with Historic England and KHCT prior to the commencement of works.

Other archaeological assets

11.3.26. Although the Scheme largely follows the existing footprint of the A2, certain elements of the Scheme, such as the construction of another bridge, the widening of roundabouts and lanes and the addition of slip roads, have the potential to impact on previously undisturbed areas that may contain surviving buried archaeological remains**.** As per above baseline, evidence of activity stretches from the Palaeolithic to the post-medieval period within the study area with a strong prevalence for Iron Age and Romano-British remains. Therefore, it is considered that any currently unknown archaeological remains may also date from the Palaeolithic to the post-medieval period. Due to the high potential for uncovering buried archaeological remains as part of the Scheme, an assessment of the potential for archaeological remains should be included at detailed assessment stage within the next stages of the EIA process.

Historic landscape

11.3.27. The KHER has identified five Historic Landscape Characterisation (HLC) types to be present within the Scheme and study area. These are as follows:

- Field patterns (Type 1);
- Horticulture (Type 3);
- Woodland (Type 4);
- Settlements (Type 9); and
- Extractive and other industry (Type 12).

11.3.28. In addition, there is extensive 20th century development, including large scale infrastructure such as the A2 highways and associated junctions, extensive quarrying to the north of the A2 and both modern industrial and housing estates that are dominant landscape features and have significantly altered the historic landscape prior to this period.

11.3.29. The Scheme will largely be contained with the existing alignment of the A2 with lane widening at the associated roundabouts, the addition of slip roads and a bridge parallel with existing crossing at Bean. With these alterations being very localised around existing infrastructure, and in considering the predominantly modern developed character of the study area, the Scheme is not considered to have a significant adverse effect on the historic landscape given the proposed improvements are consistent with the current modern landscape character. However, a site walkover survey will be undertaken to confirm this opinion or otherwise recommend further assessment at EIA stage.

Previous archaeological investigations

11.3.30. A more detailed account of previous archaeological investigations can be found within Section 5.9 of the archaeological desk-based assessment (AOC, 2017 – see PEIR Volume 1 Chapter 17 References), however, a brief summary is presented below.

11.3.31. A desk-based assessment [EKE14673] to the west of the eastern extent of the Site concluded a high potential for surviving, buried archaeological remains. A second assessment [EKE14689], which partially includes the eastern section of the Site, evaluated Palaeolithic potential and concluded that such potential varied across the area.

11.3.32. A geoarchaeological evaluation [EKE14065] within the northern extent of the study area encountered Palaeolithic and Roman remains.

11.3.33. The Scheduled Monument of *Vagniacae* [1005140] has been investigated from the 19th century onwards and mid-20th century works of the A2 unveiled a large area of it that had previously not been excavated [EKE8919].

11.3.34. Within the Ebbsfleet area, archaeological investigations have been undertaken within the last decade, largely by Wessex Archaeology and Oxford Archaeology. These mainly related to the CTRL project and included a geophysical survey [EKE14724], a field survey [EKE11611], a programme for archaeological watching briefs [EKE8576], strip map and recording works [EKE8575] and a series of evaluations [EKE8529, EKE8568, EKE8582 and EKE8919].

11.3.35. Within the Ebbsfleet Valley, geotechnical ground investigations have indicated that the ancient valley floor and lower valley sides are masked by deep colluvial deposits that have moved as a result of ploughing.

11.3.36. Large areas of the eastern extent of the Site and study area have previously been subject to archaeological investigations in response to the Channel Tunnel Rail Link (CTRL). The western half of the Site conversely, has experienced much less archaeological investigation to date.

11.3.37. Additional archaeological fieldwork has been undertaken that has not currently been publish. This information will be requested in draft format is necessary from KHCT to inform the ES. This includes the archaeological geophysical survey at Ebbsfleet Green by Archaeology South-East.

11.4. Potential impacts

11.4.1. As per the DMRB methodology, potential impacts on the cultural heritage resource are defined as changes to the historic environment resource caused by the mitigated Scheme. It should be noted that this assumes that any potential impacts are firstly avoided through careful design, such as preservation *in situ.* If impacts are still unavoidable, then by sensitive design will be employed to minimise as far as possible any remaining adverse impacts and strategies developed to ensure no additional significant effects are caused to the historic environment resource.

11.4.2. The type of impacts that can occur through a roads improvement scheme include:

- Direct physical impacts, such as partial destruction or total loss of a heritage asset; and

- Settings impacts, which include non-physical changes to the character and significance of assets arising from works such as alteration of lines of sights, removal of screening, air and noise pollution.

11.4.3. In accordance with the methodology outlined in Section 11.3 in the PEIR Volume 2 Appendix J, the assessment of direct impacts upon known remains will involve establishing the value of the affected heritage asset and the sensitivity of the asset to change. The impact magnitude is then calculated based on those factors.

11.4.4. The ES will include a full impact analysis of known heritage assets within the site and study area. It is anticipated that further detailed design and construction elements will be known at that stage. Assets identified in the pre-application EIA Scoping Report and the AOC (2017) archaeological desk-based assessment have been included below.

11.4.5. To assist with understanding the timelines of any impacts likely to be caused by the Scheme, these have been separated into 'construction' and 'operation' impacts.

Construction

11.4.6. During construction, direct physical impacts are likely to occur from earthmoving operations, creation of site compounds, road formation/construction, and construction of proposed overbridges/structures. Setting impacts are likely to occur due to the introduction of construction machinery on sites, additional construction traffic, construction of compounds and vegetation removal with the potential to create new sightlines and views of the A2 highway.

11.4.7. The potential effects of construction activities upon setting would be temporary, short term and reversible, however, direct physical impacts and new infrastructure are usually permanent in nature.

11.4.8. The proposed compound location at Bean Junction has been placed to avoid known designated and non-designated heritage assets. While the exact dimensions of the proposed compounds at Ebbsfleet are not currently known, their locations fall within the western extent of the non-designated heritage asset [MKE1632] associated with scheduled Springhead Roman settlement.

11.4.9. Table 11.4 in the PEIR Volume 2 Appendix J lists the known heritage assets that are likely to be impacted by construction of the Scheme. Furthermore, increases in site construction vehicles and effects from traffic management upon noise and air pollution levels during construction of highway and junction improvements will likely have a temporary adverse impact on the appreciation of individual heritage assets where close to Scheme.

Operation impacts

11.4.10. During operation, the Scheme should have no additional direct physical impacts on buried archaeology, as these will either have been preserved in situ at the design stage or mitigated through archaeological excavation and recording prior to construction. However, the setting of heritage assets could be impacted and these would be long term and permanent in nature. Measures will be developed therefore at both the design stage and during and after construction to avoid any significant impacts, for example via appropriate screening, and where possible

enhance the historic environment. Where impacts are unavoidable, careful design will seek to reduce such impacts to a minimum. An updated assessment of impacts will be undertaken at the EIA stage, following the submission of detailed mitigation design measures.

11.4.11. The operation of the Scheme has the potential to result in changes to the setting of 4 Listed Buildings, as set out Table 11.5 in the PEIR Volume 2 Appendix J.

11.4.12. The Scheme improvements are designed to assist traffic flow and reduce standing traffic where noise and air pollution is at its highest level. This will result in an overall beneficial effect on individual assets and the historic environment as a whole.

11.5. Potential mitigation measures

11.5.1. The planning policies and guidance as set out in the PEIR Volume 2 Appendix A, require a mitigation response to potential impacts upon heritage assets to avoid, minimise or offset adverse impacts and enhance the historic environment where possible.

11.5.2. Assessment of the historic landscape currently concludes no significant impacts are anticipated due to the scheme mainly being developed within the highway boundary, with minimal expansion and operation consistent with existing infrastructure. The key components of the historic landscape include the quarries to the north, Ebbsfleet Marshes LWS to the east and the ancient woodland to the south, all of which are not expected be significantly affected. However, a detailed assessment following a walkover survey will be undertaken once access is granted to fields surrounding the scheme. There is likely to be a number of adverse effects on buried archaeological remains through physical truncation during construction and changes to the setting of both designated and non-designated archaeological sites and listed buildings during construction and operation. No beneficial effects are considered likely based on the current design.

11.5.3. The following potential mitigation measures, which are outline only and subject to change, are proposed:

- Avoid direct impacts on known heritage assets during enabling and construction works. This can be achieved firstly through careful design by moving site works away from heritage assets and where unavoidable, through the fencing off of known heritage assets (such as the Grade II listed Swanscombe Cutting Footbridge [1119762] to ensure their continued protection;
- A programme of archaeological investigation will be undertaken in areas affected by the Scheme where there is considered to be potential for archaeological remains to survive. The scope and extent of such investigations will be developed in consultation with KHCT and HE and subject to a Written Scheme of Investigation for their approval;
- All compounds, laydown areas and access routes to avoid siting within the boundaries of, or over designated heritage assets. Similarly, these associated construction areas should avoid the non-designated assets area associated with Springhead Roman settlement at Ebbsfleet Junction; and

- Construction areas; to include all compounds and temporary routes, will erect protective fencing prior to site works in order to bar incursion into Darenth Wood Scheduled Monument [1013378] and the Roman settlement of Vagniacae [1005140].

11.6. Residual impacts

11.6.1. Residual impacts have been defined as those environmental effects predicted to remain after the application of any necessary mitigation. Significant impacts are those that have an irreversible effect and that cannot be altered once operational. It should be noted that only broad conclusions on residual impacts can be presented at this stage due to limited information presented on enabling and construction details. A detailed impact assessment will need to be undertaken once this information is available and following all on site surveys and investigations to determine the full scope and extent of potential impacts on the historic environment. The following broad conclusions are therefore offered below:

- In relation to this Scheme and the construction impacts outlined in Table 11.4 in the PEIR Volume 2 Appendix J, where buried archaeology is directly impacted by construction, and has been excavated and recorded, there should be no residual impacts;
- Operation of the Scheme should have no significant residual impacts on heritage assets or their settings (see Table 11.6 in the PEIR Volume 2 Appendix J) given the nature of the existing highway network has already significantly altered the historic landscape and will remain broadly the same in use and alignment as before; and
- Noise and air pollution levels are not expected to significantly increase with the Scheme improvements to traffic flow and therefore should have a negligible effect on the historic environment.

11.7. Cumulative effects

11.7.1. The cumulative effects are those that result from the additive impacts of both the Scheme's components, and any past, present or future developments within the surrounding landscape. These effects should be considered both during the construction and operation stages.

11.7.2. A detailed assessment of cumulative effects will be undertaken as part of the ES, following a programme of archaeological evaluation of the appropriate areas, which will be implemented to further understand the impact of the Scheme. Table 11.6 in the PEIR Volume 2 Appendix J provides the results of an initial high-level assessment of cumulative effects.

11.7.3. The preliminary assessment shows there is likely to be significant adverse cumulative effect arising from the construction of the Scheme in conjunction with other proposed development in the area, particularly in regard to important as yet determine archaeological and palaeoenvironmental remains. The scale and extent of these impacts will need to be assessed in detail in the ES and following further planning application information.

11.8. NPS compliance

11.8.1. Sections 5.126 and 5.127 of the NPS state the following:

11.8.2. 5.1.26 'Where the development is subject to EIA the applicant should undertake an assessment of any likely significant heritage impacts of the proposed project as part of the Environmental Impact Assessment and describe these in the Environmental Statement.'

11.8.3. 5.1.27 'The applicant should describe the significance of any heritage assets affected, including any contribution made by their setting. Th level of detail should be proportionate to the asset' importance and no more than is sufficient to understand the potential impact of the proposal on their significance. As a minimum the relevant Historic Environment should have been consulted and the heritage assets assessed using appropriate expertise. Where a site on which development is proposed includes or has the potential to include heritage assets with archaeological interest, the applicant should include an appropriate desk-based assessment and, where necessary, field evaluation.'

11.8.4. The EIA to be presented in the ES will provide an opportunity for the Secretary of State to assess impacts in the required manner and therefore be NPS compliant.

11.9. Assumptions and limitations

11.9.1. Limitations of current information specifically relate to the understanding of the presence and significance of buried archaeological remains within the Scheme boundary where previous investigations have not been carried out before. Liaison with stakeholders will be undertaken to enhance the knowledge and to agree the scope of archaeological surveys required to inform the assessment in the ES.

11.10. Summary

11.10.1. The PEIR has shown that there is potential for the Scheme to have an adverse effect on both designated and non-designated heritage assets within the Site and wider study area, covering archaeology and built heritage. In total, 13 known heritage assets are considered likely to be adversely affected based on the current design, with potential significant moderate to major adverse impacts expected to the non-designated asset linked to Springhead Roman settlement [MKE1632].

11.10.2. There are highly significant archaeological and palaeoenvironmental remains across the study area and in particular non-designated Roman remains associated with the Springhead Roman settlement and temple site located adjacent to the A2 at Ebbsfleet. Similarly, Palaeolithic and Neolithic activity surrounding the Ebbsfleet roundabouts is of very high interest. Any such remains likely to be affected by the Scheme will be subject to archaeological evaluation and appropriate mitigation where preservation in situ may not be possible.

11.10.3. The historic landscape is not currently considered to be significantly affected by Scheme; however, this will be further assessed during the site walkover survey and following confirmation of temporary compounds and associated construction routes and laydown areas. In particular, the ancient woodlands (The Thrift and Parkhill Wood) adjacent to the A2 may suffer changes to their setting, which will be considered in terms of sensitive design measures to minimise adverse effects.

11.10.4. The improvements will be designed to assist with traffic flow at peak times and therefore is it expected that noise and air pollution levels will not significantly increase and therefore have a negligible effect on the appreciation of individual assets.

11.10.5. Further consultation with the statutory consultees and stakeholders will be undertaken to inform the EIA process and develop appropriate mitigation strategies where significant impacts are predicted on the historic environment. Any opportunities to design improvements to the historic environment will also be considered and discussed with stakeholders.

Chapter 12 - Materials and Waste

12.1. Introduction

12.1.1. This chapter includes the preliminary environmental information for the assessment of material resources and waste associated with the A2 Bean and Ebbsfleet Junction Improvements Scheme, during construction, demolition and excavation (CD&E) and operation. Although potential mitigation measures have been identified, it should be noted that insufficient design detail was available at the time of document production to undertake the assessment, and such the assessment will be undertaken as part of the ES.

12.1.2. This section should be read in conjunction with the materials and waste information provided in the PEIR Volume 2 Appendix J, which lists the key legislation and policy, study area, methodology and tables for the materials assessment.

12.2. Consultation

12.2.1. It is proposed that Kent County Council, as the author/ owner of the Kent Minerals and Waste Local Plan 2013-30 (2016– see PEIR Volume 1 Chapter 17 References) will be consulted further on the proposed assessment methodology.

12.3. Baseline conditions

12.3.1. The PEIR has been written in accordance with IAN 153/11, which provides guidance on the identification and assessment of impacts associated with the use of material resources and waste arisings for construction and improvement schemes.

12.3.2. The Scheme will aim to prioritise waste prevention, followed by preparing for re-use, recycling and recovery and lastly disposal to landfill as per the internationally recognised waste hierarchy, as shown in Figure 12.1 the PEIR Volume 2 Appendix K.

12.3.3. Desk based information has been gathered to identify the existing baselines that may be impacted by the use of material resources and the generation of waste from the Scheme.

12.3.4. With regards to material resources associated with CD&E, no baseline is available for material resources use on a regional level. As such, national demand for key construction materials has been collated which will be used as part of the EIA process to assess at a high-level, the impact of the Scheme on the national baseline.

12.3.5. With regards to CD&E waste associated with the Scheme, this will be primarily non-hazardous and inert, with small quantities of hazardous waste (e.g. associated with sealants, paints, solvents and contaminated soil). The CD&E baseline has been collated from regional data relating to the amount of waste that is produced/ is estimated to be produced on a regional level.

12.3.6. As hazardous waste is often treated outside of the region within which it is produced (e.g. there are reported cases of hazardous waste produced in the south east of England which has been transferred to the north west of the

country), the baseline has been collated from data relating to the amount of hazardous waste that is produced/ is estimated to be produced and the infrastructure capacity at a national level. Both the baseline for waste that is produced/ is estimated to be produced and the baseline for waste infrastructure capacity will be used as part of the EIA process to assess the impact of the Scheme.

12.3.7. Less impact is envisaged during the operational stage of the Scheme due to minimal material resources use (associated with planned/ unplanned maintenance) and waste generation (through littering and planned/ unplanned maintenance). Most of these wastes would likely be non-hazardous municipal type wastes (e.g. litter (paper, food, packaging, etc.) and non-hazardous/ inert and hazardous wastes from planned/ unplanned maintenance (concrete, bituminous materials, waste electrical and electronic equipment (WEEE), oils, etc.). Data related to operational material resources use and waste generated by highway schemes is not readily available and as such will not be assessed as part of the EIA process.

12.3.8. The baselines for material resources and waste are presented below in paragraphs 12.3.9 to 12.3.14.

Material resources baseline

12.3.9. The national demand (baseline) has been estimated for the key construction materials associated with the development and are shown in Table 12.4 in the PEIR Volume 2 Appendix K. The national baseline has been sourced from data published by the Mineral Products Association, UK Steel and the Forestry Commission.

12.3.10. The key construction materials identified in the table are based on the main construction materials identified in the Bill of Quantities (or equivalent) from previous road improvement schemes. National demand data is drawn from data for both 2014 and 2015 (most readily available data). Note, given that the number, type and size of construction developments varies from year to year, the demands for construction materials also fluctuate. As such, this data should be considered representative.

Waste baseline

12.3.11. The amount of CD&E and hazardous CD&E waste arisings for Kent will fluctuate year on year based on the number, type and size of construction schemes underway. This in turn is heavily influenced by factors such as the economic situation, investment levels and legislative and policy variations. Thus, the representative baseline for CD&E waste arisings for the Scheme's construction period (2020 to 2022) has been calculated based on data in the report "Kent Waste Needs Assessment 2017 - Construction, Demolition & Excavation Waste Management Needs", as shown in Table 12.5 in the PEIR Volume 2 Appendix K.

12.3.12. The national baseline for hazardous CD&E waste arisings is taken from the Environment Agency Hazardous Waste Interrogator Tool (2016 – see PEIR Volume 1 Chapter 17 References) filtered by construction waste. As with the non-hazardous/ inert CD&E baseline this will fluctuate year on year based on the number, type and size of construction schemes underway.

Waste infrastructure baseline

12.3.13. The regional CD&E waste infrastructure capacity is based on the same report used for baseline data, "Kent Waste Needs Assessment 2017 - Construction, Demolition & Excavation Waste Management Needs" and is shown in Table 12.6 in the PEIR Volume 2 Appendix K.

12.3.14. The national hazardous waste infrastructure capacity, interpreted from the Environment Agency list of permitted facilities (2015 – see PEIR Volume 1 Chapter 17 References), is presented in Table 12.6 in the PEIR Volume 2 Appendix K.

12.4. Potential impacts

12.4.1. Potential impacts are related to the potential impacts on the existing baseline in Section 12.3.1 to 12.3.14 above.

12.4.2. Receptors which have the potential to be impacted, with regards to material resources and waste, are defined as:

- The market for key construction materials, which are to be used throughout the Scheme, as shown in Table 12.3 in the PEIR Volume 2 Appendix K;
- The waste arisings baseline – the amount of waste that is predicted to be produced during the CD&E phases of the Scheme, shown in Table 12.4 in the PEIR Volume 2 Appendix K; and
- The predicted capacity of waste infrastructure - essentially the capacity of sites receiving, placing, treating, recycling, recovering and/ or disposing of waste both regionally (non-hazardous and inert) and nationally (hazardous) which are anticipated to arise from the Scheme during the construction phase. The waste infrastructure capacity is shown in Table 12.5 in the PEIR Volume 2 Appendix K.

12.4.3. As aforementioned, less impact is envisaged during the operational stage of the Scheme (see Section 12.3.7).

12.4.4. It should be noted that potential impacts on Minerals Safeguarding Areas and consideration of contaminated soils are covered in the PEIR Volume 1 Chapter 10 Geology and Soils.

12.5. Potential mitigation measures

12.5.1. Although every effort will be made (through the design process) to maximise resource efficiency, it is inevitable that waste will be generated during each phase of the Scheme. This will have an impact on the regional waste infrastructure and the regional quantity of waste arisings.

12.5.2. Mitigation measures are necessary in order to reduce the environmental effects of both the CD&E and operational phases of the Scheme. The following sections detail the mitigation measures that should be implemented. Where applicable, design and enhancement measures have also been included. Many of the measures outlined in both the CD&E and operational sections are also mitigation measures for material resources, and as such a separate section has not been provided.

12.5.3. In light of an assessment not being undertaken at this stage, mitigation measures have been included as examples of best practice.

CD&E

12.5.4. There are a number of different design, mitigation and enhancement measures that can be utilised for waste management holistically throughout the CD&E phases as outlined in Figure 12.1 and detailed below.

Figure 12.1: CD&E mitigation measures

Designing out waste

12.5.5. Waste should be designed out early in the project development process or as early as is practicable to ensure materials used:

- Are to industry standard specifications;
- Are locally sourced, where practicable;
- Are reused/ reclaimed (potentially from excavation and/ or demolition), where practicable; and/ or
- Are recycled or reclaimed, where practicable.

12.5.6. The UK's Waste Resources Action Programme (WRAP) has produced guidelines for design teams under the following headings:

- Re-use and recovery;
- Off-site construction;
- Materials optimisation;
- Waste efficient procurement; and
- Deconstruction and flexibility.

12.5.7. In addition, it is recommended that efforts are made both by the designer and the contractor(s) to reduce the wastage rates of the construction waste streams which arise in the greatest quantities (e.g. inert materials and concrete).

12.5.8. All of these factors should be considered and implemented in the design to improve the sustainability of the Scheme, including minimising waste to landfill.

On-site management of CD&E waste

12.5.9. Best practice waste management on CD&E schemes, which should be applied to the Scheme include:

- Designing out waste at the initial stage of the Scheme through utilising standardised sizes and materials where possible and engaging with the

design team on the importance of this. This should include working to reduce the wastage rates of the construction materials that constitute the waste streams which arise in the greatest quantities;

- Setting targets for waste recovery and recycling, communicating these to those working on the Scheme with a clear understanding of what is expected;
- Preparation and maintenance of a MMP (if applicable), CEMP and a SWMP so that waste generation and management can be logged and audited;
- Using precast concrete and other materials that can be prepared off-site to minimise waste generation on-site;
- Not over ordering materials and using materials brought to site as efficiently as possible;
- Organising deliveries so materials arrive on-site as they are needed to reduce the possibility of damage and wastage occurring;
- Having clearly defined and separated skips on-site and a clearly demarked waste area(s); and
- Training staff to understand how they should sort any waste material and providing regular reminders and updates.

12.5.10. Best practice waste management not only reduces the environmental effects of a development through reducing waste to landfill or incineration, but also offers cost benefits, as the cost of disposal to landfill or incineration is not needed.

Treatment and disposal

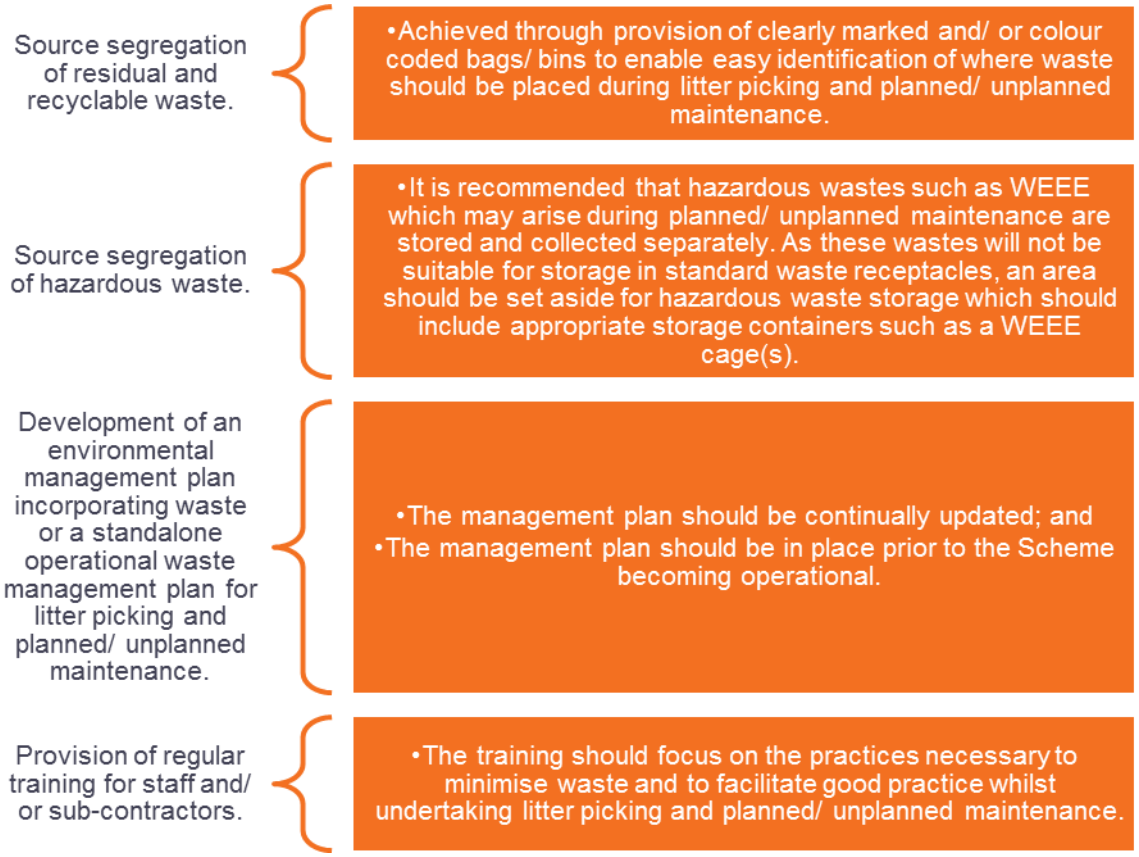
12.5.11. The Scheme should be committed to achieving a high recycling and recovery rate for all CD&E waste generated on-site. This can be achieved by arranging for the source segregation of recyclable materials and the provision of appropriate recycling facilities. Achieving a high recycling rate will minimise the environmental burden in terms of pollution, energy consumption, the carbon impact and the emission of large quantities of carbon dioxide equivalent associated with the production of products from virgin material.

12.5.12. Across the country there are a number of waste collection and disposal companies. The developer must select waste contractor(s) who are registered with the Environment Agency as a waste carrier for all CD&E waste to be transported, including hazardous waste. The contractor should be able to undertake daily collections which will be required during the CD&E phases. Completed waste transfer notes and/ or hazardous waste consignment notes must be provided by the contractor. These should be kept for a minimum of two and three years respectively. Any site that waste is transferred to must also have either a permit or exemption that allows it to receive and manage the waste being transferred.

Operation

12.5.13. The operational mitigation measures that should be implemented are detailed in Figure 12.2 below.

Figure 12.2: Operational mitigation measures



12.6. Residual impacts

12.6.1. The use of material resources and the generation of solid waste is an inevitable consequence of all forms of development and as such there will be unavoidable impacts. However, the impact level can be reduced throughout the use of mitigation measures during design, during the CD&E phases and during the operational phase.

12.6.2. As such, it is not possible to estimate the level of residual impact and therefore the potential impacts, as outlined in Section 12.3, should be considered representative.

12.7. Cumulative effects

12.7.1. The cumulative impact of material resources and waste will be assessed as part of the EIA process.

12.7.2. Several relevant planning applications from Dartford and Gravesham Borough Council were reviewed for this task.

12.7.3. From the 15 applications reviewed, only three had sufficient information relating to waste management to be able to assess cumulative effects.

12.7.4. These are detailed below:

- Eastern Quarry - Mixed use up to 6,250 dwellings and 231,000 m^2 of floorspace for business, education, community & social facilities; hotels; theatre; supporting retail & leisure facilities, ancillary & support facilities;

- Ebbsfleet Green - Mixed use redevelopment of up to 950 dwellings & non-residential floorspace for: shopping, food & drink, hotel use; community, health, education & cultural uses; assembly & leisure facilities & associated works; and
- Former Northfleet Cement Works - mixed development comprising up to 532 homes and floorspace for employment, retail/cafe/takeaway; community centre and public open space.

12.7.5. The waste impacts of these schemes are:

- Eastern Quarry - over 20 years:
  - Construction waste - 91,393 tonnes (4,570 tpa);
  - Operation waste - 10,000 tpa MSW; and
  - Operation waste - 7,000 tpa commercial waste.
- Ebbsfleet Green - over 12 years:
  - Construction waste - 17,149 tonnes (1,430 tpa);
  - Operation waste - 823 tpa MSW; and
  - Operation waste - 265 tpa commercial waste.
- Former Northfleet Cement Works - over 8 years:
  - Demolition waste: 72,000 tonnes - complete by 2011;
  - Construction waste - 17,014 m3 (1,850 tpa - converted using industry waste density for mixed C&D waste); and
  - Operation waste - 8,469 tpa.

12.7.6. Based on the figures above, during a year the three schemes were producing waste at the same time the combined total would be 7,850 tpa.

12.7.7. This would be 0.3% of the regional CD&E baseline (2,520,000 tpa) and 0.04% of the regional CD&E capacity (22,073,247). Therefore, it would have a negligible, short term impact.

12.8. NPS compliance

12.8.1. The NPS outlines of the importance of managing resources and wastes in order to prevent and minimise environmental impacts. The mitigation measures outlined in Section 12.5 should be adhered to and considered throughout all stages of the Scheme. Management measures are inclusive of, but not limited to, the implementation of the waste hierarchy (see Figure 12.1 in the PEIR Volume 2 Appendix K), the correct management of waste both on-site and off-site and identifying appropriate waste infrastructure for waste treatment and disposal.

12.9. Assumptions and limitations

12.9.1. Both the assessment of effects on materials and waste is based on design information being available. The assessment in the ES will be refer to a bill of quantities or cost schedule prepared for the Scheme design. If for any reason this is not available, the assessment will be based on the worst-case scenario

information from other similar schemes, rather than the specific details of this Scheme.

12.10. Summary

12.10.1. Potential impacts are likely to occur as a result of the Scheme during the construction phase. Waste planning and design early in the project development process will ensure wastage is minimised throughout the lifecycle. Waste can be used as a resource where practicable and designed out where possible.

12.10.2. In terms of material resources, the impacts of the Scheme are identified and evaluated against the national demand for key construction materials and raw material resources.

12.10.3. Less impact is envisaged during the operational stage of the Scheme due to minimal material resources use (associated with planned/ unplanned maintenance) and waste generation (through littering and planned/ unplanned maintenance) and as such it will not be assessed as part of the EIA process in the ES.

Chapter 13 - People and Communities

13.1. Introduction

13.1.1. Without prejudice to the findings of the forthcoming EIA in the ES, this chapter has been prepared to provide the preliminary environmental information to inform the assessment of the likely impact of construction and operation of the Scheme on people and communities.

13.1.2. The assessment topics and methodology followed is in accordance with the guidance provided in the DMRB Volume 11 and IAN 125/15.

13.1.3. This section should be read in conjunction with the peoples and community information provided in the PEIR Volume 2 Appendix L, which lists the key legislation and policy, study area, methodology and tables for the assessment and Figure 13.1 in the PEIR Volume 3.

13.2. Consultation

13.2.1. In accordance with DMRB Volume 11 Section 3 guidance, consultation will be undertaken with the Local Authorities (Dartford Borough Council, Gravesend Borough Council, Kent County Council and Ebbsfleet Development Corporation), business owners (including agricultural tenants) and managers of community facilities likely to be affected by the Scheme.

13.2.2. Consultation will also be undertaken with NMUs encountered during site surveys and at a workshop targeted to include groups that use this land for leisure or as part of their business or charitable function.

13.2.3. The aim of consultation will be to confirm the community and private assets identified within the study area baseline, to ascertain their level of usage by members of the community and obtain more information on anticipated impacts of the Scheme.

13.3. Baseline conditions

Private dwellings

13.3.1. The area around the Scheme includes a mixture of privately owned uses. Residential properties are found in the main settlements of, Northfleet, Ebbsfleet Valley, Greenhithe, and in the smaller villages of Bean and Lane End to the South of the A2. A number of isolated properties, commercial land and farms are within the A2 corridor study area including two traveller sites, Stonewoood and Darenth Wood. Initial desk based research has identified the following potential residential receptors as shown on Figure 13.1 in the PEIR Volume 3.

13.3.2. Several residential and non-residential properties are located within, or close to, the Scheme boundary, potential receptors within or adjacent to the red line boundary at the junctions are shown in Table 13.16 in the PEIR Volume 2 Appendix L. This list is not intended to be exhaustive and will be refined as part of the assessment process at this stage.

Community assets

13.3.3. There are several public and private community receptors that are located within close proximity to the Scheme. Initial desk based research has identified the following potential community receptors as shown on Figure 13.1 in the PEIR Volume 3.

13.3.4. Community facilities are located within the main settlements of Northfleet, Ebbsfleet and Greenhithe. These include many education facilities and open space. Darent Valley Hospital is located approximately 1.2 km to the west of the Scheme at Bean Junction.

13.3.5. To the south of the Scheme in the village of Bean community facilities include the Bean Youth and Community Centre, Bean Primary School, High Street Park and Allotments, Beans Post Office, Bean Village Surgery. The Spirits Rest Horse Sanctuary is located within the red line boundary at Bean Junction.

13.3.6. Community receptors will be identified and refined further as part of the assessment process.

Local businesses

13.3.7. One of the major land uses in the study area is Bluewater Retail Park, located to the north-west of Bean Junction. This large site comprises 330+ individual stores, cafes and restaurants and is a major destination for the immediate and wider area.

13.3.8. There are a number of local businesses within and adjacent to the red line boundary. These are located within the Bean Triangle and adjacent to the north and south of the Ebbsfleet Junctions.

13.3.9. Initial desk based research has identified the following potential business receptors as shown on Figure 13.1 in the PEIR Volume 3. This list in Table 13.17 in the PEIR Volume 2 Appendix L is not intended to be exhaustive and will be refined as part of the assessment process.

Agricultural land

13.3.10. The published Ministry of Agriculture, Fisheries and Food (MAFF) 1: 250,000 Provisional Agricultural Land Classification (ALC) Map, available on Defra's Magic website (2017 – see PEIR Volume 1 Chapter 17 References) provides only a broad indication of land quality and should not be used definitively on specific sites smaller than 80 ha in size. The land affected by the Scheme is all shown as being in Grade 2 (good quality agricultural land).

13.3.11. There are no, more detailed, ALC surveys of the area on the Magic website. However, it is possible to apply MAFF's 1988 Revised Guidelines taking into account climatic, site and soil conditions. Under this classification deep well drained sandy and loamy soils within the Fyfield association would be in Grade 2; hence of BMV quality, because of their gentle topography, depth, drought resistance and free drainage. The exception is the land north of the Ebbsfleet Junction where Google Earth imagery of December 2003 shows heavy disturbance during the construction phase, with the underyling chalk brought to the surface. The restored soils are unlikely to be of their original quality, as evidenced by the fact that in 1999 images they are under arable crops, but now

are under scrub and rough grass. This suggests that the ALC is Grade 4 (poor quality) or Grade 5 (very poor quality)

Development land

13.3.12. The Ebbsfleet Garden City development which proposes 15,000 new homes alongside 30,000 new jobs is located to the north of the A2.

13.3.13. Table 13.18 in the PEIR Volume 2 Appendix K provides the list of development land based on sites within 500 m of the red line boundary and are shown on Figure 13.1 in the PEIR Volume 3 and drawn from development proposals identified on the PINS website, and in relevant LPA Local Plans and Proposals maps, and planning applications. The locations of these are indicated on Figure 13.1 in the PEIR Volume 3.

Non-motorised users

13.3.14. There are a number of PRoW and NMU routes within the study area as shown on Figure 13.1 including:

- DR312 - PRoW running north - south across agricultural land to the west of the Scheme and north of the A2;
- DR18 PRoW running north - south across agricultural land to the west of the Scheme and south of the A2;
- DR19 - PRoW running in a north-easterly direction to the south of the A2 north of Bean;
- DR22 - PRoW running east-west within the village of Bean itself;
- DR27 - Restricted Byway, running east-west to the west of Bean;
- DS20 - PRoW running north from the A2 (to the west of the Northfleet Grid Sub Station) terminating at Swanscombe;
- DR128 - PRoW running south from the A2, connecting to Park Corner Road;
- NU14 - PRoW running north from the A2 (to the east of Springhead nurseries);
- DR129 - Restricted Byway running in south west from the A2;
- NU47 - PRoW running north east from the A2 towards Gravesend;
- DR33 - PRoW running north from Lane End meeting DR26 and Wood Lane;
- DR26- PRoW running east from Lane End towards Bean;
- DR21 - PRoW within Bean;
- DR20 - PRoW running north east from Sandy lane towards the A2;
- DR22- PRoW running east the High Street in Bean;
- DR23 - PRoW running east the Southfleet Road High in Bean;
- DR14 - PRoW running south from London Road meeting DR15 in Greenhithe;
- DR15 - PRoW running west from the B255 meeting DR14 in Greenhithe;
- NU16 - PRoW running west from the B262 meeting Nu47 in Northfleet;

- NU19- PRoW running south from Springhead Road continuing as NU47 in Northfleet; and
- NU20 – Restricted Byway, running east-west and meeting NU14 in Northfleet.

13.3.15. The study area contains roads which comprise NMU routes including footpaths within the highway including sections of the A2, A296, B255, A2260, B262 and local roads. Additional NMU routes across the A2 include the footbridge west of Bean Junction along Wood Lane (footpath with apparent public access), the subway between Sandy Lane and Watling Street east of Bean Junction and the Swanscombe Cutting Footbridge north of Stonewood traveller site.

13.3.16. The study area also contains routes which are suitable for cycling including National Cycle Routes 1 and 177, which run broadly parallel to the A2, and cycleway adjacent to the B255.

13.3.17. There are no PRoW bridleways within the study area, however there is a riding school (Arrow Riding Centre), that could be expected to generate equestrian trips within the vicinity.

Community severance

13.3.18. The A2 acts as a barrier, limiting movement for NMU and other local journeys, from accessing services to the north and south, including those facilities described in both community assets and local business. The North Kent railway line runs to the north of the A2 with stations at Greenhithe, Swanscombe and Northfleet, in addition to this are national and international services which are provided at Ebbsfleet International. There are bus stop and services, including the Fastrack service within the area. At Bean Junction, the bus routes use all links within the junctions, at Ebbsfleet Junction there is a bus service which travels between the A2 and the A2260. One of the aspirations of the Scheme is to reduce the isolating effect of the A2 corridor and the junctions on local communities.

13.3.19. There are existing communities to the south of the A2 (Lane End, Bean, Betsham and Southfleet), with the existing connections which cross the A2 and the services which are located to the north and which will be available as part of the new developments. The scheme has the potential to provide real benefits in reducing severance

Vehicle travellers: Views from the road

A2:

13.3.20. Views from the A2 west of Bean Junction are generally restricted as a result of the road being intermittently situated in cutting and extensive vegetation screening as a result of mature trees.

13.3.21. Views from the A2 east of the Ebbsfleet Junction are intermittent as a result of the road being partly situated in a cutting and vegetation screening.

Bean Junction:

13.3.22. Bean Lane leading off south/north from the junction contains vegetation that screens views and thins out on the approach to the A2, with views becoming more open around the area of Hope Cottages.

13.3.23. The B255 joining the A2 from the north has limited levels of screening and there are wide open views across the Thames Estuary and chalk quarries when travelling north.

Ebbsfleet Junction:

13.3.24. The A2260 joining the A2 from the north contains screening within the cutting to the west while there are open views to the east due to the differences in levels.

13.3.25. The level of vegetation screening is mirrored at the junction with the A2, and due to the differences in levels open views are available.

Vehicle travellers: Driver stress

13.3.26. The A2 is a major road in southern England, connecting London with Dover, and carrying high volumes of traffic at peak times. It is also susceptible to delays caused by frequent problems at the Dartford crossing and drivers seeking alternative routes across Dartford's road network.

13.3.27. While the current levels of congestion are manageable, the intended growth of the area (including the development of Ebbsfleet Garden City - up to 15,000 new homes alongside 30,000 new jobs), will bring significantly more traffic over and above existing conditions. Traffic modelling has indicated that without improvement to both junctions the road network will become highly congested resulting in considerable delays.

13.3.28. The strategic and local road network in this area are inter-related and cannot be separated due to proximity of a number of junctions on the strategic road network and the Dartford Crossing all closely connected by the local roads. Driver stress on the section of the A2 in the vicinity of both junctions is also considerable, because of the high volume of traffic and also the close proximity of junctions leading to weaving between Pepper Hill, Ebbsfleet and Bean junctions which essentially reduces the four lane A2 to two free flowing outer lanes.

13.4. Potential impacts

Private dwellings

13.4.1. Private dwellings, as outlined in the methodology section, have a high sensitivity.

13.4.2. At Bean junction, Bean northern roundabout would be widened to the east to provide for the new southbound link to the Bean southern roundabout adjacent to Hope Cottages. This would result in the demolition of all eleven Ightham Cottages resulting in major adverse impact and large adverse significance of effects.

13.4.3. Construction of the Scheme, subject to design, could result adverse impacts on private property through short term alterations to access. The extent will be confirmed in the main ES once the preliminary design stage is complete.

Community assets

13.4.4. Construction of the Scheme, subject to design, has potential to have a negative impact on community land. There is potential that community land is required to construct the Scheme, namely Spirits Rest Horse Sanctuary. This community

asset is located within the DCO pre-application boundary (red line boundary) at Bean Junction adjacent to Ightham Cottages. Part of the Spirits Rest Horse Sanctuary will potentially be required to enable the construction of the eastbound on-slip resulting in major adverse magnitude of impact and large adverse significance of effects.

Local businesses

13.4.5. Construction of the Scheme, subject to design, has potential to have a negative impact on retail and other businesses through demolition, land take or alterations to access.

13.4.6. A range of business uses have been identified within and around the limit of land potentially required for construction or operation of the Scheme. Notable examples include the Timber Yard located to the north of the A2. Development of the Scheme may cause travel disruption impeding vehicle movements, and affecting aspects such as deliveries and staff customer movements. This may have a negative financial impact to these businesses.

Agricultural land

13.4.7. Most of the affected land outside the existing highway boundaries is non-agricultural, consisting of woodland and scrub and so is excluded from this assessment. The exceptions are 100 m^2 of arable land just east of the Bean gyratory and 200 m^2 of pasture at Woodbine Cottage, just west of where the A296 merges with the A2. To the north of the Ebbsfleet Junction, 1.2 ha would be lost from an area of scrub and rough grassland which is not currently farmed, but has the potential for low intensity livestock grazing.

13.4.8. Table 13.19 in the PEIR Volume 2 Appendix L summarises the loss of agricultural land and the significance of effect on agricultural soils is shown in Table 13.20 in the PEIR Volume 2 Appendix L.

Development land

13.4.9. The proposed development sites identified in Table 13.18 in the PEIR Volume 2 Appendix L, are unlikely to be directly affected by the Scheme. The intended growth of the area from development of these sites will bring significantly more traffic over and above existing conditions. Without the Scheme to address this increase in traffic, the road network will become highly congested resulting in considerable delays. Therefore, the Scheme presents beneficial impacts, and opportunities, for development growth.

Non-motorised users journey length and local travel patterns

Construction

13.4.10. A number of PRoW, footways and cycleways, pass in close proximity to both the Bean and Ebbsfleet Junctions. The NMU route links the A296 via Bean Lane in front of Ightham Cottages and Hope Cottages. Further footways are located on either side of the existing B255 Bean Lane overbridge with a traffic signals and a pedestrian crossing adjacent to Hope Cottages and at the end of the A2 westbound on-slip. The Bean Junction improvements will reinstate this NMU

route. In response to comments received during the public consultation, further opportunities will be considered as part of this preliminary design stage.

13.4.11. The existing Wood Lane Overbridge, Swanscombe Cutting Footbridge and Sandy Lane Subway would be retained.

13.4.12. The Scheme may result in temporary or permanent physical alteration to PRoW and NMU routes, including and crossing points over existing highways. These physical changes may have a beneficial or negative impact upon the users of these routes.

13.4.13. In the wider study area, construction traffic associated with the Scheme has the potential to increase traffic volume, particularly HGV trip numbers, in the surrounding local highway network. This has potential to make road crossing more time consuming for NMUs.

13.4.14. Changes in journey time and journey distance resulting from closure and/or diversion of routes and increased difficulty in road crossing, either temporarily or permanently, may result in changes to travel patterns for NMUs.

13.4.15. Affected Rights of Way and paths are, due to their 'off road' nature, unlikely to be highly utilised by vulnerable groups.

13.4.16. Closure of routes, diversion of routes, and increased difficulty in road crossing may lead to increased journey length and journey time as a result of the Scheme. However, the majority of NMU trips in the study area are associated with recreation. Recreational trips are generally considered less sensitive to changes in journey length in that users are not necessarily seeking the fastest or most direct route from their location to a specific destination. A variety of alternate recreational routes that will not be directly affected by the Scheme are available in the locality.

Operation

13.4.17. Temporarily affected routes may return to their original use after construction of the Scheme is complete. Where the Scheme requires permanent alteration of such routes they are expected to be re-provided in a similar location. These routes are likely to be similarly advantageous to current routes. These routes are predominantly used for recreation and users are less sensitive to diversion.

Non-motorised users: Changes in amenity

Construction

13.4.18. NMUs within the study area may be affected by traffic, noise, air quality and the visual intrusion of the road network within the wider environment as a result of construction activities, giving rise to changes in amenity.

13.4.19. In the wider study area, construction traffic associated with the Scheme has the potential to increase traffic volume, particularly HGV trip numbers, in the surrounding local highway network. This has potential to make road crossing more difficult, dangerous, intimidating, or time consuming for NMUs.

13.4.20. The likely changes in amenity and number of people expected to be affected will be descried in more detail within the main ES.

Operation

13.4.21. Generally, it is anticipated that journey amenity will be broadly similar for NMUs during operation. The distance between the operational carriageway and some established paths may decrease, though it is expected that should a path particularly close to the revised road layout become less pleasant then alternate routes may be established, or alternative existing routes will become better used.

13.4.22. It is proposed that the existing footpath to the east of Bean Lane will be reinstated with changes created by a new crossing within the proposed enlarged Bean northern roundabout to the north of the A2, the existing east footpath across the A2 will be moved to the west allowing continuation. This will result in the removal of the pelican crossing, which will no longer be required. The new west footpath will tie into the existing west footpath at Hope Cottages south of the A2.

13.4.23. At the Ebbsfleet Junction, alterations to existing NMU routes due to the widening of highways will be reinstated along similar alignments as at present. The existing pelican crossing will be moved to the west closer to the junction with the west roundabout north of the A2 and the existing footpath/ cycleway alignment extended to meet this new crossing.

13.4.24. Overall, it is anticipated there will be no significance effects on amenity for NMUs once the Scheme is in operation and slight beneficial effects will occur due to the improvements made to NMU provisions.

Community severance

13.4.25. Changes in journey length or journey time and changes in amenity for pedestrians and others may be such that they affect the degree to which a locality is subject to 'community severance'.

Construction

13.4.26. Construction traffic directly associated with the Scheme has the potential to increase traffic volume, particularly HGV trip numbers, in the surrounding local highway network. This has potential to make road crossing more difficult, dangerous, intimidating, or time consuming. This could introduce a temporary isolation effect.

13.4.27. Due to the availability of alternate routes and lack of set destinations, it is considered that NMUs are unlikely to experience significant changes to journey distance or journey time during construction. Temporary closure of crossings over may however result in more substantial changes to journey distance and journey time.

13.4.28. On balance, it is expected that construction will have a slight or moderate adverse severance effect on NMUs within the study area during construction.

Operation

13.4.29. It is anticipated that many affected journeys are likely to be those associated with recreational use rather than routes in regular use by members of the community to access services and facilities. Temporary or permanent closure or diversion of footpaths is unlikely sever communities from services and facilities.

13.4.30. Generally, during operation journey distance, journey time, and journey amenity are expected to be broadly similar to that found prior to development. The proposed alterations to the NMU provision at both Bean and Ebbsfleet Junctions follow similar alignment and routes to the existing provision. No significant NMU severance is therefore expected to result from the Scheme during operation.

13.4.31. Beneficial impacts are predicted for community severance in relation to the existing communities to the south of the A2, such as Bean, Betsham and Southfleet, and the existing connections that cross the A2 and the services located to the north.

Vehicle travellers: Views from the road

13.4.32. It is anticipated that views from the road are likely to change from what is currently experienced, due to the required land take, loss of vegetation screening and proposed environmental mitigation around the affected junctions.

13.4.33. The Scheme is likely to alter the views experienced by users of the A2, B255, A296 Watling Street (Roman Road), A2260, B262 and local roads. The magnitude of change will depend on final scheme alignments, elevations, and structure types. The potential for significant effects on road user amenity will be determined by the extent of existing screen planting removed to facilitate the construction of Scheme at Bean Junction.

13.4.34. The assessment of views from the road will draw on findings from the landscape and visual impact assessment and will be reported in the main ES.

Vehicle travellers: Driver stress

13.4.35. Driver stress is anticipated to be temporarily adversely impacted by construction of the Scheme, but is likely to be reduced during the operational phase due to the Scheme's enhanced capacity to cater for traffic, reduced queueing, congestion and risk of conflicts and collisions.

13.4.36. Quantitative assessment for driver stress will be undertaken for the main ES drawing on data from the traffic model.

13.5. Potential mitigation measures

13.5.1. The Scheme design includes a range of built in mitigation, for example ensuring that overbridges that cross the A2 are upgraded or replaced and the provision of alternate access to property.

13.5.2. In addition to mitigation that is part of the Scheme design, additional mitigation will be implemented where significant adverse effects are identified. The nature of mitigation is likely to be informed by consultation with landowners and other stakeholders, in which the potential impacts of the Scheme and appropriate mitigation will be discussed. If adequate mitigation cannot be provided, compensation measures may be appropriate in some instances, for example relating to instances of land take or where business viability is significantly affected.

13.5.3. There is no environmental mitigation for permanent land take. Financial compensation is a matter for the District Valuer and is outside the scope of this report.

13.5.4. Land occupied or disturbed during the construction process that is not permanently acquired for engineering and landscaping will be restored to a condition equivalent to its original.

13.5.5. The quality and quantity of soil on site will be maintained by implementing appropriate techniques for stripping, stockpiling and reinstatement.

13.5.6. This approach will be adopted in a Soil Handling and Management Strategy (SHMS), which will in due course form part of the CEMP. A qualified soil scientist will supervise all aspects of this work.

13.5.7. Accommodation works, temporary access arrangements, livestock fencing and other mitigation of Scheme impacts will be identified through consultation with landowners.

13.5.8. Land occupied or disturbed during the construction process, such as site compounds, that is not permanently acquired for engineering and landscaping, will be restored to a condition equivalent to its original (see Chapter 10 Soils and Geology).

13.5.9. Noise and dust control is covered in the PEIR Volume 1 Chapters 5 Air Quality and 6 Noise and Vibration.

13.6. Residual impacts

13.6.1. The extent of likely effects arising as a result of the Scheme is not yet certain and appropriate mitigation has not yet been determined other than for agricultural land. It is therefore not yet clear what, if any, residual People and Community impacts may occur.

13.6.2. The ES will consider whether the Scheme is likely to result in additional residual impacts - those impacts that remain after the application of mitigation. Any residual effects found to be likely will be reported under the sub headings:

- Private dwellings;
- Community assets;
- Local businesses;
- Agricultural land;
- Development land;
- Non-motorised users; and
- Vehicle travellers.

13.7. Cumulative effects

13.7.1. A list of projects to be considered in the cumulative assessment of effects is outlined in the PEIR Volume 1 Chapter 16: Cumulative Effects Assessment. The potential for cumulative effects will be considered in each chapter of the ES and a summary provided in Chapter 16 to outline the cumulative effects arising.

13.8. NPS compliance

13.8.1. This assessment has taken account of the NN NPS. It is considered that the Scheme is fully compliant with the relevant NN NPS policies and principles, as follows:

- In delivering junction improvement, the Scheme will contribute to enhancing the existing national road network to improve journey quality, reliability and safety;
- The Scheme will improve quality of life, accessibility and inclusivity, link up communities, and reduce community severance; and
- The Scheme incorporates measures to avoid and mitigate environmental and social impacts, including on land, access to open spaces, PRoW, and opportunities for sport and recreation where applicable.

13.9. Assumptions and limitations

13.9.1. The assessment provides a broad, high level indication of effects based on preliminary assessment. Further assessment of effects will be possible when more details concerning the Scheme design, in particular the construction of the Scheme, is available.

13.9.2. It is assumed that the Scheme boundary will include the likely locations of any engineering features, such as construction compounds, haul roads and attenuation ponds. Further assessment maybe required following detailed design should amendments to the Scheme boundary or design be necessary.

13.10. Summary

13.10.1. The Scheme is likely to affect a range of People and Communities receptors. In lieu of a full assessment to support the forthcoming ES, it is anticipated that the Scheme may:

- Result in demolition of all 11 properties at Ightham Cottages resulting in large adverse significance of effect;
- Result in potential direct loss to curtilage of Hope Cottages on Bean Lane and altered access arrangements to many residential properties, which may in some cases be locally significant;
- Loss of amenity to residents of Hope Cottages on Bean Lane during construction due to noise, visual and dust/emissions impacts;
- Beneficial impacts to nearest properties in Bean village due to improved access and screening once operational;
- Temporary access restrictions to properties in Northfleet due to realignment of Pepper Hill Link Road;
- Loss of amenity to residents of new Ebbsfleet Green development during construction due to noise, visual and dust/emissions impacts;
- Less than 1.3 ha of agricultural land is land affected by the A2 Bean and Ebbsfleet Junction improvements (including the rough grass and scrub north of the Ebbsfleet Junction), of which only 300 m^2 is of BMV quality;

- The significance of effect of loss of agricultural soils is neutral to slight adverse and no special protection is given to the affected land under current policy and regulatory frameworks;
- Construction will have a slight or moderate adverse severance effect on NMUs within the study area during construction;
- The Scheme is considered to facilitate the growth planned for the area resulting in beneficial impacts to development growth aspirations;
- Impact on other businesses during construction in terms of access restrictions and amenity including Springhead Nurseries; and
- Has potential to cause delays or diversions that may have a temporary isolating effect in terms of community severance during operation. On balance, improve accessibility, driver stress and connectivity during operation.

13.10.2. The Scheme has the potential to provide benefits in reducing severance once operational e.g. current severance experience between the existing communities to the south of the A2 (Lane End, Bean, Betsham and Southfleet) with existing connections which cross the A2 and the services which are located to the north and which will be available as part of the new developments.

Chapter 14 - Climate

14.1. Introduction

14.1.1. This chapter outlines the methodology that will be used to identify and assess the likely effects of the Scheme on climate and the vulnerability of the Scheme to climate change, during construction and operation.

14.1.2. This chapter been divided into two sections in order to address the climate change requirements outlined in The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 (SI 2015/517) which states that the assessment should consider both:

- The potential effects of the Scheme on climate, in particular, the magnitude of greenhouse gases (GHG) emissions emitted during both construction and operation; and
- The vulnerability of the Scheme to climate change, in particular, the impacts of extreme weather scenarios on the Scheme during operation.

14.1.3. This section should be read in conjunction with the climate change information provided in the PEIR Volume 2 Appendix M, which lists the key legislation and policy, study area, methodology and tables for the climate change assessment.

14.2. Consultation

Effect of the Scheme on climate

14.2.1. It is proposed that Kent County Council, as the author/ owner of the Environmental Policy, and the Environmental Strategy and Implementation Plan will be consulted on the proposed assessment methodology post submission of the PEIR.

Vulnerability of the Scheme to climate change

14.2.2. In identifying receptors with High or Medium vulnerabilities to climate change and extreme weather, technical advice will be sought from relevant Highways England staff (i.e. local route managers or similar), local authority and the Environment Agency flood officer to inform the vulnerability assessment and to seek their advice as to the development of appropriate mitigation measures.

14.3. Baseline conditions

Effect of the Scheme on climate

14.3.1. The baseline conditions for the effects on climate are defined by the total background emissions, i.e. all emissions, and the total emissions occurring from the current traffic and operational activities related to the Scheme. These are explained in the following sub-sections. Information is also present on the emissions from other similar road improvement schemes, for the purposes of proxy emissions quantification and assessment.

UK baseline emissions

14.3.2. Background emissions concerning all emissions, i.e. the global total, is approximately 50 billion tonnes of CO_2e. The total background UK emissions for 2015 (the last reported year at the time of preparing this chapter) is 495.7 million tonnes of CO_2e. The breakdown of this figure by sector is shown in Table 14.6 in the PEIR Volume 2 Appendix M. The emissions from any UK infrastructure scheme compared against the global or UK total will always be negligible.

14.3.3. The baseline emissions for the Scheme cover the PAS 2080:2016 use activities of the 'Do Minimum' scenario, which includes:

- Operational energy use (B6) and replacement works (B2-5) within the boundary of the construction site of the Scheme; and
- The current traffic (B9 and D) as defined by the 'Do Minimum' air quality assessment for the Option Selection Stage EAR.

14.3.4. Only these lifecycle stages are included as they are the only stages relevant to and an operational highway.

14.3.5. There is currently no data available for any of these lifecycle stages for the Scheme, so the emissions cannot be quantified using the methodology defined in Section 14.3 in the PEIR Volume 2 Appendix M. However, the emissions can be considered to be proportionally similar to the $OpCO_2e$ levels defined in Table 14.7 in the PEIR Volume 2 Appendix M on the basis that the operation, maintenance and use of highways is sufficiently consistent across the UK road network. The Scheme emissions have therefore been quantified on this basis, but only proportionally, not by total mass.

14.3.6. The $OpCO_2e$ levels defined in Table 14.7 in the PEIR Volume 2 Appendix M show that proportionally emissions for operational energy use and replacement works equate to between 0.05 and 0.29% of in-use traffic emissions, as follows:

- (Operation + Maintenance per Annum)/ Use per Annum = Operational Proportion (%):
  - M4CaN: (1,600/ (1600 + 2,268,700)) x 100 = 0.07%;
  - A14: (2,400/ (2,400 + 4,386,400)) x 100 = 0.05%; and
  - A465: (2,600/ (2,600 + 882,000)) x 100 = 0.29%.

14.3.7. Based on the above, the total Scheme baseline emissions are estimated to consist of 99.71% for in-use emissions, and 0.29% for operation and annual maintenance, assuming the worst-case performance for operational energy use, and replacement works.

Vulnerability of the Scheme to climate change

14.3.8. The baseline conditions for vulnerability of the Scheme to climate change are defined by the current local climate, past extreme weather events, and projected changes in climate.

14.3.9. Table 14.8 in the PEIR Volume 2 Appendix M summarises the local climate, whilst Table 14.9 in the PEIR Volume 2 Appendix M summarises weather extreme records for South-East and Central Southern England.

14.3.10. The UK Climate Projections 2009 summarises the projected changes in climate for London by the 2050s for the high emissions scenario as described below:

- The central estimate of increase in winter mean temperature is 2.5ºC; it is very unlikely to be less than 1.4ºC and is very unlikely to be more than 3.8ºC. A wider range of uncertainty is from 0.9ºC to 3.8ºC;
- The central estimate of increase in summer mean temperature is 3.1ºC; it is very unlikely to be less than 1.4ºC and is very unlikely to be more than 5.2ºC. A wider range of uncertainty is from 1.1ºC to 5.2ºC;
- The central estimate of increase in summer mean daily maximum temperature is 4.3ºC; it is very unlikely to be less than 1.7ºC and is very unlikely to be more than 7.4ºC. A wider range of uncertainty is from 1.2ºC to 7.4ºC;
- The central estimate of increase in summer mean daily minimum temperature is 3.3ºC; it is very unlikely to be less than 1.6ºC and is very unlikely to be more than 5.7ºC. A wider range of uncertainty is from 1.2ºC to 5.7ºC;
- The central estimate of change in annual mean precipitation is 0%; it is very unlikely to be less than -5% and is very unlikely to be more than 5%. A wider range of uncertainty is from -5% to 5%;
- The central estimate of change in winter mean precipitation is 16%; it is very unlikely to be less than 2% and is very unlikely to be more than 35%. A wider range of uncertainty is from 0% to 35%; and
- The central estimate of change in summer mean precipitation is -19%; it is very unlikely to be less than -43% and is very unlikely to be more than 9%. A wider range of uncertainty is from -43% to 16%.

14.3.11. In the detailed assessment phase UKCP09 gridded data relevant to the study area will be presented.

14.4. Potential impacts

Effect of the Scheme on climate

14.4.1. It should be noted that insufficient design detail was available to undertake a Scheme specific assessment at the time of preparing this chapter. In place of this and for the purposes of indicating significance in the context of the Scheme, a proxy assessment has been carried out using the Scheme description and proxy data from other highways schemes. A Scheme specific assessment will be undertaken as part of the ES. Notwithstanding the lack of Scheme specific assessment, potential mitigation measures have been identified where practicable.

14.4.2. The headline potential impacts of the Scheme are defined by the total emissions occurring across the defined lifecycle stages for the ‘Do Something’ scenario. However, as per the baseline, there is currently no data available for any of the relevant lifecycle stages. Consequently, the emissions cannot be quantified using the methodology defined in Section 14.4 in the PEIR Volume 2 Appendix M. However, the emissions can be considered to be proportionally similar to the all of the levels defined in Table 14.7 in the PEIR Volume 2 Appendix M. The Scheme emissions have therefore been quantified on this basis, but only proportionally, not by total mass. They are calculated at headline lifecycle scale,

as per Table 14.7 in the PEIR Volume 2 Appendix M, as there is insufficient data in Table 14.7 to determine emissions by PAS 2080:2016 lifecycle stages.

14.4.3. The emissions proportions were calculated for construction as follows:

- (Sum of Materials, Labour + Plant, Earthworks)/ (Sum of Materials, Labour + Plant, Earthworks + Operation + Maintenance per Annum + Use per Annum) = Construction Proportion (%):
  - M4CaN: (522,600/ (1,600 + 522,600 + 2,268,700)) x 100 = 18.71%;
  - A14: (983,900/ (2,400 + 983,900 + 4,386,400)) x 100 = 18.31%; and
  - A465: (52,600/ (2,600 + 52,600 + 882,000)) x 100 = 5.61%.

14.4.4. The emissions proportions for operational energy use and replacement works were calculated as follows:

- (Operation + Maintenance per Annum)/ (Sum of Materials, Labour + Plant, Earthworks + Operation + Maintenance per Annum + Use per Annum) = Operational Proportion (%):
  - M4CaN: (1,600/ (1,600 + 522,600 + 2,268,700) x 100 = 0.06%;
  - A14: (2,400/ (2,400 + 983,900 + 4,386,400) x 100 = 0.04%; and
  - A465: (2,600/ (2,600 + 52,600 + 882,000) x 100 = 0.28%.

14.4.5. The emissions proportions for in-use emissions were calculated as follows:

- (Use per Annum)/ (Sum of Materials, Labour + Plant, Earthworks + Operation + Maintenance per Annum + Use per Annum) = In-Use Proportion (%):
  - M4CaN: (2,268,700/ (1,600 + 522,600 + 2,268,700)) x 100 = 81.23%;
  - A14: (4,386,400/ (2,400 + 983,900 + 4,386,400)) x 100 = 81.65%; and
  - A465: (882,000/ (2,600 + 52,600 + 882,000)) x 100 = 94.11%.

14.4.6. Based on the above the proportion of emissions for each lifecycle stage, for construction and year one of operation are estimated to be as follows:

- Construction (A1- A5): 6 – 19%;
- Operation (B2 - 5, and B6): <1%; and
- In-use traffic (B9): 81 – 94%.

14.4.7. These initial findings are based on the limited data available and should be considered as proxy/ indicative only.

Significance

14.4.8. The scope of assessment for effects on climate comprises the study area as defined in Section 14.2 in the PEIR Volume 2 Appendix M.

14.4.9. In the absence of suitable guidance for EIA assessment of emissions, using DMRB terminology, a ‘simple’ assessment of the Scheme’s effects on climate will be undertaken. This will be done using a desk based assessment to quantify the magnitude of emissions, evaluate changes to the road network, and determine the significance of effects of the Scheme. This will be used to determine whether the effects are positive or negative and major, moderate, minor, negligible or no

change, as shown in the matrix Table 4.1 and defined in Table 4.2 in the PEIR Volume 1 Chapter 4 Environmental Impact Assessment Process. The level of detail will be determined by the data available to inform the assessment.

14.4.10. It is acknowledged that revision to the guidance on determining significance is currently underway and this will be reviewed, addressed and updated in the ES, if within the timeframes of the assessment. Should the guidance not be available, technical expertise on emissions performance will be used to generate a clear and justifiable technical explanation of the project's performance against other similar projects, UK carbon emissions totals, and UK carbon reduction budgets. Given that in the absence of any guidance there would not be any framework to determine significance, the significance of any impact will be based on professional judgement.

Vulnerability of the Scheme to climate

Receptors

14.4.11. The potential impacts of changes in different climate variables (and impacts associated with extreme weather) on the Scheme receptors are identified in this section. Receptors may be summarised as roads and supporting infrastructure, including bridges, embankments, earthworks and drainage.

Potential impacts of climate on road infrastructure

14.4.12. As summarised in Table 14.10 in the PEIR Volume 2 Appendix M, these receptors are all susceptible to damage or disruption from climate-related hazards. However, not all climate-related impacts are threats and there are also likely to be opportunities brought about by climate change. This section describes the likely potential impacts (and opportunities) of climate change and extreme weather events on road infrastructure using relevant literature and expert opinion.

14.4.13. The weather can have a significant negative impact on the road network, which can often be running close to or at capacity in parts of the UK. In addition to landslips, the key impacts are associated with surface water and river flooding (see the PEIR Volume 1 Chapter 8 Road Drainage and Water Environment) as well as increased thermal loadings on roads and control equipment.

14.4.14. Currently 6,600 km of the road network is located in areas susceptible to flooding (ASC, 2016b – see PEIR Volume 1 Chapter 17 References). The cost of disruption from widespread flooding in 2007 was £200 million and a flood event of this disruptive scale could be possible on an annual basis by the 2080s (Chatterton et al., 2011 – see PEIR Volume 1 Chapter 17 References).

14.4.15. Warmer summer temperatures will increase thermal loading on bridges and pavements causing expansion, bleeding and rutting which will need repairing. Repairs cannot be performed until temperatures reduce. The 2003 and 2006 heatwaves provide a useful temporal analogue of this impact (Willway et al., 2008; Defra, 2012b – see PEIR Volume 1 Chapter 17 References). Cold weather (including snow and ice) is currently a major cause of damage and disruption, causing 16% of all weather-related delays to the strategic road network in England between 2006 and 2014 (ASC, 2014 – see PEIR Volume 1 Chapter 17 References). This is likely to reduce in the future, along with reduced winter maintenance costs (Arvidsson and Chapman, 2011 – see PEIR Volume 1 Chapter 17 References).

14.4.16. Wind effects road operations as high sided vehicles can become unstable in gusts of wind over 45 mph, this is particularly significant on exposed sites such as bridges (ASC, 2016b – see PEIR Volume 1 Chapter 17 References). High winds can also damage roadside furniture, such as traffic signs, and blow nearby vegetation onto the road. There is no evidence for increased incidence (due to climate change) and most failures of objects (such as road signs) are considered to be due to inadequate foundations (Galbraith et al., 2005 – see PEIR Volume 1 Chapter 17 References).

Climate vulnerability assessment

14.4.17. This section presents the findings of the scoping phase (Table 14.11 in the PEIR Volume 2 Appendix M). The sector (road infrastructure) sensitivity and the regional (London) geographic exposure to extreme weather and climate change has been appraised to determine the level of climate vulnerability in this scoping phase. This assessment is based on a review of supporting literature and expert review.

14.5. Potential mitigation measures

Effect of the Scheme on climate

14.5.1. Mitigation measures for effects on climate consist of strategic approaches that drive reduction across all lifecycle stages, and those specific to the separate lifecycles stages.

14.5.2. Strategically, emissions are mitigated by applying the carbon reduction hierarchy specified in PAS 2080:2016, covering:

- **Build nothing** - challenge the root cause of the need; explore alternative approaches to achieve the desired outcome;
- **Build less** - maximise the use of existing assets; optimise asset operation and management to reduce the extent of new construction required;
- **Build clever** - design in the use of low carbon materials, streamline delivery processes, minimise resource consumption; and
- **Build efficiently** - embrace new construction technologies; eliminate waste.

14.5.3. It is recommended the carbon reduction hierarchy is covered both at a Scheme level and at a structures and equipment level within each Scheme. It should also be acknowledged that the application of the hierarchy is likely to be, in some instances, an inherent outcome of good design practice and cost efficiencies.

14.5.4. Potential mitigation measures for the specific lifecycle stage are provided in Table 14.12 in the PEIR Volume 2 Appendix M. These currently only include the main strategic mitigation measures, these will be expanded as necessary based on the outcome of the assessment undertaken and presented in the ES.

Vulnerability of the Scheme to climate

14.5.5. Table 14.13 in the PEIR Volume 2 Appendix M summarises some potential mitigation measures for reducing vulnerability of road infrastructure receptors to climate impacts. During the detailed assessment phase (input into the ES) the

project team will identify the provision of appropriate mitigation measures for High (and selected Medium) impacts.

14.6. Residual impacts

Effect of the Scheme on climate

14.6.1. The generation of emissions is an inevitable consequence of infrastructure schemes and the operation of road networks and as such there will be unavoidable impacts. However, the impact level can be reduced through the use of mitigation measures during the design, construction and operational phases.

14.6.2. It is currently not possible to estimate the level of residual impact and therefore the potential impacts, as outlined in Section 14.4 above, should be considered representative.

Vulnerability of the Scheme to climate

14.6.3. Current design standards and operational and maintenance practices are expected to provide a degree of resilience to climate risks. Design, construction and operational climate change adaptation measures may however be required to provide an appropriate degree of climate resilience over the life of the Scheme.

14.7. Cumulative effects

Effect of the Scheme on climate

14.7.1. Cumulative effects are considered applicable when considering the impacts of in-use traffic on the wider network, and the overall Scheme on total UK emissions. As such, emissions assessment considered in the EIA will inherently consider the cumulative impacts of other proposals, and the wider UK emissions.

Vulnerability of the Scheme to climate

14.7.2. The Scheme may have an impact on the climate resilience of other projects and stakeholders. Also, climate change adaptation measures create wider cumulative impacts on other projects and stakeholders. These impacts may be positive or negative. The ES will consider the cumulative impacts for other projects and stakeholders in a climate change adaptation context.

14.8. NPS compliance

Effect of the Scheme on climate

14.8.1. The NN NPS acknowledges that highways developments will likely only have very small impacts on aggregate levels of emissions. Regardless, as stated in Section 14.1 in the PEIR Volume 2 Appendix M, it requires evidence of the emissions impact of a scheme, an assessment of the emissions against the Government's carbon budgets, and evidence of mitigation measures.

14.8.2. The assessment methodology proposed in Section 14.2 in the PEIR Volume 2 Appendix M will provide the required evidence and assessment against targets.

14.8.3. Implementation of the mitigation measures outlined in Section 14.5 above will reduce the emissions as far as practicable during the construction and operational phases, where the emissions occur. The measures are inclusive of but not limited to, the ongoing implementation of the carbon reduction hierarchy (see Section 14.5.2 above) and the lifecycle specific mitigation measures listed in Table 14.12 in PEIR Volume 2 Appendix M.

14.8.4. As the design of the preferred route alignment progresses, the following activities will be undertaken in order to implement the mitigation measures:

- Appropriate personnel will be made aware of emissions impacts and mitigation measures which are recommended to reduce them;
- Appropriate personnel will implement the measures as part of ongoing design development and specification processes; and
- Measures to address construction and operational emissions not mitigated during design will be identified and specified in the CEMP and the OEMP, for implementation by the appropriate contractor(s).

Vulnerability of the Scheme to climate

14.8.5. 4.36 Section 10(3)(a) of the Planning Act requires the Secretary of State to have regard to the desirability of mitigating, and adapting to, climate change in designating an NPS.

14.8.6. New developments should be planned to avoid increasing vulnerability to climate change and to ensure that risks can be managed through suitable adaptation measures.

14.8.7. In compliance with the NN NPS the environment statement will take into account of:

- The potential impacts of climate change using the latest UK Climate Projections available;
- Identify appropriate risk mitigation or adaptation measures; and
- Demonstrate that there are no critical features of the design which may be seriously affected by climate change.

14.9. Assumptions and limitations

14.9.1. There is only one limitation of the current information, which is that without project specific data it is not possible to confirm that the effects are adverse or beneficial, or the level of these impacts.

14.9.2. The assumptions for the above are:

- Manufacturing and construction will be carried out using largely fossil fuel powered processes and plant; and
- The Scheme will not involve reduction of vehicles using the road network covered by the scheme. Therefore, vehicle emissions will continue to be produced, and at a level that causes them to be the dominant impact.

14.9.3. The ‘vulnerability of the Scheme to climate change’ will be considered in the ES. This assessment will consider aspects of the Scheme that are susceptible to damage or disruption from climate-related hazards highlighted in this chapter

and informed by 'met office' regional records for extreme weather conditions in the South-East and Central Southern England and UK climate projections as set out in the PEIR Volume 2 Appendix M.

14.10. Summary

Effect of the Scheme on climate

14.10.1. The Scheme specific emissions cannot be quantified due to insufficient data, however the proxy assessment indicates the proportions of emissions from each of the headline lifecycle stage, with in-use emissions being the predominant source for all scenarios.

14.10.2. In order to quantify and assess the emissions from the Scheme necessary data will be gathered from the appropriate personnel (e.g. the design team, the contractor(s) and the environmental assessment team).

14.10.3. The emissions will be calculated in the CKB and using the methodology specified for air quality. The resulting model/ footprint will be used to assess the emissions against the Government's emissions reduction targets. The model/ footprint will also be used to identify the further mitigation measures that are required.

Vulnerability of the Scheme to climate

14.10.4. The following climate variables/hazards have been identified as High or Medium vulnerabilities for road infrastructure in London:

- Extreme (air) temperature (frequency and magnitude);
- Extreme rainfall (frequency and magnitude);
- Gales and extreme winds (frequency and magnitude);
- Solar radiation;
- Flood (coastal and fluvial);
- Subsidence and ground stability;
- Fog;
- Snow, ice and hail; and
- Storms and lightning.

Chapter 15 - Assessment of Cumulative Effects

15.1. Introduction

15.1.1. Without prejudice to the findings of the forthcoming EIA, the cumulative effects chapter of the PEIR brings together the initial findings of each of the environmental topic areas, identifying and assessing the cumulative effects of the Scheme.

15.1.2. This assessment draws upon the guidance provided within the DMRB Volume 11 Section 2 Part 5: Assessment and Management of Environmental Effects' and the PINS) 'Advice Note Seventeen: Cumulative Effects Assessment' (December 2015).

15.1.3. Combined and cumulative effects result from multiple actions on receptors over time and are generally additive or interactive (synergistic) in nature. They can also be considered as effects resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project, identified as:

15.1.4. Cumulative effects can be identified as:

- Combined effects from a single project (the inter-relationship between different environmental factors); and
- Cumulative effects from different projects (with the project being assessed).

15.1.5. This section should be read in conjunction with the cumulative assessment information provided in the PEIR Volume 2 Appendix N, which lists the study area, methodology and tables for the cumulative assessment and Figure 15.1 in the PEIR Volume 3.

15.2. Potential impacts

15.2.1. Table 15.5 in the PEIR Volume 2 Appendix N presents the preliminary cumulative effects assessments from the topic chapters of the PEIR. For the main ES in-combination effects will be reported when this information is available from the individual topic assessments following their assessments to inform the ES.

15.3. Assumptions and limitations

15.3.1. A high-level summary of anticipated effects has been provided for some environmental topics, however a full assessment of cumulative effects has not currently been undertaken, and therefore the full extent of combined and cumulative effects is not currently known.

15.3.2. Furthermore, the cumulative effects assessment is based on the list of ‘Other Developments’ which is produced at the time of assessment, however, as new applications come forward and extant applications are ‘varied’ the list may become outdated.

15.3.3. The list of development projects listed in the cumulative effects assessment will be updated as part of the assessment, in discussions with Gravesham and Dartford Borough Council’s and Ebbsfleet Development Corporation.

15.3.4. This list will also be updated to breakdown the number of dwellings proposed, the number of jobs expected to be created and the anticipated phasing for the delivery of the development, where available.

15.3.5. A limitation of the assessment is that the development projects list is speculative and whilst the Local Planning Authorities and potentially developers will have been consulted on phasing, the developments may not be delivered in line with the assumptions.

15.4. Summary

15.4.1. Initial high-level analysis has shown that some receptors have the potential to experience effects from the Scheme relating to multiple environmental assessment areas. In particular, it is acknowledged that the Scheme may have significant negative effects on the historic environment, though further assessment will be required to establish the extent of this. There is also likely to be an overall negative effect on biodiversity, though potential mitigation and compensation measures would assist in reducing this impact.

15.4.2. Many of the potential impacts will be minimised through a combination of best practice and mitigation measures. In some environmental assessment areas this is likely to sufficiently reduce impacts so that they are negligible or neutral in severity for example road drainage and the water environment; and geology and soils.

15.4.3. There may be cumulative effects on air quality; noise and vibration; people and communities; landscape; and climate change, however these are yet to be assessed and will be considered in further detail in the ES.

Chapter 16 - Summary

16.1.1. This PEIR represents the preliminary assessment stage in the EIA process and sets out the methodology for the assessment of the environmental impacts which have potential to arise due to construction and operation of the Scheme. This PEIR sets out the basis for a comprehensive assessment of the environmental effects of both of these elements of the Scheme, the results of which will be presented in the ES.

16.1.2. A summary of the environmental impacts for each environmental topic is presented in Table 16.1

Table 16.1: Summary of impacts

Topic	Environmental impacts	Mitigation to reduce the impact	Significance of effect
Air Quality	Construction: dust deposition and soiling at properties from construction activities and increase in vehicle movement.	Good practice measures in the CEMP including; water-spraying and sweeping of unpaved roads, wheel washes, sheeting vehicles, speed limits, damping down surfaces, and suitable storage.	Unlikely to be a significant effect
	Operation: increase in NO2 and NOx concentrations on some receptors from new alignment.		Not expected to have a significant effect
Noise and Vibration	Construction: activities have the potential to cause some disturbance, with demolition and piling work in particular, on receptors including ecological.	Good practice measures in the CEMP including: the use of exhaust silencers, sound reduced generators, pneumatic muffler or suppressors. Construction noise and vibration assessment will be untaken with accordance with a BS5228-1:2009+A1:2014.	To be provided in the ES
	Operation: changes in vehicle activity will cause a short-term increase but long term decreases for most receptors.		No perceptible detrimental effects
Biodiversity	Construction: land take and indirect impacts from air, noise and water on ancient woodland, lowland mixed deciduous woodland, lowland meadows, lowland calcareous grassland, arable field margins, hedgerows and the River Ebbsfleet.	Good practice measures in the CEMP including; protection of designated sites protection of retained trees, mitigation measures under licence, precautionary methods of working and provision of an Ecological Clerk of Works. Locations of site compounds and access tracks will be kept away from notable habitats. Advance planting will be considered to mitigate temporary habitat loss. Replanting of temporary clear areas will be undertaken. Maintenance and enhancement of habitat connectivity will be considered.	Likely to be direct and indirect impacts and will be assessed further in the ES
	Operation: indirect and direct impacts from air, noise and water on ancient woodland, lowland mixed deciduous woodland, lowland meadows, lowland calcareous grassland, arable field margins, hedgerows and River Ebbsfleet. Beneficial impact on some key receptors.		
Road Drainage and the Water Environment	Construction: risk to surface water and ground water and increase in flood risk due to excavation and deposition construction materials to accommodate new watercourse crossings, spillage of fuels or other contaminating liquids and through uncontrolled site runoff.	Good practice measures in the CEMP including; emergency procedures and response plan. The contractor will comply with BS 6031 ‘Code of Practice for Earthworks’. Designed drainage to minimise risk to groundwater and surface water receptors.	Likely to be temporary
	Operation: pollution risk from routine runoff and from accidental spillage, on surface water and groundwater.		Likely to be permanent

Topic	Environmental impacts	Mitigation to reduce the impact	Significance of effect
Landscape	Construction: loss of vegetation screening, land re-profiling and new structures and the temporary introduction of construction compounds, lighting and traffic management and increase in traffic movements.	Retaining and protecting existing trees and hedges wherever possible, replant woodland edges. Provide screening to Hope Cottages by using tailored environmental barriers or planting. Reinstate and recreate the high-quality standard of horticulture at the Ebbsfleet roundabout. During the design process consider design solutions to increase space for screening, include ecological enhancements	To be provided in the ES
	Operation: introduction of large scale infrastructure features, changes to street lighting, new signage and gantries and environmental planting and potential noise barriers.		
Visual	Construction: loss of existing vegetation screening will impact on Hope Cottages and residents of Bean, and PRoWs users.		
	Operation: introduction of planting and environmental barriers will reinstate screening of the new infrastructure.		
Geology and Soils	Construction: activities may contribute to the creation of new PCLs, new pathways for pollutants and remobilisation of pollutants, impacting surface water runoff and groundwater conditions. There may be impacts on ground stability, soil erosion and quality.	Good construction practice in the CEMP will be implemented. Suitable design has been used to mitigate any impacts including stockpile management, pollution prevention. Pre-construction ground investigation will be undertaken. Implementation of a Material Management Plan and Site Waste Management Plan.	Not considered to be significant
	Operation: introduction of new sources of pollutants, and below ground services could create additional pathways.		Moderately beneficial to negligible
Cultural Heritage	Construction: direct impacts from earthmoving operations, creation of site compound, road formation and proposed structures on heritage assets and settings including Vagniacae, Lower Bean Farmhouse, Barn at Lower Bean farmhouse, Stone Castle and Blue House.	The Scheme shall seek to avoid direct impacts on known heritage assets during enabling and construction works. A programme of archaeological investigation should be undertaken in areas affected by the Scheme where there is considered to be potential for significant archaeological remains to survive. Construction areas; to include all compounds and temporary routes, should erect protective fencing prior to site works in order to bar incursion into Darenth Wood Scheduled Monument and the Roman settlement of Vagniacae.	Temporary, short term and reversible, however, direct physical impacts are usually permanent in nature.
	Operation: no impact on buried archaeology.		To be provided in the ES

Topic	Environmental impacts	Mitigation to reduce the impact	Significance of effect
		Visual impacts will be reduced through mitigation planting.	
Materials and Waste	Construction: waste produced during CD&E, hazardous CD&E waste.	Design out waste at the early stages or as early as is practicable to ensure materials used. Best practice waste management on CD&E schemes, which should be applied to the Scheme. The Scheme should be committed to achieving a high recycling and recovery rate for all CD&E waste generated on-site.	To be provided in the ES
	Operation: waste produced from littering and planned/ unplanned maintenance.		
People and Communities	Construction: direct loss properties or gardens at private dwellings adjacent to Scheme, community land take, disruption to local businesses, loss of agricultural land, impacts on PRoWs including change in journeys time or temporary closures, noise, traffic and air quality impacts on NMUs, increased traffic volume and potential for increased driver stress and changes in views from the road.	Adoption of a Soil Handling and Management Strategy that will form part of the CEMP as well as good practice measures outlined in the Air Quality and Noise chapters. Consideration that overbridges are upgraded or replaced during Scheme design, restore land to original state from temporary use and financial compensation for permanent land take. Consultation with landowners and other stakeholders will influence mitigation measures.	Large adverse effects if loss of properties
	Operation: beneficial impacts on local developments, alteration of some PRoW routes and some beneficial effects on improved PRoWs for NMUs.		Beneficial
Climate Change Effects of the Scheme on climate change	Construction: there is a one-off impact of 19% in comparison to one year of in-use emissions for the 'Do Something' scenario.	Undertake the following activities; reduction of materials consumption (as per the PEIR Volume 1 Chapter 11 Materials and Waste), use alternative carbon materials, limit materials transportation distance, minimise construction water consumption, minimise construction waste and use suitable waste treatment / disposal.	To be provided in the ES
	Operation: there is an on-going annual impact of <1% in comparison to one year of in-use emissions based on the first year of the Scheme being operational. In-use traffic emissions as the largest aspect, show a 81-94% increase for the Scheme over the 'Do Minimum' scenario.	Best practice replacement design, use of low energy lighting and traffic management systems and explore in-use emissions management options.	
Climate Change Vulnerability of the	Construction: precipitation or high temperatures can provide difficult working conditions, excessive moisture	Undertake the following activities; more night-time construction to avoid undue heat stress for construction	

Topic	Environmental impacts	Mitigation to reduce the impact	Significance of effect
Scheme to climate change	in materials, reduce working periods, water damage, and wind can produce more dust.	workers, undertake construction in the dry season, use of unslaked lime and the use of water efficiency measures. Prepare and implement a dust management plan.	To be provided in the ES
	Operation: extreme weather conditions can create additional damage and maintenance requirements, reduced opportunities maintenance and operational disruption.	Ensure adequate resources and capacity in in place, undertake regular monitoring, maintenance and preventive actions. Implement emergency planning for climate impacts as well as install early warning systems and evaluation routes. Incorporate additional measures into existing assets during planned maintenance and repairs.	

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Acronyms, Abbreviations and Descriptions

Acronyms and Abbreviations	Description
ºC	Degrees Celsius
AADT	Annual Average Daily Traffic
ADMS Roads	A comprehensive software tool for investigating air pollution problems due to networks of roads that may be in combination with industrial sites
AIES	Assessment of Implications on European Sites
ALC	Agricultural Land Classification
APA	Archaeological Priority Area
AQAP	Air Quality Action Plan
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ARN	Affected Road Network
AURN	Automatic Urban and Rural Network
BAP	Biodiversity Action Plan
BGS	British Geological Survey
BMV	Best and Most Versatile
BNL	Basic noise level
CD&E	Construction, Demolition and Excavation
CEA	Cumulative Effects Assessment
CEMP	Construction Environmental Management Plan
CMS	Continuous Monitoring Stations
CO2	Carbon Dioxide
COSHH	Control of Substances Hazardous to Health
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
CTRL	Channel Tunnel Rail Link
dB	Decibel
DCLG	Department for Communities and Local Government
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
Defra	Department for Environment, Food and Rural Affairs
DfT	Department for Transport

Acronyms and Abbreviations	Description
DM	'Do Minimum'
DMRB	Design Manual for Roads and Bridges
DS	'Do Something'
EA	Environment Agency
EAR	Environmental Assessment Report
EAST	Early Assessment and Sifting Tool
EEA	European Economic Area
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standards
ES	Environmental Statement
ESR	Environmental Study Report
EZoI	Ecological Zone of Influence
FRA	Flood Risk Assessment
GAC	Generic assessment criteria
GHG	Greenhouse gas
GLHER	Greater London Historic Environment Record
GI	Ground Investigation
GLAAS	Greater London Archaeological Advisory Service
GLVIA	Guidelines for Landscape and Visual Impact Assessment
GQRA	Generic quantitative risk assessments
HAGDMS	Highways Agency Geotechnical Data Management System
HAWRAT	Highways Agency Water Risk Assessment Tool
HDV	Heavy Duty Vehicle/Heavy Delivery Vehicle
HE	Highways England
HER	Historic Environment Record
HGV	Heavy Goods Vehicle
HIA	Health Impact Assessment
HLC	Historic Landscape Character
HPI	Habitats of Principal Importance
HRA	Habitats Regulation Assessment
IAN	Interim Advice Note
JNCC	Joint Nature Conservation Committee

Acronyms and Abbreviations	Description
KBAP	Kent Biodiversity Action Plan
LAQM.TG	Local Air Quality Management Technical Guidance
LAQN	London Air Quality Network
LLFA	Lead Local Flood Authorities
LOAEL	Lowest Observed Adverse Effect Level
LDF	Local Development Framework
LNR	Local Nature Reserve
LWS	Local Wildlife Site
MAFF	Ministry of Agriculture, Fisheries and Food
MAGIC	Multi-Agency Geographic Information for the Countryside
MAFF	Ministry of Agriculture, Fisheries and Food
MT	Motorised Travellers
NPPG	National Planning Practice Guidance
NCA	National Character Area
NCNR	National Cycle Network Route
NE	Natural England
NHBC	National House Building Council
NHLE	National Heritage List for England
NIA	Noise Important Area
NMU	Non-Motorised User
NN NPS	National Networks National Policy Statement
NNR	National Nature Reserves
NO2	Nitrogen Dioxide
NOx	Nitrogen Oxide
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework
NPPG	National Planning Practice Guidance
NPSE	Noise Policy Statement for England
NPSNN	National Policy Statement for National Networks
NSIP	Nationally Significant Infrastructure Project
OS	Ordnance Survey
PCF	Project Control Framework

Acronyms and Abbreviations	Description
PCL	potential contaminant linkages
PCM	Pollution Climate Mapping
PCSM	Preliminary Conceptual Site Model
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PM10	Particulate Matter with a diameter of 10 micrometres or less
PPE	Personal Protective Equipment
PPG	Planning Practice Guidance
PRoW	Public Right of Way
PSSR	Preliminary Sources Study Report
RBD	River Basin District
RBMP	River Basin Management Plan
RIS	Road Investment Strategy
SAC	Special Areas of Conservation
SBI	Site of Borough Importance
SEB	Statutory Environmental Bodies
SLI	Shoulder of Mutton Wood Site of Local Importance
SMI	Site of Metropolitan Importance
SNCI	Sites of Nature Conservation Importance
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Areas
SPI	Species of Principal Importance
SPZ	Source Protection Zone
SoCC	Statement of Community Consultation report
SSSI	Site of Special Scientific Interest
SUP	Shared use path
SuDs	Sustainable Drainage Systems
SWMP	Site Waste Management Plan
TAG	Transport Analysis Guidance
TIN	Technical Information Note
UAEL	Unacceptable Adverse Effect Levels
UXO	Unexploded Ordnance

Acronyms and Abbreviations	Description
VISSIM	Traffic in Cities - Simulation Model {in German}
WEEE	Waste electrical and electronic equipment
WFD	Water Framework Directive
WHO	World Health Organisation
WMO	World Meteorological Organisation
ZVI	Zone of Visual Influence

Glossary

Term	Description
ADMS Roads	A comprehensive software tool for investigating air pollution problems due to networks of roads that may be in combination with industrial sites
Affected Road Network	The parts of the road network that would be affected by a change in traffic levels as the result of a transport scheme
Agricultural Land Classification	A framework for classifying land according to the extent to which its physical or chemical characteristics impose long term limitations on agricultural use. Agricultural land is classified into five categories according to versatility and suitability for growing crops. The top three grades, Grade 1, 2 and 3a, are referred to as 'Best and Most Versatile' land.
Air Quality Management Area	An area identified where the National Air Quality Objectives are not likely to be achieved. The Local Authority is required to produce a Local Air Quality Action Plan to plan how air quality in the area is to be improved.
Air Quality Strategy	The Air Quality Strategy sets out air quality objectives and policy options to further improve air quality in the UK from today into the long term.
Annual Average Daily Traffic	The number of vehicles travelling on a particular stretch of road on an average day.
Appraisal Summary Table	A table that appraises the performance of each option against economic, environmental, social and distributional sub-impacts and is used to directly inform the Value for Money assessment for the Economic Case.
Archaeological Priority Area	An area where there is significant known archaeological interest or potential for new discoveries. They are used to highlight where development may affect heritage assets.
Area of Outstanding Natural Beauty	An area outside a National Park designated for conservation due to its natural beauty.
At grade	On the same level, for example, an at grade junction is two or more roads meeting or crossing on the same level.
Best and Most Versatile	Defined as Grades 1, 2 and 3a of the Agricultural Land Classification as land which is most flexible, productive and efficient in response to inputs and which can best deliver future crops for food and non-food uses such as biomass, fibres and pharmaceuticals.

Term	Description
Biodiversity Action Plan	An internationally recognized program addressing threatened species and habitats and is designed to protect and restore biological systems. The original impetus for these plans derives from the 1992 Convention on Biological Diversity.
British Geological Survey	A partly publicly-funded body which aims to advance geoscientific knowledge of the United Kingdom landmass and its continental shelf by means of systematic surveying, monitoring and research.
Calculation of Road Traffic Noise	Method of calculating (and measuring) road traffic noise levels for new and altered highways.
Campaign to Protect Rural England	A national charity dedicated to the protection of rural England, protecting the local countryside where there is threat and enhancing it where there is opportunity. They aim to limit urban sprawl and ribbon development.
Client Scheme Requirements	The objectives of the A2 Bean and Ebbsfleet junction improvements scheme.
Conceptual Site Model	Serves to conceptualize the relationship between contaminant sources and receptors through consideration of potential or actual migration and exposure pathways.
Congestion Reference Flow	The maximum achievable hourly throughput of traffic on a particular stretch of road, expressed in terms of AADT.
Conservation Area	An area of special environmental or historic interest or importance, of which the character or appearance is protected by law against undesirable changes (Section 69 of the Planning (Listed Buildings and Conservation Areas) Act 1990).
Construction Environmental Management Plan	A plan by the contractor describing how the environmental impacts of construction activities of a project will be minimised and mitigated.
Contaminated Land Report 11	The Model Procedures for the Management of Land Contamination (CLR 11) have been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. The process involves identifying, making decisions on, and taking appropriate action to deal with land contamination in a way that is consistent with government policies and legislation within the UK.
Continuous Monitoring Site	An air quality monitoring station that houses analysers that continuously monitor the concentrations of air pollutants.
Control of Substances Hazardous to Health	Under the Control of Substances Hazardous to Health Regulations 2002, employers need to either prevent or reduce their workers' exposure to substances that are hazardous to their health.
County Wildlife Site	A non-statutory conservation designation in the UK which affirms a site's importance and value for wildlife in its county context. The designation is classified by Natural England as being a 'Local Site' designation, though sites can also be of a regional and national importance.
Defence Infrastructure Organisation	The arm of the Ministry of Defence (MoD) responsible for building, maintaining and servicing the MoD estate.
Defra	Defra is the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland. Defra is a ministerial department, supported by 33 agencies and public bodies.

Term	Description
Department for Transport	Government department responsible for the transport network in England, and for aspects of the transport network in the devolved administrations.
Design, Build, Finance and Operate	A single contractor is appointed to design and build a project and then to operate it for a period of time. The contractor finances the project and leases it to the client for an agreed period (perhaps 30 years) after which the development reverts to the client.
Design Manual for Roads and Bridges	A series of 15 volumes that provide standards, advice notes and other published documents relating to the design, assessment and operation of trunk roads, including motorways in the United Kingdom, and, with some amendments, the Republic of Ireland.
Development Consent Order	The means of applying for consent to undertake a Nationally Significant Infrastructure Project (NSIP). NSIPs include, for example, major energy and transport projects.
Disasters	A sudden accident or a natural catastrophe that causes great damage or loss of life.
Early Assessment and Sifting Tool	A decision support tool that has been developed to quickly summarise and present evidence on options in a clear and consistent format. It provides decision makers with relevant, high level, information to help them form an early view of how options perform and compare. The tool itself does not make recommendations and is not intended to be used for making final funding decisions.
Ecological Zone of Influence	the area in which there may be ecological features subject to impacts and subsequent effects as a result of the Scheme, including those that would occur as a result of habitat loss, and those that would occur through disturbance, such as noise.
English Heritage	Charity that cares for the National Heritage Collection of state-owned historic sites and monuments across England, under licence from Historic England.
Environment Agency	A non-departmental public body with responsibilities relating to the protection and enhancement of the environment in England.
Expressway/Expressway Standard	A road with high quality performance and safety standards, as described in the July 2013 Action for Roads report.
Habitats of Principal Importance	Under Section 41 of the Natural Environment and Rural Communities (NERC) Act, the Secretary of State is required to publish a list of habitats which are of principal importance for the conservation of biodiversity in England. Fifty-six habitats of principal importance are included on the S41 list. These are all the habitats in England that were identified as requiring action in the UK Biodiversity Action Plan and continue to be regarded as conservation priorities in the subsequent UK Post-2010 Biodiversity Framework.
Historic England	Publicly funded body that champions and protects England's historic places, including Stonehenge and Avebury; also known as the Historic Buildings and Monuments Commission for England.
Interim Advice Note	Contrains specific guidance, which shall only be used in connection with works on motorways and trunk roads in England, subject to any specific implementation instructions contained within an IAN.
Local Air Quality Management Technical Guidance	A technical guidance document designed to support local authorities in carrying out their duties under the Environment Act 1995 and

Term	Description
	subsequent Regulations. These duties require local authorities to review and assess air quality in their area from time to time.
Local Geological Site	Are non-statutory sites that have been identified by local geoconservation groups as being of importance.
Local Nature Reserve	A statutory designation made under Section 21 of the National Parks and Access to the Countryside Act 1949, and amended by Schedule 11 of the Natural Environment and Rural Communities Act 2006, by principal local authorities. A Local Nature Reserve must be of importance for wildlife, geology, education or public enjoyment.
Limit Values	Refers to airborne concentrations of chemical substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed, day after day, over a working lifetime, without adverse health effects.
Local Enterprise Partnership	A voluntary partnership set up between local authorities and businesses to drive local economic growth and job creation activities. There are 39 LEPs across England.
Mineral Consultation Area	An area identified in order to ensure consultation between the relevant minerals planning authority, the minerals industry and others before certain non-mineral planning applications made within the area are determined.
Mineral Safeguarding Area	An area designated by Minerals Planning Authorities which covers known deposits of minerals which are desired to be kept safeguarded from unnecessary sterilisation by non-mineral development.
Ministry of Agriculture, Fisheries and Food	A UK government department created by the Board of Agriculture Act 1889. The Ministry was dissolved in 2002, at which point its responsibilities were merged into the Department for Environment, Food and Rural Affairs (Defra).
Ministry of Defence	Government department responsible for the defence of the UK and its overseas territories, including the maintenance of the armed forces.
Motorised Travellers	A person who travels by a motorised vehicle which is a vehicle that is fitted with an engine or a motor e.g. mobility scooter.
Multi-Agency Geographic Information for the Countryside	A web-based interactive map to bring together information on key environmental schemes and designations in one place. Multi-Agency Geographic Information for the Countryside (MAGIC) is a partnership project involving six government organisations who have responsibilities for rural policy-making and management.
National Character Area	The subdivision of England into 159 distinct natural areas. Each area is defined by a unique combination of landscape, biodiversity, geodiversity, history, and cultural and economic activity. Their boundaries follow natural lines in the landscape rather than administrative boundaries.
National Infrastructure Plan	Document published by the UK Government, setting out its strategy for meeting the infrastructure needs of the UK economy.
National Nature Reserve	Reserves established to protect some of the most important habitats, species and geology in the United Kingdom, and to provide 'outdoor laboratories' for research. There are currently 224 NNRs in England with a total area of over 94,400 hectares - approximately 0.7% of the country's land surface. Natural England manages about two thirds of England's NNRs. The remaining reserves are managed by organisations approved by Natural England, for example, the

Term	Description
	National Trust, Forestry Commission, RSPB, Wildlife Trusts and local authorities.
National Vegetation Classification	The National Vegetation Classification was commissioned in 1975 by the Nature Conservancy Council (NCC) to provide a comprehensive and systematic catalogue and description of the plant communities of Britain. It has now been accepted as a standard, not only by the nature conservation and countryside organisations, but also by forestry, agriculture and water agencies, local authorities, nongovernmental organisations, major industries and universities.
Nationally Significant Infrastructure Project	A project of a type and scale defined under the Planning Act 2008 and by order of the Secretary of State relating to energy, transport, water, waste water and waste generally. These projects require a single development consent. Planning permission, listed building consent and scheduled monument consent amongst others are not required for Nationally Significant Infrastructure Projects.
National Trust	Charity that cares for historic houses, gardens, ancient monuments, countryside and other sites across England, Wales and Northern Ireland, including the Stonehenge landscape.
Natural England	Executive non-departmental public body responsible for the natural environment.
Non-Motorised User	Cyclists, pedestrians (including wheelchair users), and equestrians using the public highway.
Noise Important Area	Areas where the 1% of the population that are affected by the highest noise levels from major roads are located according to the results of Defra's strategic noise maps.
Outstanding Universal Value	To be included on the UNESCO World Heritage List, sites must be deemed to be of 'outstanding universal value'.
Pollution Climate Mapping	A collection of models designed to fulfil part of the United Kingdom's EU Directive (2008/50/EC) on ambient air quality and cleaner air for Europe, requirements to report on the concentrations of particular pollutants in the atmosphere. There is one model per pollutant, each with two parts: a base year model and a projections model. The Pollution Climate Mapping model provides outputs on a 1x1 km grid of background conditions plus around 9,000 representative road side values. The Mapping is also used for scenario assessment and population exposure calculations to assist policy developments and provides model runs to support the writing of Time Extension Notification applications for PM10 and NOx.
Project Control Framework	A joint Department for Transport and Highways England approach to managing major projects. The Framework comprises a standard project lifecycle; standard project deliverables; project control processes and governance arrangements.
Public Right of Way	A way over which the public have a right to pass and repass. The route may be used on foot, on (or leading) a horse, on a pedal cycle or with a motor vehicle, depending on its status. Although the land may be owned by a private individual, the public may still gain access across that land along a specific route. Public rights of way are all highways in law.
Publicly Funded Structure	A structure in which the initial capital costs of the scheme are (principally) met through sources from government funding.

Term	Description
Road Investment Strategy	The long-term strategy to improve England's motorways and major A roads. The first RIS (known as RIS1) was published in 2014 and covers the period 2015-2020. A second RIS (RIS2) was published in 2015, and covers the post-2020 period.
Royal Horticultural Society	The UK's leading gardening charity dedicated to advancing horticulture and promoting gardening.
Royal Society for the Protection of Birds	A charitable organisation that works to promote conservation and protection of birds and the wider environment through public awareness campaigns, petitions and through the operation of nature reserves throughout the UK.
Scheduled monument	A 'nationally important' archaeological site or historic building, given protection against unauthorised change and included in the Schedule of Monuments kept by the Secretary of State for Culture, Media and Sport. The protection given to scheduled monuments is given under the Ancient Monuments and Archaeological Areas Act 1979.
The Scheme	The A2 Bean to Ebbsfleet Scheme.
Sites of Nature Conservation Importance	Locally important sites of nature conservation adopted by local authorities for planning purposes.
Site of Special Scientific Interest	A conservation designation denoting to a protected area in the United Kingdom. The Sites are protected by law to conserve their wildlife or geology.
Site Waste Management Plan	A Site Waste Management Plan should describe how materials will be managed efficiently and disposed of legally during the construction of the works, explaining how the re-use and recycling of materials will be maximised. This involves estimating how much of each type of waste is likely to be produced and the proportion of this that will be re-used or recycled on site, or removed from the construction site for re-use, recycling, recovery or disposal. It is the joint responsibility of the client and the principal contractor to ensure that a Site Waste Management Plan is in place before construction begins and to ensure that it is enforced.
Source Protection Zone	Areas of land around over 2000 groundwater sources such as wells, boreholes and springs used for public drinking water supply. The zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. There are three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied to a groundwater source. The zones are used in conjunction with the Groundwater Protection Policy to set up pollution prevention measures in areas which are at a higher risk, and to monitor the activities of potential polluters nearby.
Special Area of Conservation	Areas of strictly protected sites designated under the EC Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora. The listed habitat types and species are those considered to be most in need of conservation at a European level (excluding birds).
Special Protection Area	Areas of strictly protected sites classified in accordance with Article 4 of the EC Birds Directive (2009/147/EC) on the conservation of wild birds. They are classified for rare and vulnerable birds (as listed on Annex I of the Directive), and for regularly occurring migratory species.

Term	Description
Strategic Economic Plan	A document produced by a Local Enterprise Partnership setting out its plans for the future and the funding that will be required to deliver these plans.
Strategic Road Network	The network of approximately 4,300 miles of motorways and major 'trunk' A roads across England, managed by Highways England.
Transport Analysis Guidance	Guidance produced by DfT on the process of appraisal of transport interventions.
Tree Preservation Order	A Tree Preservation Order is made by a Local Planning Authority to protect specific trees or a particular area, group or woodland from deliberate damage and destruction. TPOs can prevent the felling, lopping, topping, uprooting or otherwise wilful damaging of trees without the permission of the Local Planning Authority.
Unexploded Ordnance	An explosive weapon (bombs, shells, grenades, land mines, naval mines, cluster munition, etc.) that did not explode when they were employed and still pose a risk of detonation, sometimes many decades after they were used or discarded.
Vulnerability	The quality or state of being exposed to the possibility of being attacked or harmed, either physically or emotionally.
Water Framework Directive	The Water Framework Directive (2000/60/EC) is a EU directive which aims to achieve good status of all water bodies (surface waters, groundwaters and the sites that depend on them, estuaries and near-shore coastal waters) and the prevent any deterioration. It has introduced a comprehensive river basin management planning system to protect and improve the ecological quality of the water environment. It is underpinned by the use of environmental standards.
World Heritage Site	A site listed by UNESCO because of its special natural or cultural value.
Zone of Theoretical Visibility	A map, usually digitally produced, showing areas of land within which a development is theoretically visible.

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