M25 Junction 28 Improvement Environmental Impact Scoping

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1. Introduction

1.1 Overview of project

1.1.1 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 the improvement to M25 Junction 28 (the Scheme).

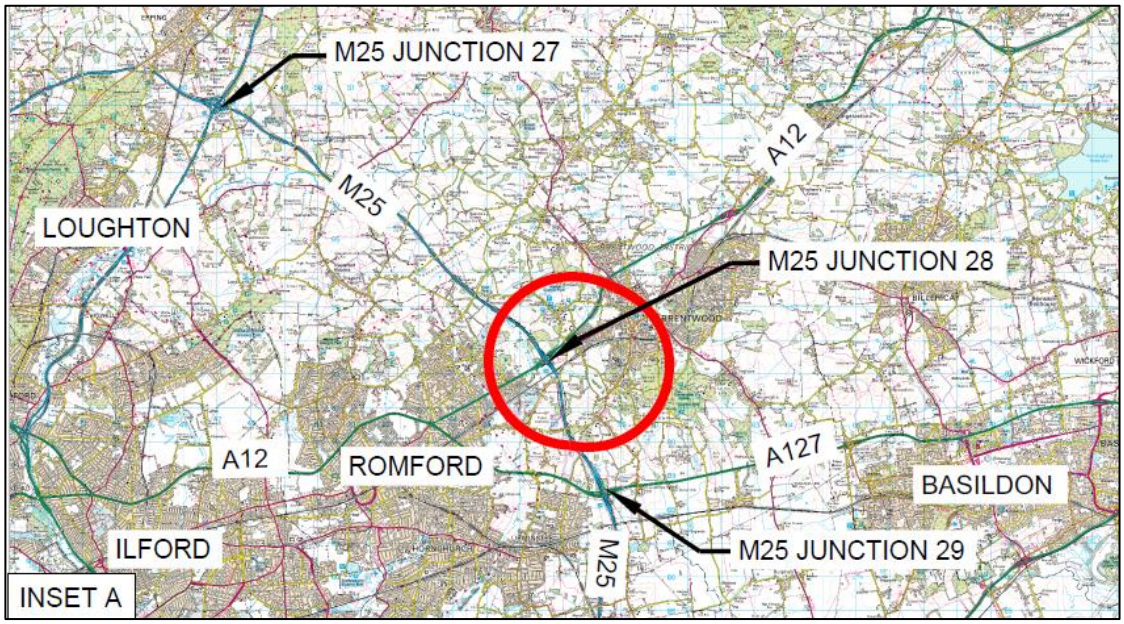
1.1.2 As shown in Figure 1.1, the Scheme is located between Brentwood and Romford. This junction is one of the major improvement projects planned within the south east and will provide better access towards Essex and London, as well as connecting Brentwood, Chelmsford, Colchester and Suffolk with London and other key destinations. Construction is due to begin by March 2020.

1.1.3 The Scheme was announced by Highways England in July 2017 and comprises upgrading Junction 28 located at the junction between the M25 anti-clockwise and the A12 in Essex, and includes the provision of a dedicated link for this right-turn movement and minor improvements of the existing roundabout.

1.1.4 The Scheme (in Appendix A-3) converts the use of the existing hard shoulder over the M25 viaduct to the proposed deceleration lane and associated diverge configuration. The diverge commences to the north of the existing structure, consequently requiring no works to the existing railway structure and the existing M25 viaduct. Following the diverge nose it begins to turn into the adjacent land, north-east of the existing junction. The existing circulatory/M25 northbound merge will be realigned to pass under the proposed link. The horizontal alignment continues in a loop while the vertical profile starts to decline from the proposed structure on an embankment following the existing topography downhill towards the A12.

1.1.5 The overseeing organisation and project sponsor is Highways England and the designer is Atkins.

Figure 1.1: Scheme location



1.2 Purpose of the Scoping Report

1.2.1 This Scoping Report sets out the scope of the Environmental Statement (ES) for the Scheme in the Preliminary Design Stage. The scoping phase is carried out prior to the environmental impact assessment (EIA) process and aims to identify significant issues and determine the scope of the subsequent impact assessment phase.

1.2.2 The Scoping Report, a statutory document, will lead to a statutory EIA which will be reported in an ES. The Scheme is likely to constitute a Nationally Significant Infrastructure Project as it meets the thresholds set out in Highway and Railway (Nationally Significant Infrastructure Project) Order 2013. Therefore, Highways England will be required to submit an application for a Development Consent Order (DCO). A Preliminary Environmental Information Report (PEIR) will be prepared which will set out the effects of the Scheme as they are known at the statutory consultation stage to inform stakeholders and the public ahead of the preparation of the ES to support the application for DCO.

1.2.3 This document has been prepared in accordance with PINS Advice Note 7 Environmental Impact Assessment: Preliminary Environmental Information, Screening and Scoping March 2015 (version 5); Highways England guidance; DMRB Volume 11 Environmental Assessment, Section 2 in particular

- Part 1 HA 201/08;
- Part 4 HA 204/08;
- Part 6 HD 48/08; and
- Interim Advice Note (IAN) 125/15 and 126/15.

1.2.4 Refer to Table 1.1 below for details on how the PINS Advice Note 7 has been applied to this Scoping Report.

1.2.5 The objectives of this Scoping Report are to:

- Review existing data, identify sensitive resources and receptors, and scope the work required for the ES;
- Identify the level of impact of the Scheme;
- Determine the appropriate level of effort that should be applied to the various environmental topics, namely whether a Simple or Detailed assessment as defined in DMRB Volume 11, Section 2, Part 1 HA 201/08, Volume 11, Section 2, Part 4 HA 204/08 and Annex A of IAN 125/15;
- Ensure the scope and depth of any subsequent assessment is both appropriate and proportionate; and
- Provide decision makers and stakeholders with a clear indication of how the project is to be assessed and to set out the scope/content of that assessment, whilst setting out any consultation process.

Table 1.1: Suggested Scoping Report Contents in PINS Advice Note 7

Suggested Scoping Report Contents (from Advice Note 7)	Chapter / Section / Appendix in this Scoping Report
A plan showing: – The proposed draft DCO site boundary (identified by a red line) including any associated development; – any permanent land take required for the proposed development; – any temporary land take required for construction, including construction compounds; – any existing infrastructure which would be retained or upgraded for use as part of the scheme; – proposed development and any existing infrastructure which would be removed; and – features including planning constraints and designated areas on and around the site such as national parks or historic landscapes.	Appendix A
A description of the proposed development including both the NSIP and any of the associated development	Chapter 2
In dealing with the description of the development and its possible effects on the environment, applicants should: • Set out the information using the headings in Schedule to the EIA Regulations, being: – characteristics of the development; – location of the development; and – characteristics of the potential impacts. • ensure that all aspects of the environment likely to be significantly affected by the development are addressed.	Chapters 5 to 14
An outline of the main alternatives considered and the reasons for selecting a preferred option.	Chapter 3
Results of desktop and baseline studies where available	Chapters 5 to 14
Referenced plans presented at an appropriate scale to convey clearly the information and all known aspects associated with the Scheme.	Appendix A

Suggested Scoping Report Contents (from Advice Note 7)	Chapter / Section / Appendix in this Scoping Report
Guidance and practice to be relied upon, and whether this has been agreed with the relevant bodies together with copies of correspondence to support these agreements.	Chapters 5 to 14
Methods used or proposed to be used to predict impacts and the significance criteria framework used	Chapters 5 to 14
Any mitigation proposed and predicted residual impacts	Chapters 5 to 14
Where cumulative development has been identified, how the developer intends to assess these impacts in the ES	Chapter 15
An indication of any European designated nature conservation sites that are likely to be significantly affected by the proposed development and the nature of the likely significant impacts on these sites	Chapter 7
Where a developer seeks to scope out matters, a full justification for scoping out such matters, preferably supported by evidence of agreement with the relevant bodies	Chapters 5 to 14
Key topics covered as part of the developer's scoping exercise	Section 1.3
An outline of the structure of the proposed ES	Chapter 16

1.3 Contents of the Scoping Report

1.3.1 The contents of the Scoping Report covers DMRB (Volume 11, Section 3) topics which are:

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

1.3.2 This Scoping Report also covers Climate Change, as required under the EIA Regulations (2017).

1.3.3 Consultation on the Scheme includes both informal (non-statutory) (undertaken in 2016) and formal (statutory) consultation (to be held early in 2018). Further details on the consultation planned future consultation for the Development Consent Order application can be found in the Statement of Community Consultation document, produced separately to this Scoping Report

1.3.4 All general figures show the Scheme, including the environmental constraints plan, the red line boundary and the Scheme proposals, are presented in Figures A-1, A-2, A-3 (respectively) in Appendix A.

1.4 Need for an Environmental Impact Assessment

1.4.1 As the Scheme is likely to be greater than 15 hectares in area, and likely to have a significant effect on the environment, an EIA will be required in accordance with the Infrastructure Planning (EIA) Regulations 2017 (EIA Regulations) which transposed the 2014 amended EIA Directive into UK law and came into force in May 2017. The EIA Regulations (2017) set out the requirements for an applicant who proposes to request a scoping opinion from PINS. Regulation 10 (3) requires a request for a scoping opinion to include.

- a plan sufficient to identify the land;
- a description of the proposed development, including its location and technical capacity;
- an explanation of the likely significant effects of the development on the environment; and
- such other information or representations as the person making the request may wish to provide or make.

1.4.2 The EIA Regulations (2017), in Schedule 1 also sets out thresholds for certain types of projects that by their scale or nature require an EIA to be prepared. Where projects do not meet these thresholds Schedule 2 of the Regulations lists projects (including highways projects) for which EIA may still be required if the effects on the environment are deemed to be significant. A Screening Report for the Scheme was produced at Options Selection Stage. The Screening Report also concluded that, because of the likelihood of significant environmental effects, a statutory EIA would be required.

1.4.3 The purpose of EIA is to provide information for decision-making on the environmental consequences of proposed actions; and promote environmentally sound and sustainable development through the identification of appropriate enhancement and mitigation measures. The aim of EIA is also to provide the public with the information required to participate in the decision-making process.

1.4.4 The EIA will be undertaken by a team of specialists working in close collaboration with the design engineers responsible for the preliminary design of the Scheme as part of an iterative design, consultation and assessment process. This will maximise the opportunity to avoid or reduce environmental effects at source and to identify mitigation measures to address those effects which cannot be avoided.

1.5 Key legislation and policy

Legislative framework

1.5.1 On 12 March 2014, the European Parliament voted to adopt substantive amendments to the EIA Directive 2011/92/EU. These amendments made by EIA Directive 2014/52/EU were transposed into UK legislation in May 2017 and therefore will be relevant to this Scheme and the topic assessments. This is irrespective of the vote to leave the EU in the referendum on the UK's membership as EU legislation will be incorporated into UK legislation in the short to medium term.

Policy overview

1.5.2 A summary of the key support and considerations for the Scheme identified in the relevant national, regional and local policy documents for the Scheme are set out below in Table 1.2.

Table 1.2: Policy overview

Scale	Policy Document	Key Considerations for the Scheme
National	Road Investment Strategy (2014)	Promote safe movement, satisfy users of the network, support efficient movement, improved environmental outcomes, support local access and well-being and be demonstrably cost effective
	Highways England Business Plan	Support short-term targets as well as long-term aspirations and not significantly impact on network availability
	National Policy Statement on National Networks	Identifies that there is a critical need to address road congestion and provide safe, expeditious and resilient networks that should be designed to minimise social and environmental impacts and improve quality of life.
	National Planning Policy Framework	Advises that local authorities should take account of the need for strategic infrastructure, including nationally significant infrastructure within their areas.
Regional	South East England Strategic Economic Plan	Enable local housing and employment growth in Essex and the wider South East by supporting efficient movement along the A12 and M25
	London Plan	Enable targets for employment and housing growth in outer London by providing efficient access to the M25
	Mayor's Transport Strategy	Support the smooth and efficient movement of traffic along the A12 to the west of the M25
Local	Essex Local Transport Plan (2011)	Manage the impacts of traffic on the local community, support access to strategic locations in Essex along the A12 corridor and support multimodal access for Brentwood
	Brentwood Local Plan	Ensure improvements are consistent with land use and environmental constraints and help to deliver local aspirations for housing and employment growth.

2. The Project

2.1 Project location

2.1.1 The Scheme is located on the M25 at Junction 28 between Brentwood and Romford, on the border of London Borough of Havering and Brentwood Borough Council.

2.1.2 The north-east quadrant of the M25, where Junction 28 is located, is one of the busiest sections of the M25 motorway and often experiences severe congestion. The junction provides the intersection between the M25 motorway, the key trunk route of the A12 and the A1023, providing connectivity between London and Chelmsford, Ipswich and Brentwood and other key destinations across the South East of England. The junction caters for several dominant movements particularly between the M25 motorway and the A12 towards Essex. One of these, the M25 clockwise to A12 east movement was improved in 2008 with the introduction of a dedicated free flow left turn link.

2.2 Need for the project

2.2.1 Junction 28 plays a vital role connecting the M25 with the A12, as well as providing local access to Brentwood via the A1023 (Brook Street). It is a heavily used junction which features a roundabout mainly controlled by traffic lights. Up to 7,500 vehicles per hour currently travel through the roundabout at peak times. It is already operating at capacity, motorists regularly experience congestion and delays. Research shows that traffic in the area is expected to increase by up to 30% by 2037, with more than 9,000 vehicles per hour travelling through the roundabout at peak times.

2.2.2 Without intervention, there will be further deterioration in traffic conditions:

- Delays will be at least 5 times greater; and
- Average speeds will be reduced by 25%.

2.2.3 The roundabout also caters for traffic accessing Brentwood via the A1023 (Brook Street). Although the Scheme is not directly focused on Brook Street, the proposed improvements to Junction 28 will deliver some benefits for customers using the A1023. The A1023 (Brook Street) arm of the roundabout is the only one not controlled by traffic lights. After leaving the roundabout, motorists pass through traffic lights at the Nags Head Lane and Mascalls Lane junctions.

2.2.4 During peak times, these junctions operate over capacity and queues of traffic regularly develop along Brook Street and often back on to the roundabout. These queues can also lead further back on to the M25 north and A12 east entry and exit roads.

2.2.5 In recent years, there have also been a number of accidents and incidents at Junction 28, which create delays and congestion along the M25, A12 and local roads.

2.3 Project objectives

2.3.1 The overall project objectives are set out in Table 2.1.

Table 2.1: The Scheme objectives and desired outcomes

Project objectives	Desired outcomes
To cater for future traffic demands efficiently with minimal delay and to support future development and economic growth	• Improve journey time reliability • Improve journey times • Increase the vehicular throughput of the junction • Support employment and housing development planned for Brentwood, Essex and Havering
To improve the network resilience and enable smoother flow of traffic and reliable journey times	• Improve journey time reliability • Improve journey times
Improve road safety on the approaches to and through Junction 28	• Reduce the severity and rate of accidents and causalities
Minimise the impact of high traffic volumes and stopping traffic on local air quality and noise	• Reduce (or at least keep to neutral) local emissions (e.g. NO_2, NO_x, and PM_{10}) • Reduce (or at least keep to neutral) noise levels

2.4 Key environmental constraints

2.4.1 The Scheme is within a predominantly rural setting in a narrow strip of Green Belt between the edge of the settlement of Brentwood just to the east and Romford further to the west. Brentwood Borough Council have declared two Air Quality Management Areas (AQMA): for the eastern half of the junction and for the area near Nags Head Lane to the south. The London Borough of Havering has declared a borough-wide AQMA which covers much of the area to the west. Defra has recorded elevated nitrogen dioxide (NO_2) concentrations on the A12. There are four Noise Important Areas within the area.

2.4.2 There is a Grade II Listed Building, The Nags Head just to the east of the junction on Brook Street and two Registered Park and Gardens at Warley Place to the south and Weald Park to the north. There are no designations for landscape quality but there are a number of Ancient Woodlands of national importance around the junction. There are two Local Nature Reserves (LNR) to the north west of the junction but no national or international designated ecological sites. The area surrounding the junction is Grade 3 Agricultural Land Classification (ALC) and there is a former landfill site immediately to the north west. Two waterbodies cross the site, the Ingrebourne and the Weald Brook which both have associated fluvial flood plains. These environmental constraints are shown on the environmental constraints drawings in Appendix A.

2.5 Project description

Scheme overview

2.5.1 As discussed previously the Scheme comprises upgrading Junction 28, which is the junction located between the M25 anti-clockwise and the A12 in Essex, and includes the provision of a dedicated link for this right-turn movement and minor improvements of the existing roundabout.

2.5.2 The Scheme converts the use of the existing hard shoulder over the M25 viaduct to the proposed deceleration lane and associated diverge configuration (refer to Appendix A). The diverge commences to the north of the existing structure, consequently requiring no works to the existing railway structure and the existing M25 viaduct. Following the diverge nose it begins to turn into the adjacent land, north-east of the existing junction. The existing circulatory/M25 northbound merge will be realigned to pass under the proposed link. The horizontal alignment continues in a loop while the vertical profile starts to decline from the proposed structure on an embankment following the existing topography downhill towards the A12.

Non-motorised user provisions

2.5.3 Footways exist on the A12 and A1023. On the northern side of the A12, west of the M25 Junction 28 roundabout, a footway provides access to the vicinity of the roundabout and then to the southern side of the A12 via an uncontrolled crossing of the A12 entry slip and exit slip road. This then connects with a shared use path (SUP) to the southern side of the A12/A1023. SUPs exist on the A1023 immediately east of the M25 Junction 28 roundabout junction, through the southern side of the junction via one uncontrolled and one controlled crossing point. This SUP then continues along the southern side of the A12 west of the roundabout towards Harold Wood providing a connection to National Cycle Network Route (NCNR) 136.

2.5.4 A further SUP exists on the northern side of the A12 in the vicinity of Harold Wood but this is discontinuous and does not provide a direct route to the roundabout junction on the northern side of the A12. Therefore, the only direct SUP access to and from the roundabout is currently via the SUP to the southern side of the A12. A grade separated crossing exists in the vicinity of Harold Wood to facilitate crossing movements of the A12.

2.5.5 Route 136 of the NCNR crosses the A12 approximately 1 km west of the junction. It is a largely traffic free route connecting the village of Noak Hill and Dagnam Park north of the A12 south to Upminster and the Thames at Rainham via Harold Hill and Hornchurch and passing through parks and green spaces. It can therefore be assumed that local cyclists from Brentwood, Romford and areas in between will likely travel to and from this route and access it from the vicinity of the A12.

Construction phase

2.5.6 Currently the estimated total volume of excavation for the construction of the Scheme is approximately 67,500 m^3 (factor 1:1)[1]. A number of structures are proposed to be demolished and extended on site, including gantries and

[1] 2,000 m^3 + M25 Slip road: 65,000 m^3 + A12 Slip road: 500 m^3 = 67,500 m^3 Total Excavation

culverts. New structure and extensions to be built on site include the Interchange Link structure over M25 slip road and the A12 slip road over Interchange Link.

Construction, operation and long term management

2.5.7 Construction of the Scheme is planned to commence in March 2020, with the Scheme to be operational in March 2022.

2.5.8 Maintenance of the Scheme will be the responsibility of Highways England.

Decommissioning

2.5.9 The Scheme has an indefinite design life, it is not considered appropriate for decommissioning to be included in the environmental assessments, rather the focus will be upon seeking to minimise disruption and to re-use materials that will also form part of the Materials assessment.

3. Alternatives

3.1 Introduction

3.1.1 A staged approach was undertaken in developing options for the Scheme. Firstly, a number of high-level, strategic solutions were developed; more detailed scheme options were then developed and assessed.

3.1.2 The 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

Strategic Options

3.2.1 A range of strategic options which could potentially be considered to address key problems at M25 Junction 28 were initially identified. The options considered are set out in Table 3.1.

Table 3.1: Strategic Options

Strategic Option	Brief Description
Option 1 – Do Minimum	This focuses on short term measures to reduce safety concerns and issues on the gyratory. Primarily it is concerned with introducing traffic signals on the A1023 Brook Street approach (currently uncontrolled), lane markings and signage
Option 2 - Local access and demand management	This would consider options to change or reduce demand at the junction, for instance with new access strategies to and from Brentwood such as closing A1023 Brook Street and creating a new access on the A12
Option 3 - Enhanced public transport	Improved bus and rail provision between key destinations (Brentwood, Havering, London, Chelmsford etc., including future Cross Rail)
Option 4 - Highway junction improvements	Junction capacity improvements to cater high demands for M25 anticlockwise to A12 Essex movements.
Option 5 - Do Maximum – Full junction improvements	Junction capacity improvements to cater all the high volume dominant movements between M25 and A12 including heavy right turn movements
Option 6 - Strategic road network classification	A wider strategic option that would consider reviewing the classification of the Strategic Road Network (SNR) alongside future considerations for a Lower Thames Crossing. For example, this may look to make best use/enhance the A13/A130, A12 and A127 corridors

Option Identification

3.2.2 Based on an assessment process which involved scoring these Strategic Options against Early Assessment Sifting Tool (EAST) and the Scheme's objectives, a number of variants were developed. This assessment process included a consideration of the deliverability and risks associated with environmental issues, in particular the effects of the option variants on air quality, noise, traffic, ancient woodland, ecology, visual intrusion and ground conditions. Each of the variants were also designed to provide a new free flow link for right turning traffic between the M25 motorway anticlockwise and the A12 east. The options identified at the Options Identification stage were refined and are set out in Table 3.2.

Table 3.2: Option Identification

Option	Brief Description
Do-Minimum	Focuses on short term measures with signal optimisation at Junction 28.
Option 1 - Hamburger through-about	Provides additional connectivity from the M25 anticlockwise to A12 eastbound and M25 clockwise to A12 westbound. This includes signal controlled junctions where the proposed link roads bypass through the centre of an existing circulatory with a Hamburger configuration. This option requires the centre of the existing circulatory to be raised, a new structure, and reconfiguration of the existing M25 viaduct columns.
Option 2 - Northern loop	Provides additional connectivity from M25 anti-clockwise to A12 eastbound via a proposed link road. This proposed link road exits the M25 after Nag's Head Lane and under the existing railway embankment. The proposed link then crosses the A12 and M25 on new structures before merging with the A12 eastbound before Wigley Bush Lane over-bridge.
Option 3 - Satellite roundabout	Provides a satellite roundabout to the south-west of the existing junction. In doing so, it reduces the number of conflict points at the existing junction thus improving capacity. This option requires a new structure, diversion of the A12 in both directions, reconfiguration of the A12 westbound on-slip to include a structure over the diverted A12, and a culvert over Weald Brook.
Option 4 - Compact northern loop	Provides additional connectivity from M25 anticlockwise to A12 eastbound via a proposed link road. The proposed link requires a structure parallel to and then over the M25 before merging with the A12 eastbound before Wigley Bush Lane over-bridge.
Option 5 - Single cloverleaf	Provides additional connectivity from M25 anti-clockwise to A12 eastbound via a proposed loop road in the form of a cloverleaf. The proposed loop requires a structure parallel to the M25 and exits the existing highway boundary to the north-west before looping round to join the A12 eastbound.
Option 6 - Southern link	Provides additional connectivity from the M25 anticlockwise to A12 eastbound via a proposed link road. The proposed link requires several structures and extensive land take.
Option 7A - Do-Maximum, double cloverleaf	Incorporates all infrastructure associated with Option 5. Furthermore, this option provides additional connectivity from the A12 westbound to M25 anti-clockwise. The option achieves this via an additional proposed loop road in the south-west corner of the existing junction. The proposed loop diverges from the A12 westbound before the alignment is raised over the existing circulatory, existing A12 and the loop proposed in Option 5 on a structure before merging to the M25 anticlockwise. Further realignment of the existing M25 anti-clockwise on-slip will be required for this option to accommodate the merging of the A12 westbound to M25 anti-clockwise

Option	Brief Description
	traffic in the most compact layout possible. The proposed link requires several structures and extensive land take.
Option 7B - Do-Maximum, cloverleaf plus northbound link	Incorporates all infrastructure associated with Option 5. Furthermore, this option provides additional connectivity from the A12 westbound to M25 anti-clockwise. The option achieves this via an additional proposed link road. The proposed link diverges from the A12 westbound immediately after the existing junction, before crossing over the existing A12 on a structure then heading towards, and ultimately merging with the M25 anti-clockwise at the existing ground level. The proposed link requires several structures, a culvert of the Weald Brook and extensive land take.

Option Selection

3.2.3 Based on an assessment process which involved scoring these options identified in Table 3.2 against criteria and the Highways England and EAST, three variants of option 5 were shown to offer the greatest value in achieving the project objectives and deliverability. Option 5 variants were also identified as one of the better options in relation to environmental impact.

3.2.4 All three options diverted traffic away from the roundabout and included a new dedicated loop road between the M25 and the A12.The options are described in Table 3.3.

Table 3.3: Option Selection

Option	Brief Description
Option 5B	Single lane loop road, widening existing M25 bridge over Junction 28. This option would involve: • works on the M25 with the likely closure of the hard shoulder; • narrow lanes on the M25; and • speed restriction over a long period during construction.
Option 5C	Single lane loop road, widening short section of M25. This option was identified as having least impact in disrupting traffic across the network during construction.
Option 5F	Two lane loop road, widening short section of M25, reconfiguration of A12. This option would require some disruption on the A12 eastbound and westbound carriageways during construction.

3.2.5 Options 5C and 5B feature a larger loop road than Option 5B, as moving the diverge further north along the M25 avoids the need to widen the existing M25 structures and addresses adverse safety and operational issues related to successive diverges.

3.2.6 An environmental assessment of these options was undertaken to inform final option selection which included a consideration of all the environmental topics set out in this Scoping Report. All options had similar potential impacts in relation to air quality and noise, however Option 5B had an overall lower environmental impact than options 5C and 5F due to a smaller scheme footprint.

3.2.7 Taking into account transport performance, environment, economics and social aspects, Option 5F was selected as the preferred option. This was primarily because the 2-lane configuration of this option would be the optimum solution in

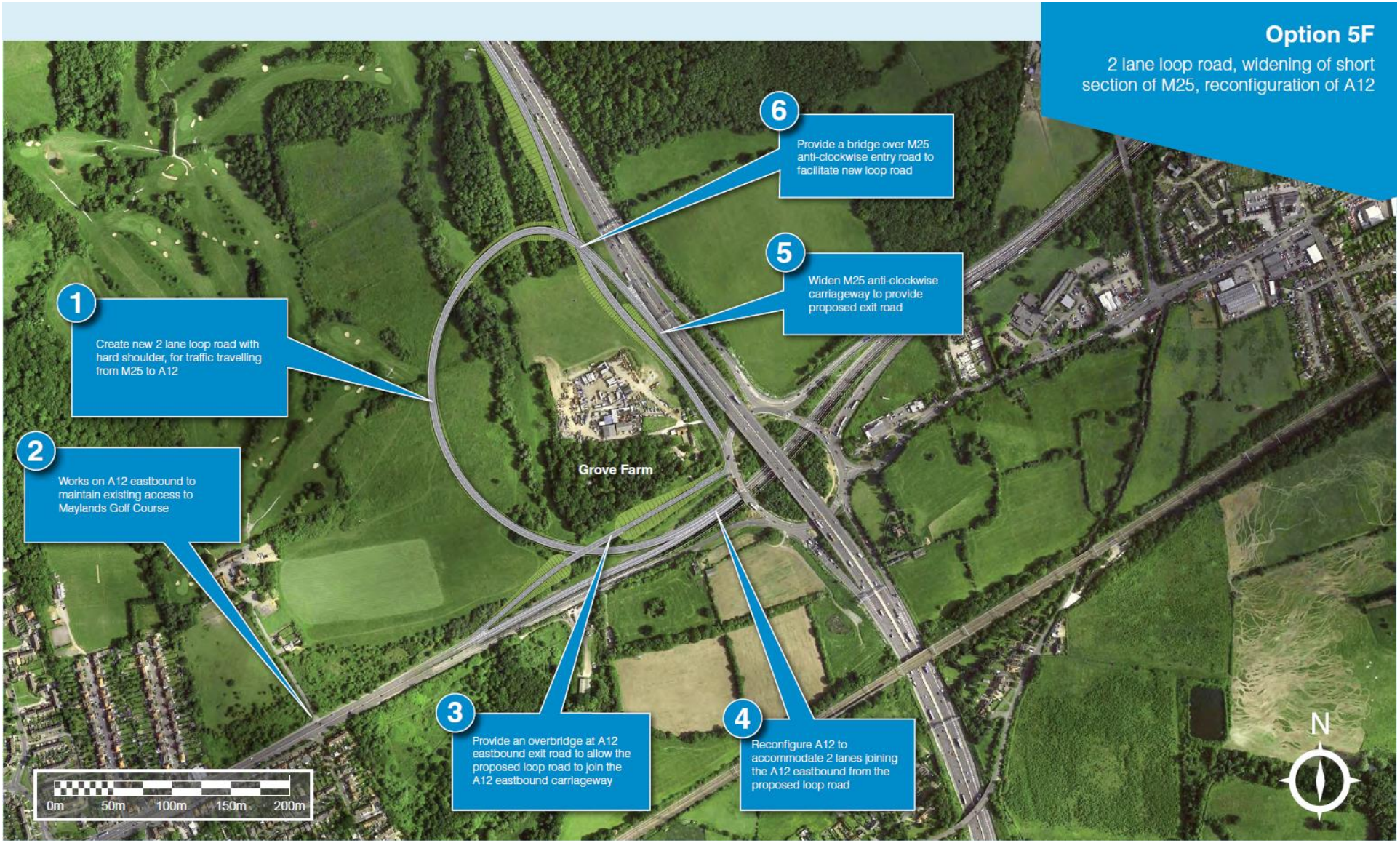
terms of network resilience, maintenance requirements and avoiding disruption to traffic. The higher environmental impact of Option 5C could also not be justified when the same 1-lane configuration could be achieved with Option 5B.

3.2.8 Option 5F, as shown in Figure 3.1, has therefore been taken forward forming the basis of this Scoping Report and will be assessed as part of the ES. This option was selected as achieving the scheme objectives, and balancing the needs of road users, the community, the environment and businesses. Option 5F is recommended as the preferred option based on the following:

- Performs strongest in achieving the primary objective of improving journey times, particularly in the longer term beyond the 2037 design year;
- Options 5B and 5C are 1 lane options and forecast traffic volumes are expected to approach and exceed capacity beyond the design year. It is noted that two lanes cannot be provided on the Option 5B alignment;
- Option 5F can be constructed without the significant disruption to traffic on the M25 motorway as expected under Option 5B (which requires widening of the M25 viaduct over the Junction 28 roundabout);
- Option 5B involves a departure from standard relating to the sub-standard distance between the successive diverges on the M25 anti-clockwise carriageway. This presents a significant concern over operational safety of the road user;
- Option 5F provides greater network resilience through having a second lane on the new link;
- Option 5F offers a two-lane link that is expected to be more advantageous in terms of maintenance and avoiding disruption to traffic;
- Provides a strong BCR of 6.1 despite the additional cost associated with providing a second lane on the new link to cater longer term forecast demand flows;
- In terms of environmental implications Option 5C would have the similar impacts as that shown for Option 5F. It is noted that Option 5C features only 1 lane (compared to 2 lanes in Option 5F). Therefore, the higher environmental impact of Option 5C is not justified when the same 1 lane configuration could be achieved with Option 5B; and
- Option 5F is selected over Option 5B based on the foregoing reasons, and that it also has the highest overall weighted Value Management score and was shown to be the preferred option noted as part of the public consultation.

3.2.9 Further key environmental constraints relating to this option are outlined in Section 2.4.

Figure 3.1: Option 5F (the Scheme)



4. Scope of Assessment

4.1 The Design Manual for Roads and Bridges

Overview

4.1.1 DfT DMRB, Volume 11, Section 2, Part 1, General Principles and Guidance on Environmental Impact Assessment outlines the approach to assessment that may be relevant dependent upon the potential environmental effects and the stage of the project. The assessment levels are: scoping, simple assessment and detailed. These levels are not intended to be sequential, but consequential. The assessment levels are defined as follows:

- Scoping – defines the scope of the assessment and is the purpose of this Scoping Report. Establishes the need for further assessment and whether some environmental topics can be 'scoped out' from further assessment; and
- Simple Assessment – typically based on the data and information that is readily available and fulfils one of three functions:
  - To address potential aspects identified at the scoping level;
  - To reach an understanding of the likely environmental effects to inform the final design or assessment; or
  - To reach an understanding of the likely environmental effects that identified the need for a Detailed Assessment.

4.1.2 The Simple Assessment would be sufficient if it established confidently that the forecast environmental effect would not be a fundamental issue in the decision-making process.

4.1.3 Detailed Assessment – Likely to require detailed field surveys and/or quantified modelling techniques. Detailed assessments would be undertaken where there is the potential to cause significant effects on environmental resources and receptors. The objective of this level of assessment is to gain an in-depth appreciation of the beneficial and adverse effects of the project.

Scoping

4.1.4 Volume 11, Section 1, Part 1 of the DMRB supplemented by IAN 125/15 Supplementary guidance for users of DMRB Volume 11 'Environmental Assessment' identifies the topics that the scoping of the ES should consider. These are:

- Air Quality;
- Noise and Vibration;
- Ecology and Nature Conservation (referred to as Biodiversity in this Scoping Report);
- Road Drainage and the Water Environment;
- Landscape;
- Geology and Soils;

- Cultural Heritage;
- Materials and Waste; and
- People and Communities.

4.1.5 Each of these topics are considered in individual chapters (Chapters 5 to 14) following the same format and structure. For each topic, a different level of assessment may be appropriate and this has been stated.

4.1.6 Article 3(1) of the EIA Directive contains a number of new requirements, including topics to be included in EIAs. New requirements relevant to this Scoping Report and the ES are:

- Population and human health (previously population);
- Climate Change;
- Biodiversity;
- Monitoring; and
- Major Accidents and Disasters.

4.2 Proposed EIA approach for the Scheme

4.2.1 The key stages of the EIA process for the Scheme are:

- Screening;
- Scoping;
- Establishment of baseline conditions;
- Impact assessment and identification;
- Develop mitigation measures;
- Prediction of residual environmental effects;
- Cumulative impact assessment;
- Transboundary impacts; and
- Environmental and management plan.

4.3 Defining the study area

4.3.1 Study areas have been defined individually for each environmental topic, according to the geographic scope of the potential impacts relevant to that topic or of the information required to assess those impacts, and drawing on guidance in DMRB where this specifies the extent of study areas. The study areas are defined within each relevant chapter of this report.

4.4 Establishment of baseline conditions

4.4.1 The existing baseline conditions need to be defined to allow the assessment of changes that would be caused by the Scheme. The identification of the baseline requires the description of the existing situation and then a prediction of how it is likely to change in the absence of the Scheme.

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

4.5 Impact assessment and identification

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

4.5.2 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.

4.5.3 In accordance with guidance in DMRB Volume 11, Section 2, 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 Source: Adapted from Highways England DMRB, Volume 11, Section 2, Part 5

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

Significance Category	Typical descriptors of effect
	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.

Table Source: From Highways England DMRB, Volume 11, Section 2, Part 5, Table 2.3

4.5.4 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.

4.5.5 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).

4.6 Defining assessment years

Temporal scope

Scheme phases

4.6.1 The ES will include consideration of effects arising from the construction and operation of the Scheme. Decommissioning is not relevant for this Scheme.

Do-minimum and Do-something scenarios

4.6.2 The assessment of effects involves comparing a scenario with the Scheme against one without the Scheme over time. The absence and presence of a Scheme are referred to as the ‘Do-Minimum’ and ‘Do-Something’ scenarios respectively. Dependent upon the topic, the scenarios will be assessed in the baseline year and a future assessment year or a series of future assessment years (for example 15 years after opening, or the worst year in the first 15 years of operation).

4.6.3 The ‘Do-Minimum' scenario is defined by DMRB as ‘the conditions that would persist in the absence of the implementation of a construction or improvement

project, but given that maintenance is ongoing'. Identification of the baseline therefore requires first the identification of the existing situation, and then the prediction of how it is likely to change between now and implementation of the Scheme.

Develop mitigation measures

4.6.4 Proposals for mitigation will follow the mitigation hierarchy of avoid, reduce, remedy and compensate. Mitigation will incorporate best practicable measures, construction environmental management procedures identified in the Construction Environmental Management Plan (CEMP) and will also describe design features that have been adapted to reduce or prevent impacts, such as noise attenuation measures. Incorporated mitigation is included within the assessment.

4.6.5 Mitigation is defined as 'measures intended to avoid, reduce and, where possible, remedy significant adverse environmental effects' (DMRB Volume 11, Section 1, Part 7 HA 218/08). Enhancement measures are defined as 'measures over and above normal mitigation' (IAN 125/15).

Prediction of residual environmental effects

4.6.6 The residual effect will then be assessed using the same system as described above to include any further mitigation proposed. The residual effect as classified will be considered for its significance. Generally, effects considered to be moderate or major are deemed significant, and those minor, or negligible, to be not significant, based on the described classification (Table 4.2) and professional judgement.

Assessment of cumulative effects

4.6.7 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.
- The combined action of a number of different projects, in combination with the project being assessed, on a single resource/receptor.

4.6.8 Further details on the scope of the cumulative effects assessment is provided in Chapter 15.

4.7 Dealing with uncertainty

4.7.1 EIA is an iterative process, and the Scheme may include somewhat uncertain aspects. At the time that the EIA 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.

4.7.2 The Rochdale Envelope principle would be applied in accordance with the Planning Inspectorate's Advice Note Nine: Using the Rochdale Envelope (Planning Inspectorate, 2012). The ES will explain clearly 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.

4.8 Transboundary impact screening

4.8.1 Regulation 24 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009 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.

4.9 Habitats Regulations Screening

4.9.1 In accordance with the requirements of PINS Advice Note 10: Habitats Regulations Assessment scoping has been undertaken at options stage. The outcome was that Habitats Regulations Assessment is not required for this project.

4.10 Health Impact Assessment and Equalities Impact Assessment

4.10.1 The assessment of the effect of the Scheme on Population and Human Health is a requirement under the 2017 EIA regulations. This assessment is informed by the assessments in existing topics such as Air Quality and Noise. A Health Impact Assessment (HIA) will be produced if required and reported separately to the EIA. Similarly, an Equalities Impact Assessment (EqIA) which reports the effect of the Scheme on different social groups will also be produced and reported separately, if required.

4.10.2 Health impacts will be covered in the following chapters:

- Air Quality;
- Noise;
- Road Drainage and the Water Environment; and
- People and Communities.

4.11 Climate change

4.11.1 Climate Change will be covered in the ES in line with the new requirements for climate outlined in Article 3(1) of the EIA Directive. The scope of the assessment will cover:

- Effects on climate (for example greenhouse gas emissions); and
- Vulnerability of the project to climate change (and impacts relevant to adaptation).

4.12 Heat and Radiation

4.12.1 The potential for impacts in relation to heat and radiation has been considered. Due to the nature of highways schemes, it is concluded that there is no potential for significant impacts in relation to heat and radiation. This topic has therefore been scoped out of further consideration in the EIA process.

4.13 Major accidents and disasters

4.13.1 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.

4.13.2 In considering these elements of vulnerability, the ES will:

- apply professional judgement in consultation with the Overseeing Organisation 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.

4.13.3 Major events will be reported within the relevant environmental topic chapters.

4.14 Monitoring

4.14.1 Proposals for monitoring will be developed as part of the topic impact assessments in the ES.

5. Air Quality

5.1 Introduction

5.1.1 This chapter identifies the air quality study area and presents the baseline conditions therein. It identifies the potential impacts on air quality associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

5.1.2 The chapter presents the proposed scope and methodology for the EIA. The air quality assessment identifies the likely potential effects on air quality due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

5.2 Study area

5.2.1 The air quality study area for assessing the potential effects of construction dust during the construction phase is defined as the area within 200 m of the construction site boundary, in accordance with the DMRB Volume 11, Section 3, Part 1 HA 207/07 ‘Air Quality’ (DfT, 2007).

5.2.2 The air quality study area for assessment of construction traffic and during the operational phase is determined in accordance with traffic change criteria set out in the DMRB HA 207/07 which defines affected road networks (ARN) for local (paragraph 3.12) and regional (paragraph 3.20) air quality assessments. The Scheme is located within the boundaries of Brentwood Borough Council and London Borough of Havering. For the purposes of this Scoping Report the air quality study area is assumed to be based on the ARN that was defined at Option Selection Stage and includes the area within 200 m of the Scheme extent, including the M25 Junction 28, the M25 north and south of Junction 28 and the A12. The ARN will be reviewed on the basis of strategic traffic modelling to be undertaken in the Preliminary Design stage to inform the assessment in the EIA.

5.2.3 The study area for local air quality during operation (Figure B-1) and the indicative study area for construction dust (Figure B-2) is provided in Appendix B.

5.3 Planning and policy context

Air quality criteria

5.3.1 There are two sets of ambient air quality criteria for the protection of public health: legally binding, mandatory limit values set by the EU; and objectives set out in the UK National Air Quality Strategy (AQS) (Defra, 2007) which local authorities are required to work towards achieving. Both sets of criteria are implemented in Air Quality Regulations (SI 2010/1001 for EU limit values and SI 2000 No. 928, as amended for AQS objectives). Air quality criteria relevant to the air quality assessment are summarised in Table 5.1, and for nitrogen dioxide (NO_2) and particulate matter (PM_{10}) are the same criteria for both the EU limit values and the AQS objectives.

Table 5.1: Relevant human health air quality criteria

Pollutant	Criteria
NO_2	1-hour mean concentration should not exceed 200 µg/m^3 more than 18 times a year
	Annual mean concentration should not exceed 40 µg/m^3
PM_{10}	24-hour mean concentration should not exceed 50 µg/m^3 more than 35 times a year
	Annual mean concentration should not exceed 40 µg/m^3

Ecological criteria

5.3.2 The EU has set a critical level for annual mean concentrations of nitrogen oxides (NO_x) to protect sensitive vegetation. This is included in the Air Quality Standards Regulations (SI 2010/1001) (National Archives, 2010). Assessment of compliance with this critical level is undertaken at locations more than 20 km from towns with more than 250,000 inhabitants or more than 20 km from other built-up areas, industrial installations or motorways or major roads with traffic counts of more than 50,000 vehicles per day. UK statutory nature conservation agencies' (Natural England) policy is to apply the limit value of 30 µg/m^3, on a precautionary basis, as a benchmark only in all designated conservation sites, including 'Ramsar' sites, Special Protection Areas (SPAs), Special Areas of Conservation (SACs) and Sites of Special Scientific Interest (SSSIs).

National Planning Policy

5.3.3 The National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012) sets out the Government's requirements of the planning system. The NPPF requires local planning authorities (LPAs) to take account of air quality in plan making, stating at paragraph 124:

5.3.4 "Planning policies should sustain compliance with and contribute towards EU limit values or national objectives for pollutants, taking into account the presence of Air Quality Management Areas and the cumulative impacts on air quality from individual sites in local areas. Planning decisions should ensure that any new development in Air Quality Management Areas is consistent with the local air quality action plan."

National Policy Statement

5.3.5 The National Networks National Policy Statement (NN NPS) (DfT, 2014), prepared by the Department for Transport (DfT), provides policy and guidance relating to the development of NSIPs. 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 (paragraph 5.11) of the NN NPS, which states:

5.3.6 "Air quality considerations are likely to be particularly relevant where schemes are proposed: within or adjacent to AQMAs; roads identified as being above Limit Values or nature conservation sites; and where changes are sufficient to bring about the need for a new AQMA or change the size of an existing AQMA; or bring about changes to exceedances of the Limit Values, or where they may have the potential to impact on nature conservation sites."

5.3.7 Furthermore, paragraph 5.13 of the NN NPS, states:

5.3.8 "The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the scheme will: result in a zone/agglomeration which is currently reported as being compliant; or affect the ability of a non-compliant area to achieve compliance with the most recent timescales reported to the European Commission at the time of the decision."

Road Investment Strategy (RIS) and Strategic Business Plan

5.3.9 The DfT RIS published in 2015 (DfT, 2015) sets out the DfT's aspirations for the Strategic Road Network (SRN) over the next 25 years. It states that by 2040 DfT aspires to a network that will be sustainable with "zero breaches of air quality regulations and major reductions in carbon emissions across the network".

5.3.10 The Highways England Delivery Plan 2015-2020 (Highways England, 2015) identifies Highways England's commitment to investing £75m "*in a range of projects to reduce pollution and ensure the air around the network is clean and healthy"*. The Highways England Delivery Plan 2017-2018 (Highways England, 2016) sets out indicators that will be used to measure performance, including, of relevance to air quality, the number of air quality pilot studies completed.

Local Planning Policy

5.3.11 Appendix B provides details of local planning policies. The following policies are of relevance to air quality:

- Brentwood Borough Council – Replacement Local Plan (2005) polices CP1 General Development Criteria and PC6 Transport Pollution; and
- London Borough of Havering – LDF (2008) policies Core Policy 15 Environmental Management and DC52 Air Quality.

5.3.12 Both Brentwood Borough Council and London Borough of Havering are currently preparing updated local plans. Details of the proposed polices are provided in Appendix B.

Local Air Quality Action Plan

5.3.13 Following assessment of air quality in their area, local authorities are required to prepare Air Quality Action Plans (AQAPs) where the authority has declared an Air Quality Management Area (AQMA), describing the pollution reduction measures it will put in place.

5.3.14 The Brentwood Borough Council AQAP (2008) states that the main source of air pollution in the borough is derived from road traffic. In order to achieve the NO_2 air quality objective the AQAP describes three specific schemes to help reduce congestion including: the M25 Junction 28/A12/Brook Street improvement; Junction 27 to 30 M25 Widening; and Wilson's Corner in Brentwood town centre. In addition, the AQAP describes general measures to be taken such as the implementation of Low Emission Zones, park and ride facilities, travel plans, freight management, and the promotion of public transport services, walking, cycling and bus priority measures. Brentwood Borough Council will also encourage Essex County Council's Local Transport Plan that comprises the Essex Transport Strategy. The strategy sets out the council's transport aims over a fifteen-year period. One of the strategy's five broad outcomes is to "reduce carbon dioxide emissions and improve air quality through lifestyle changes, innovation and technology" by reducing the carbon intensity of travel in urban areas and along key corridors.

5.3.15 London Borough of Havering does not currently have an adopted air quality strategy, however it is due to be published in late 2017.

5.4 Baseline conditions

5.4.1 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);
- Department for Environment, Food and Rural Affairs (Defra) Pollution Climate Mapping (PCM) model data for the latest available year for compliance assessment (2015) (Defra, 2017b);
- Local Authority Local Air Quality Management (LAQM) Reports (London Borough of Havering, 2015; London Borough of Havering, 2016; Brentwood Borough Council, 2014; Brentwood Borough Council, 2016);
- Highways England (Atkins 2015; 2016) project specific nitrogen dioxide (NO_2) diffusion tube survey data;
- Defra Automatic Urban and Rural Network (AURN) continuous monitoring data (Defra, 2017);
- The London Air Quality Network (LAQN) (LAQN, 2017);
- Ordnance Survey base mapping to identify locations of sensitive receptors (residential properties, schools, hospitals and elderly care homes); and
- Natural England (NE) MAGIC website (Magic, 2017) to identify boundaries of designated ecological sites.

5.4.2 Air quality constraints with the Scheme study area are presented in the Figure B-1 in Appendix B.

Pollutants

5.4.3 The air pollutants of concern in the context of the air quality assessment for the Scheme are nitrogen dioxide (NO_2) and fine particulate matter (PM_{10}). 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, and are hence the focus of the assessment. The regional assessment of vehicle emissions associated with the Scheme considers oxides of nitrogen (NO_x), carbon dioxide (CO_2) and PM_{10}. Further information on these pollutants is provided in Appendix B. Air quality criteria is provided in Table 5.1.

5.4.4 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.

5.4.5 An assessment of the effects of NO_x emissions due to the Scheme on vegetation within designated ecological sites is not currently thought to be necessary, given that there are no designated sites within 200 m of the ARN as defined at Option Selection Stage. However, this will be reviewed upon receipt of the revised traffic data at Preliminary Design Stage as the study area may need to be revised.

5.4.6 In addition to these air pollutants, dust may be generated during the construction phase in areas adjacent to the Scheme. 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).

Local Air Quality Management

5.4.7 The air quality study area is within the boundaries of Brentwood Borough Council and London Borough of Havering. These local authorities have carried out regular reviews and assessments of local air quality, as part of the LAQM regime. In common with many other authorities across the UK, the UK AQS objectives most likely to be exceeded within the air quality study area are for annual mean NO_2 due to road traffic emissions.

5.4.8 There are three AQMAs within the air quality study area, designated for exceedances of the annual mean NO_2 UK AQS objective. In addition, the London Borough of Havering has designated its borough-wide AQMA for exceedances of the 24-hour mean PM_{10} AQS objective. These AQMAs are described further in in Table 5.2 and illustrated in Figure B-1 in Appendix B. The Scheme is within the London Borough of Havering borough wide AQMA, and the Brentwood Borough Council AQMA No. 2 for Brook Street. Brentwood Borough Council AQMA No. 1 is located just to the south of M25 Junction 28. There are further AQMAs declared by Brentwood Borough Council, but these are unlikely to be affected by the Scheme as they are outside of the air quality study area (as determined at the Option Selection stage), although this will be reviewed upon receipt of final traffic data. Details of these AQMAs are provided in Appendix B.

Table 5.2: Description of AQMAs

Local Authority	Name	Air Quality Criteria Exceeded	Description
London Borough of Havering	Havering AQMA	NO_2 annual mean PM_{10} 24-hour mean	An area encompassing the entire London Borough of Havering.
Brentwood Borough Council	AQMA No.1	NO_2 annual mean	Comprises parts of Nags Head Lane, Brentwood and the M25.
	AQMA No.2	NO_2 annual mean	Comprises parts of Brook Street, Brentwood and the A12.

Defra Mapping

Pollution Climate Mapping

5.4.9 Further information on areas exceeding the EU limit values is available from Defra's PCM model. This model provides estimates of roadside concentrations of pollutants, including annual mean NO_2 and PM_{10}, which are used in annual reporting to the EU regarding compliance with the limit values. The modelled roadside concentration comprises a background component together with a roadside increment.

5.4.10 Not all roads are included within the PCM model. In the vicinity of the air quality study area, Defra's PCM model only includes the A12 east and west of Junction 28 and the A1023 Brook Street.

5.4.11 For 2015, the most recent year for which data is available, there were roadside exceedances of the annual mean NO_2 EU limit value of 40 µg/m^3 on the A12 both east and west of Junction 28, but not on the A1023. There were no exceedances of the annual mean PM_{10} EU limit value.

5.4.12 Defra PCM links are illustrated in Figure B-1 in Appendix B.

Background mapping

5.4.13 Estimates of current and future year background pollutant concentrations in the UK (i.e. locations away from immediate sources of air pollution) are available on the Defra UK Air Quality Information Resource (UK-Air) website (UK Air Defra, 2017). The background estimates, which are a combination of measured and modelled data, are available for each one kilometre grid square throughout the UK for a base year of 2013, which is the basis for the future year estimates up to 2030. These background estimates include contributions from all source sectors, e.g. road transport, industry, and domestic and commercial heating systems.

5.4.14 Estimated annual mean background concentrations for the grid squares covering the air quality study area for the base year used in the Option Selection stage Environmental Assessment Report (EAR) (2014) for the pollutants NO_2 and PM_{10} are presented in Table 5.3. Mapped background concentrations of NO_2 and PM_{10} for 2014 were below relevant air quality criteria, as would be expected, and ranged from between 19.6 to 24.5 µg/m^3 for NO_2 and 18.6 to 19.4 µg/m^3 for PM_{10}. This indicates that concentrations at background locations in the vicinity of the Scheme and associated ARN are likely to currently meet relevant air quality criteria for these pollutants. Mapped background concentrations for the revised base year for the Preliminary Design stage, 2015, are likely to be lower than those provided here, as emissions decrease in future years.

Table 5.3: Defra background air quality mapping pollutant concentrations for 2014 and 2022 (µg/m^3)

Grid Square (x,y)	2014	
	NO_2	PM_{10}
556500, 192500	24.5	19.4
557500, 192500	19.6	18.7

Air Quality Monitoring

5.4.15 Air quality monitoring data from continuous monitoring stations (CMS) and passive diffusion tubes in the air quality study area are presented in Figure B-1 in Appendix B and summarised below.

Highways England Monitoring

5.4.16 Connect Plus have measured NO_2 concentrations using diffusion tubes at a number of sites around the M25 on behalf of Highways England. A three year survey commenced in September 2013. One of the sites (CP7) is located close to the Scheme as shown in Figure B-1 in Appendix B. The annual mean NO_2

concentrations for this monitoring site between September 2013 and 2016 are tabulated in Appendix B. The results show that measured pollutant concentrations at site CP7 exceeded the NO_2 annual mean air quality criterion during all three monitoring periods. Site CP7 is located at the junction of Brook Street (A1023) with the M25 Junction 28, with relevant exposure within 50 m.

5.4.17 Highways England also conducted a 6 month diffusion tube survey between February and August 2016 to inform the assessment of the Scheme. The survey consisted of 25 diffusion tubes located near to Junction 28 at predominantly roadside sites. Survey locations are illustrated Figure B-1 in Appendix B. The results are tabulated in Appendix B. The results show that the NO_2 annual mean AQS objective of 40 µg/m^3 was exceeded at six sites in 2016. Two of these sites (HE01 (~5 m from road edge), and HE22 (~10 m from road edge)) are located on Brook Street close to M25 Junction 28 and within the Brentwood AQMA No.2; one site (HE02) is located on Brook Street, while the remaining three sites (HE13, HE14 and HE15) are located on the A12 west of the junction and within the London Borough of Havering AQMA.

Local Authority Monitoring

5.4.18 Both London Borough of Havering and Brentwood Borough Council have undertaken air quality monitoring in the vicinity of the Scheme and the air quality study area.

Continuous monitoring

5.4.19 Neither of the local authorities operate a CMS within the air quality study area. The closest CMS to the study area is an urban background site operated by Brentwood Borough Council located at the Brentwood Council offices approximately 3 km to the north east of Junction 28. London Borough of Havering operate two CMS, however both are located over 7 km from the Scheme. Further information on measured pollutant concentrations may be found in Appendix B.

Passive monitoring

5.4.20 Passive monitoring of NO_2 using diffusion tubes has been undertaken by both London Borough of Havering and Brentwood Borough Council. Figure B-1 in Appendix B presents an overview of the locations of monitoring sites within the locality of the air quality study area.

5.4.21 Annual mean concentrations recorded at sites within the locality of the air quality study area for the period of 2010 to 2015, are tabulated in Appendix B, for the London Borough of Havering and Brentwood Borough Council local authority areas. The NO_2 diffusion tube network in London Borough of Havering was enlarged from four to 37 sites in 2014, which explains why data is only available from 2014 for some of the sites.

5.4.22 Key areas and traffic corridors where exceedances of the annual mean AQS objective for NO_2 were measured in recent years include:

- M25 Junction 28 (BRW 5);
- A12 south west of Junction 28 at Harold Court Road (HAV37);

- The roundabout junction at Gallows Corner between the A12 Colchester Road, A127 Southend Arterial Road and A118 Main Road (HAV32/33/34);
- The junction between the A127 and Wingletye Lane (HAV47);
- A1023 just north of Kings Road in Brentwood (BRW40 and BRW41); and
- The A118 Main Road west of Gallows Corner (HAV40).

Receptors

5.4.23 Sensitive human health receptors within 200 m of the Scheme and roads which form the ARN (as determined at Option Selection stage) are provided in Table 5.4 below and shown in Appendix B. There are a total of six human health receptors within 200 m of the ARN, which is primarily limited to an area around Junction 28. The receptor points include residential properties as well as two different points of a hotel.

5.4.24 There are no designated ecological sites within the air quality study area.

Table 5.4: Relevant receptors

ID	Affected Road	Receptors
1	A12 Eastbound	61 Brook Street, Brentwood, CM14 5NA
2	M25 Northbound	The Poplars, 60 Brook Street, Brentwood, CM14 5ND
3	A12 Eastbound	Southern façade of Holiday Inn Brentwood, Brook Street, Brentwood, CM14 5NF
4	A12 Eastbound	Northern façade of Holiday Inn Brentwood, Brook Street, Brentwood, CM14 5NF
5	A12 Eastbound	63 Brook Street, Brentwood, CM14 5NA
6	A12 Eastbound off-slip	Grove Farm, Brook Street, Brentwood, CM14 5NG

5.5 Potential impacts

5.5.1 The Scheme has the potential to affect local air quality, both during construction and once in operation in the following ways:

- There could be increased emissions of dust during construction of the Scheme from dust-raising activities on site;
- Air quality could be affected by changes in traffic flows during construction, as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant and labour;
- Once operational, air quality could be affected (positively or negatively) by changes in vehicle activity (flows, speeds and composition); and
- Operationally, air quality could also be affected by any changes to the distance between sources of emissions and air quality sensitive receptors.

5.5.2 The Scheme also has the potential to affect regional emissions by changes (positive or negative) in vehicle activity (flows, speeds, composition and distance travelled).

Construction

5.5.3 Demolition and construction activities can give rise to dust emissions if not effectively managed. Construction of the Scheme has the potential to affect nearby receptors either due to dust from demolition and construction activities, or the tracking out of dust from heavy goods vehicles (HGVs) onto the local road network. Implementation of best practice mitigation measures will generally control construction dust and minimise any short term adverse effects.

5.5.4 In addition, the local highway network may experience changes in traffic flows and speeds during construction as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant and labour. However, any effects on air quality would be short term and temporary (i.e. during the period of construction works only).

Operation

5.5.5 Once operational, air quality could be affected (positively or negatively) by changes in vehicle activity (flows, speeds and composition). Air quality could also be affected by any changes to the distance between emission sources and air quality sensitive receptors as a result of a change to road alignment for the operational Scheme.

5.5.6 The three AQMAs within the air quality study area have the potential to be affected by the Scheme, as they are within 200 m of the ARN (as determined at the Option Selection stage).

5.5.7 The Option Selection stage assessment showed that changes in pollutant concentrations with the Scheme were expected to be imperceptible i.e. less than 0.4 µg/m^3 (Highways England, 2017).

5.6 Proposed level and scope of assessment

5.6.1 Construction effects will be assessed qualitatively in accordance with the DMRB (paragraph 3.45). Should information on proposed traffic management measures and / or volumes of construction traffic be available at Preliminary Design Stage, a quantitative assessment of vehicle emissions during construction will be undertaken in accordance with the DMRB.

5.6.2 Potential effects on local air quality resulting from operation of the Scheme will be assessed in accordance with relevant guidance outlined in DMRB, associated IANs and where relevant Defra's Local Air Quality Management Technical Guidance (LAQM.TG(16)) (Defra, 2016). Relevant guidance documents are listed in Chapter 18: References.

5.6.3 For the assessment of operational effects, DMRB provides methodologies for undertaking simple and/or detailed levels of assessment, for local and regional air quality. For this stage, detailed dispersion modelling of the Scheme will be used to determine potential effects on NO_2 and PM_{10} concentrations at human health receptors, given the complex nature of the junction and the presence of AQMAs in the area which are likely to be affected by the Scheme.

5.7 Proposed assessment methodology

5.7.1 The air quality assessment for the Scheme will consist of:

- Discussion of existing baseline conditions;
- Production of constraints maps;
- Qualitative assessment of the likely effect on local air quality during construction;
- Quantitative assessment of the likely effect on local air quality from changes in traffic during construction, if suitable information is available;
- Detailed assessment of the likely changes in local air pollutant concentrations during operation at a number of receptors; and
- Assessment of the likely changes in regional emissions during operation.

5.7.2 The Transport Analysis Guidance (TAG) assessment will be reported separately. Quantitative outputs for reporting within the Appraisal Summary Table will be generated where provision of suitable traffic data allows. The TAG assessment of regional pollutant emissions will use the local air quality study area, in line with the latest guidance from WebTAG (DfT, 2013c).

Existing Air Quality Information

5.7.3 A summary of existing air quality will be provided based on information collated for the scoping report, supplemented with any further data available since that stage.

Additional Constraints Maps

5.7.4 A constraints map for the Scheme air quality study area will be produced, updating the information provided for this scoping report. The constraints maps will include: affected roads, 200 m boundary from affected roads, sensitive receptors, AQMA boundaries, designated ecological site boundaries, and exceedance areas of air quality criteria without and with the Scheme where known.

Construction Impacts

5.7.5 A qualitative assessment of impacts on air quality from construction will be undertaken in accordance with the DMRB. The assessment will consider the nature of any proposed construction activities that have the potential to generate dust and the location of sensitive receptors within 200 m of the Scheme construction works that could be at risk of being affected. Quantitative assessment of vehicle emissions during construction will be undertaken should sufficient information on traffic management measures, construction vehicle numbers and total traffic flows, composition and speeds be available which exceed relevant DMRB criteria.

Operational Impacts

5.7.6 The air quality assessment will be undertaken principally following the guidance given in the DMRB and associated IANs. The air quality assessment will use detailed dispersion modelling software to calculate potential impacts on NO_2 and PM_{10} concentrations at selected human health receptors in the Scheme opening

year. A simple level of assessment will be undertaken for regional emissions of NO_x, PM_{10} and CO_2 for the opening and design years.

5.7.7 The key scenarios for assessment are:

- Base year for model verification purposes (2015);
- Projected base year (2022);
- Opening year for both the without (Do-Minimum (DM)) and with Scheme (Do-Something (DS)) (2022); and
- Design year DM and DS (2037) – regional emissions only.

5.7.8 Traffic data will be provided for the air quality assessment, which will enable the ARN for the Scheme to be determined. Traffic data will be provided from the strategic SATURN traffic model, provided by Atkins transport planners.

5.7.9 The ARN for the Scheme will be determined for the local air quality assessment and regional assessments. An affected road for the purposes of a local air quality assessment is defined in DMRB HA 207/07 (Para 3.12) as a road that meets any of the following criteria:

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

5.7.10 An affected road for the purposes of a regional air quality assessment is defined in DMRB HA 207/07 (Para 3.20) as a road that meets any of the following criteria:

- A change of more than 10% AADT; or
- A change of more than 10% to the number of HDVs; or
- A change in daily average speed of more than 20 km/hr.

5.7.11 The changes are applied to roads, rather than links, and so where relevant are determined under two-way traffic conditions.

Local Air Quality

5.7.12 The local air quality assessment will be undertaken using the dispersion model ADMS Roads. Representative receptors will be selected for the local air quality assessment and will include those closest to the ARN. The traffic data required for input into the dispersion model will include: AADT, percentage of HDV and speed, which will be input as a speed category, as determined in accordance with IAN 185/15 on speed banding.

5.7.13 The output from the model will provide estimates of the contribution from road traffic emissions to annual mean concentrations of NO_x and PM_{10} at discrete receptors. These concentrations will be combined with estimates of background concentrations, to account for other sources of air pollution, to derive total annual

mean concentrations. Background concentrations are expected to be derived from Defra's background maps, however, mapped backgrounds will be checked against relevant monitored data at background sites in the area to ensure they are suitable for use in the assessment.

5.7.14 Concentrations of NO_2 will be derived from NO_x concentrations using the most up to date version of Defra's NO_x to NO_2 calculator. The annual mean NO_2 and PM_{10} concentrations will be verified where possible. This will include a comparison against available ratified monitoring data and adjusted where appropriate, with reference to Defra's LAQM.TG(16).

5.7.15 In addition, an assessment will be undertaken in accordance with IAN 170/12 v3 (DfT, 2013a) on the assessment of future NO_x and NO_2 projections on long term trends, to account for future year uncertainties in emissions.

5.7.16 Evaluation of compliance with EU limit values will be undertaken in accordance with IAN 175/13 (DfT, 2013b).

5.7.17 Evaluation of the significance of the effect of the Scheme on local air quality will be undertaken in accordance with IAN 174/13 (DfT, 2014).

Regional Emissions

5.7.18 An assessment of regional emissions of NO_x, PM_{10} and CO_2 will be undertaken in accordance with DMRB HA 207/07 to determine the total annual pollutant emissions for the ARN. Emissions calculations will be undertaken using emission rates derived from IAN 185/15 on speed banding. The key scenarios for assessment are:

- Base year (2015);
- Opening year (2022), for both the without (DM) and with Scheme (DS) cases; and
- Design year (2037), for both the DM and DS cases.

5.8 Vulnerability to major accident and disasters

5.8.1 Major accidents and disasters which could potentially affect air quality receptors include: events which could affect traffic in the area such as major road traffic accidents, terrorist attacks or plane/rail crashes; and other events such as fires or chemical explosions or releases which emit air pollutants. The potential for change in significance on air quality receptors will be discussed as part of the air quality assessment. However, it should be noted that any effect would be temporary and considered unlikely to significantly affect local air quality findings in the context of the determination of significance using IAN 174/13.

5.9 Proposed consultation

5.9.1 Consultation with local authorities will be undertaken to obtain relevant air quality monitoring data, supplementary to that presented in this scoping assessment, and to ensure relevant receptors have been included in the assessment.

5.10 Potential mitigation measures

Construction

5.10.1 Mitigation measures to control dust emissions during construction will be specified within contract documentation and incorporated in a Construction Environmental Management Plan (CEMP). The precise measures will depend on the intended construction methods and the potential degree of dust generation at the 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.).

Operation

5.10.2 The Option Selection stage assessment indicated that there are not expected to be any significant adverse effects with the Scheme for the human health receptors. This will be confirmed in the assessment. Hence mitigation measures for human health receptors are not thought to be necessary at this stage.

Monitoring

5.10.3 Monitoring parameters and a programme will be established once the assessment at Preliminary Design stage has been undertaken to identify any significant adverse effects. As noted above the assessment undertaken at Option Selection stage indicated that there were not expected to be any significant adverse effects with the Scheme either during construction or during operation. This will be reviewed upon completion of the assessment at Preliminary Design stage.

5.11 Assumptions and limitations

5.11.1 Any air quality model has inherent areas of uncertainty, including:

- The traffic data used in the air quality model;
- The suitability of emissions data;
- Simplifications in model algorithms and empirical relationships that are used to simulate complex physical and chemical processes in the atmosphere;

- The suitability of background concentrations; and
- The suitability of meteorological data.

5.11.2 Uncertainty associated with traffic data will be minimised by using a validated traffic model.

5.11.3 Uncertainties associated with emissions data will be minimised by using the most up to date speed-band emission factors available and by applying the IAN 170/12 v3 for long term trends.

5.11.4 Uncertainties associated with model algorithms and empirical relationships will be minimised by using algorithms and relationships that have been independently validated and judged as fit for purpose.

5.11.5 Another uncertainty is with using historical meteorological data to estimate future concentrations. The key limiting assumption is that conditions in the future will be the same as in the past; however, in reality no two years are the same. In line with best practice, the base year meteorology (as used in the model verification and adjustment process) will be used in future year modelling to allow any adjustments to be applied in future cases.

5.12 Conclusion

5.12.1 An air quality scoping assessment has been undertaken for the Scheme. A review of baseline conditions has indicated that there are three AQMAs within the air quality study area which may be affected by the Scheme. These AQMAs are located within two local authority administrations (London Borough of Havering and Brentwood Borough Council), one AQMA encompasses the majority of Junction 28 within London Borough of Havering, whereas those within Brentwood Borough Council include an area immediately adjacent to the east of M25 Junction 28 and a small section of the M25 mainline to the south of Junction 28. Air quality monitoring data within the air quality study area has shown that concentrations of local air pollutants exceeded the annual mean NO_2 AQS objective in recent years at roadside sites adjacent to the M25 Junction 28 and A1023 Brook Street. Defra PCM mapping shows exceedances of the annual mean NO_2 EU limit value of 40 µg/m^3 on the A12 both east and west of Junction 28.

5.12.2 During construction, there is the potential for increased emissions of dust, however, with the application of appropriate mitigation significant adverse effects at nearby receptors are unlikely. Additional traffic during construction could potentially affect air quality at receptors so cannot be scoped out. During operation, changes in traffic have the potential to affect human health receptors within the air quality study area.

Table 5.5: Air quality effects scoped in and out of further assessment

Effects	Scoped in (✓) / out (✗)	Comment/Justification
Construction Dust	✓	Receptors within 200 m of potential dust raising activities
Construction Traffic	✓	Numbers of additional construction vehicles not yet known so cannot scope out
Operational Traffic	✓	The Option Selection stage assessment showed that local air quality at receptors within 200 m of the Scheme could be affected by changes in traffic. The Option Selection stage also showed that the Scheme had the potential to increase regional emissions.

6. Noise and Vibration

6.1 Introduction

6.1.1 This chapter identifies the study area for noise and vibration, and presents the baseline conditions therein. It identifies the potential noise and vibration impacts associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

6.1.2 The chapter presents the proposed scope and methodology for the EIA. The noise and vibration assessment identifies the likely potential noise and vibration effects due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

6.2 Study area

Construction phase

6.2.1 With regards to construction phase impacts, HD213/11 DMRB Volume 11, Section 3, Part 7 (DMRB HD213/11) states that:

'the area in which construction is considered to be a nuisance is generally more localised than where the impacts of the road project are likely to be a cause of concern once it has opened to traffic. The impact of construction nuisance in one form or another diminishes rapidly with distance'.

6.2.2 The study area for construction noise impacts will consider the potential for impact at to-be-selected representative nearest noise sensitive receptors located in proximity to the physical works associated with the Scheme.

6.2.3 Although DMRB does not provide a distance for the construction noise study area, it is considered unlikely that properties beyond 300 m from the road would experience a significant impact from the scheme, given the noise limits for construction activities and the high levels of ambient noise from the M25 itself.

Operational phase

6.2.4 For an appraisal of noise effects, the study area and calculation area will be defined based on the updated traffic modelling in accordance with guidance set out in DMRB HD213/11. This involves undertaking the following steps:

i. Identify the start and end points of the physical works associated with the road project.

ii. Identify the existing routes that are being bypassed or improved and any proposed new routes between the start and end points (for each option).

iii. Define a boundary 1 km from the carriageway edge of the routes identified in (ii) above.

iv. Define a boundary 600 m from the carriageway edge around each of the routes identified in (ii) above and also 600 m from any other affected routes within the boundary defined in (iii) above. The total area within these 600 m boundaries is termed the 'calculation area'

v. Identify any affected routes beyond the boundary defined in (iii) above

vi. Define a boundary 50 m from the carriageway edge of routes identified in (v) above.

6.2.5 An affected route is one where there is a possibility of a change in the basic noise level (BNL) of at least 1 dB LA10,18h in the short term (on opening) or 3 dB LA10,18h in the long term (assessed between the opening year and the design year). BNLs for each road link in the traffic model will be calculated in accordance with Calculation of Road Traffic Noise (CRTN).

6.2.6 Determination of the affected routes, and consequently the study area, may be constrained by the geographical extent, and area of validity, of the traffic modelling made available for the Scheme appraisal. The study area for the noise impact assessment will be determined, once the strategic traffic model has been finalised.

6.3 Planning and policy context

6.3.1 Currently DMRB does not provide a method for assigning significance to noise level changes. Methods of doing this are likely to include taking into account the numbers of receptors affected by a given noise impact and taking into account the baseline and predicted noise levels with the Scheme.

6.3.2 Account will be taken of the requirements of the NPPF (DCLG, 2012), the Noise Policy Statement for England (NPSE) (Defra, 2010), The NN NPS (2014) and Planning Practice Guidance concerning noise (DCLG, 2016).

NPPF

6.3.3 The NPPF includes the following statements relating to noise and the requirement to take it into account in the planning process.

6.3.4 Section 109 indicates that the planning system should contribute to and enhance the natural and local environment by:

6.3.5 ’preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.’

6.3.6 Section 123 of the NPPF is specifically related to noise, according to which, planning policy decisions should aim to:

- avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
- mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
- recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
- identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

6.3.7 These aims are echoed in the NPSE and NN NPS.

NN NPS

6.3.8 The NN NPS provides details on the requirements of the noise assessment, including why it is required, the factors that determine a likely noise impact and the potential mitigation measures that can be used.

6.3.9 The document includes a list of the information required within the noise and vibration section of the EIA:

- a description of the noise sources;
- identification of noise sensitive premises and noise sensitive areas that may be affected;
- the characteristics of the existing noise environment;
- a prediction on how the noise environment will change with the proposed development;
- In the shorter term such as during the construction period;
- in the longer term during the operating life of the infrastructure;
- at particular times of the day, evening and night as appropriate;
- an assessment of the effect of predicted changes in the noise environment on any noise sensitive premises and noise sensitive areas;
- measures to be employed in mitigating the effects of noise. Applicants should consider using best available techniques to reduce noise impacts; and
- the nature and extent of the noise assessment should be proportionate to the likely noise impact.

6.3.10 The Secretary of State should not grant development consent unless satisfied that the proposals will meet, the following aims, within the context of Government policy on sustainable development:

- avoid significant adverse impacts on health and quality of life from noise as a result of the new development;
- mitigate and minimise other adverse impacts on health and quality of life from noise from the new development; and
- contribute to improvements to health and quality of life through the effective management and control of noise, where possible.

NPSE and PPG

6.3.11 With regard to significant adverse and adverse impacts, the NPSE states in its explanatory note that “there are two established concepts from toxicology that are currently being applied to noise impacts, for example by the World Health Organisation (WHO). They are:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise; and
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

6.3.12 The NPSE and Planning Practice Guidance extends this concept to include:

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur; and
- UAEL – Unacceptable Adverse Effect Levels. This level identifies the onset of unacceptable impacts on health and quality of life.

6.3.13 The policy notes that it is not possible to have a single objective noise-based measure that defines SOAEL, which is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is therefore for the project to identify relevant SOAELs taking account of the different sources of exposure and different receptors.

6.3.14 As set out in the Planning Practice Guidance, it is not intended that noise should be considered in isolation, separate from the economic, social and other environmental dimensions of the proposed development.

6.4 Baseline conditions

6.4.1 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);
- NE's Multi-Agency Geographic Information for the Countryside (MAGIC) (2013) website to identify boundaries of designated ecological sites that may be considered as sensitive to noise;
- Extrium Noise Map Viewer (2016) showing Defra Noise Important Areas (NIA) mapping; and
- Extrium Noise Map Viewer (2016) showing Defra Strategic Noise Mapping for Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended) (2015).

6.4.2 In addition to the above, it is proposed that a baseline noise survey is undertaken to further inform the noise impact appraisal.

Noise Sensitive Receptors

6.4.3 The land use within 600 m of the M25 Junction 28 is generally agricultural and commercial, with the closest business located 55 m from the junction on Brook Street. Maylands Golf Course is located approximately 600 m from the existing junction layout.

6.4.4 The closest residential areas to the Scheme are The Poplars (50 m) and Nag's Head Lane (250 m). Further residential communities are located at Brook Street (600 m), Harold Park (800 m), Wigley Bush Lane (850 m), and South Weald (1.1 km). These are areas of mixed residential and commercial land use.

6.4.5 The following non-residential noise sensitive receptors have been identified within 1 km of proposed design options for alleviating congestion at the M25 Junction 28: Harold Park Recreation Ground, Drapers' Academy, Harold Court

Primary School, St Peter's Church of England Primary School, St Peter Church of England Church, Holiday Inn Brentwood, Colmar Farm Riding School, Brentwood Police Station and Court, and London Road Cemetery.

6.4.6 The locations of the Noise Important Areas for the Scheme are shown in the Environmental Constraints Figure A-1 in Appendix A.

Noise Climate

6.4.7 Aerial imagery suggests that the M25 and the A12 are the main noise source influencing noise levels within the study area. The railway line operating between Stratford and Shenfield is to the south of the study area, influencing noise levels to the south of the Harold Park and Brook Street residential areas, and will likely contribute to the noise climate in its vicinity.

6.4.8 During the previous appraisal stage, the Option Selection stage, publicly available online mapping sources provided an appropriate and proportionate method for ascertaining information regarding the existing noise baseline conditions. Strategic noise maps were published during 2015 by Defra for major road and railways sources to meet the requirements of the Noise Action Plan: Agglomerations Environmental Noise (England) Regulations 2006, (as amended) (2014). The strategic noise maps for road traffic noise and railways during the daytime (07:00-23:00) and night-time (23:00-07:00) periods are shown in Appendix C.

6.4.9 The 'Important Areas' for noise were identified to highlight any particular constraints on the design options for the Scheme. Important Areas are the locations where the top 1% of the population are affected by the highest noise levels from major roads and railways according to the strategic noise mapping undertaken by Defra. The locations of the Important Areas close to the Scheme are shown in the Environmental Constraints Plan in Appendix A, and are also shown in Appendix C.

6.4.10 As stated, it is proposed that a baseline noise survey is undertaken to further inform the noise impact appraisal. The proposed locations for noise surveying will be established upon final design alignment confirmation in order to ensure that proposed locations are suitable for use for the construction phase appraisal and also for informing the operational appraisal.

6.5 Potential impacts

6.5.1 The Scheme has the potential to affect local noise climate, both during construction, and once in operation, in the following ways:

- There could be a temporary increase in noise levels during construction of the Scheme from activities on site;
- Noise climate could be affected by changes in traffic flows during construction, as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant and labour;
- Once operational, the noise climate could be affected (positively or negatively) by changes in vehicle activity (flows, speeds and composition) as a result of the route options; and

- Operationally, the noise levels could also be affected by the introduction of new or removed links, and any changes to the alignment (horizontal or vertical) potentially affecting distance attenuation and screening.

Construction phase

6.5.2 Demolition and construction activities can give rise to increases in local noise levels, if not effectively managed. Construction of any of the Scheme has the potential to affect nearby receptors either due to noise from demolition and construction activities themselves, or from additional construction associated HGVs onto the local road network. Implementation of best practice mitigation measures will generally minimise increases in noise and any short term adverse effects.

6.5.3 In addition, the local highway network may experience changes in traffic flows and speeds during construction as a result of temporary traffic management measures and/or additional vehicles travelling to and from the construction site transporting materials, plant and labour. It should be noted however that any effects on the noise climate would be short term and temporary (i.e. during the period of construction works only).

Operational phase

6.5.4 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 alignment (horizontal or vertical) potentially affecting distance attenuation and screening between carriageways and noise sensitive receptors.

6.6 Proposed level and scope of assessment

6.6.1 It is proposed that the assessment of the Scheme is undertaken in line with a “detailed” level of appraisal as defined within the DMRB, and the quantitative outputs from the detailed appraisal then inform the competition of the WebTAG worksheets and Appraisal Summary Tables.

6.6.2 In the absence of a formal methodology for assigning significance of noise impact according to both the value of a resource and the magnitude of an impact, the magnitude of traffic noise impact will be classified into levels of impact in order to assist with the significance of impacts appraisal.

6.6.3 Locations requiring potential noise mitigation will be reviewed to allow mitigation measures to be incorporated in the design of the Scheme.

6.6.4 Detailed noise modelling will be undertaken with potential noise mitigation in place, based on traffic projections from appropriate strategic traffic modelling to permit the degree of accuracy as would be required for such detailed mitigation design. This will include any existing noise mitigation measures that will be retained or replaced by the Scheme. The proposed mitigation measures will be reviewed based on the results of the detailed noise modelling.

6.7 Proposed assessment methodology

Construction phase methodology

6.7.1 It is intended that a proportionate assessment of likely construction phase noise and vibration impacts will be undertaken, based on knowledge of assumed activities and duration of works. This will incorporate the latest information in terms of the proposed construction works and methodology where made available.

6.7.2 BS 5228 Part 1 2009 +A1:2014 provides guidance on the prediction and assessment of construction noise as it affects those exposed to it. Calculation procedures are set out in Annex F for predicting the likely noise levels from specific construction activities at a point of interest; taking into account distance, ground absorption, screening, reflections and the percentage on-time for an activity.

6.7.3 BS 5228-1 Annexes C and D provide generic noise data for various items of plant which can be used for undertaking predictions where no specific information is available. These predictions can then be compared with existing ambient noise levels and/or threshold levels to give an indication of the impact of the construction noise.

6.7.4 BS 5228 Part 2 2009 +A1:2014 provides guidance on vibration levels that can be used to assess the likely impacts of construction activities on the environment and people. Annex B of BS 5228-2 gives guidance on the significance of vibration effects in terms of human response to vibration and structural response to vibration.

Operational phase methodology

6.7.5 Noise modelling will be undertaken to permit an assessment in line with a “detailed” level of appraisal as defined within the DMRB, which consists of the following elements:

- Prediction of daytime ($L_{A10,18h}$) noise levels in the short-term (Scheme opening) and the long-term (future assessment year);
- Prediction of night-time noise levels in the long-term;
- Noise contour plots showing the predicted changes in noise level throughout the study area;
- Assessment of noise levels at traffic links located in the wider area; and
- Assessment of traffic nuisance impacts;

6.7.6 The results of this quantitative assessment would then be used to inform the completion of WebTAG worksheets (including calculation of net present value for noise) and Appraisal Summary Tables, and would be reported in accordance with TAG Unit A3 Environmental Impact Appraisal, Chapter 2 Noise Impacts. The Transport Analysis Guidance (TAG) assessment will be reported separately, and quantitative outputs for reporting within the Appraisal Summary Table will be generated where provision of suitable traffic data allows.

6.7.7 In the absence of a formal methodology for assigning significance according to both the value of a resource and the magnitude of an impact, the magnitude of

traffic noise impact will be classified into levels of impact in order to assist with the appraisal, in accordance with DMRB. An assessment of the predicted absolute noise levels at noise sensitive receptors will also be undertaken, that will indicate:

- Locations where the LOAEL is exceeded;
- Locations where the existing road traffic noise levels are below the SOAEL and are predicted to exceed the SOAEL as a result of the Scheme; and
- Locations where existing road traffic noise levels are above the SOAEL and are increased by at least 1dB $L_{A10,18h}$ due to the Scheme.

6.7.8 Locations requiring potential noise mitigation will be reviewed to allow mitigation measures to be incorporated in the design of the Scheme. Noise mitigation may be required under the following conditions:

- Noise sensitive receptors which are predicted noise increases as a result of the Scheme; and
- To mitigate noise levels in areas with existing high noise levels, such as NIAs, which is a stated objective of the overarching RIS scheme programme.

6.7.9 As stated, detailed noise modelling will be undertaken with potential noise mitigation in place, based on traffic projections from appropriate strategic traffic modelling to permit the degree of accuracy as would be required for such detailed mitigation design. This will include any existing noise mitigation measures that will be retained or replaced by the Scheme. The proposed mitigation measures will be reviewed based on the results of the detailed noise modelling.

6.8 Vulnerability to major accident and disasters

6.8.1 Man-made incidents requiring the closure of roads within the project area, such as terrorist incidents, plane crashes or road traffic incidents, will cause a reduction of noise levels at properties most influenced by noise from the closed road sections. However, these properties may be subject to noise temporarily from clean-up or repair and rebuilding works. Noise from alternate routes used during the road closure will increase noise levels from these routes during free-flow conditions or cause congestion, leading to lower noise levels. These impacts will last as long as the road closure and/or redirections are in place. Natural events causing road closures and the use of alternate routes, such as flooding or diseases (such as Foot and Mouth) will affect noise in the same way.

6.8.2 Road surfaces can be damaged from extreme heat, chemical spills, and seismic events/landslips, and this will affect its acoustic performance. This can lead to higher noise levels, especially if the damage has caused surface irregularities that can increase noise and vibration. Resurfacing the affected section of road would reverse the damage.

6.8.3 Noise barriers have the potential to be damaged during severe storms, pest infestations (e.g. rats, woodworm spring, etc.), road traffic accidents, malicious damage, and chemical spills, which will lead to degraded performance. This will cause a temporary noise increase until remedial works have been undertaken.

6.8.4 Weather conditions can affect sound propagation and it is possible that extreme conditions or temperature inversions will enable sound from the Scheme to be audible over greater distances.

6.9 Proposed consultation

6.9.1 Stakeholder consultation is proposed with regard to the following notable concerns:

- As noted within NPSE, it is not possible to have a single objective noise-based measure that defines SOAEL, which is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is therefore for the project to identify relevant SOAELs taking account of the different sources of exposure and different receptors;
- Locations requiring potential noise mitigation will be reviewed to allow mitigation measures to be incorporated in the design of the Scheme;
- Noise sensitive receptors which are predicted noise increases as a result of the Scheme; and
- To mitigate noise levels in areas with existing high noise levels, such as NIAs, which is a stated objective of the overarching RIS scheme programme.

6.10 Potential mitigation measures

Construction phase

6.10.1 Best practicable means as defined by the Control of Pollution Act 1974, should be implemented as part of the working methodology. This will serve to minimise the noise and vibration impacts at receptors in the vicinity of the construction works.

6.10.2 The use of temporary noise barriers may need to be introduced when working in close proximity to noise sensitive receptors, particularly if night-time working is implemented. BS 5228 advises that the approximate acoustic attenuation provided by a barrier will be 5 dB when the top of the plant is just visible to the receiver over the noise barrier and 10 dB when the barrier completely hides the noise source from the receiver.

6.10.3 To reduce the likelihood of noise complaints, community liaison and communication throughout the construction phase should also be considered to provide information to occupants of properties located in the vicinity of the construction works.

6.10.4 It may also be appropriate to apply for a Section 61 prior consent once a more detailed construction methodology is developed and the effectiveness of practicable mitigation measures have been defined.

Operational phase

6.10.5 It is anticipated that operational phase mitigation will consider the effectiveness of the following measures:

- The introduction of roadside noise barriers or the extension of existing barriers where present; and
- The use of low noise surfacing.

6.11 Assumptions and limitations

6.11.1 The following limitations will be applicable to the assessment:

- The traffic data provided to inform the assessment;
- Knowledge of existing road surfacing finishes provided to inform the assessment;
- Knowledge of existing in-situ noise mitigation provided to inform the assessment;
- The construction phase assessment will comprise a proportionate quantitative assessment only based on the available construction phase information at the time of appraisal; and
- Unless information is provided to the contrary, then the construction phase impact calculations will be undertaken based upon the assumption of construction plant and activities being located at the nearest point within a-to-be-provided boundary of works, to the noise sensitive receptor being considered.

6.12 Conclusion

6.12.1 The Scheme has the potential to impact upon the amenity of nearby noise sensitive receptors, and consequently a noise impact appraisal in line with a "detailed" level of appraisal as defined within the DMRB is proposed. The table presented below concludes the findings of this scoping report and highlights the effects which have been scoped in for further assessment.

Table 6.1: Noise and vibration effects scoped in and out of further assessment

Effects	Scoped in (✓) / out (✗)	Comment/Justification
Construction	✓	Information regarding construction methodologies, plant itineraries, activity schedules, activity locations, and construction traffic etc is expected to become available in the EIA process and this information will be appraised accordingly.
Operational Traffic	✓	Simple noise modelling undertaken previously identified the requirement for the Scheme to proceed to a "detailed" DMRB assessment to confirm the level of impact for the Scheme. The detailed noise modelling will incorporate new traffic data obtained from a strategic traffic model and any new mitigation measures incorporated into the design. A further assessment of the impact significance is also required based on the results, particularly at locations where the baseline noise levels already exceed the significant adverse effect level.

7. Biodiversity

7.1 Introduction

7.1.1 This chapter identifies the study area for biodiversity and presents the baseline conditions therein. It identifies the potential impacts on biodiversity associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

7.1.2 The chapter presents the proposed scope and methodology for the EIA. The biodiversity assessment identifies the likely potential effects on biodiversity due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

7.2 Study area

7.2.1 The study area defines the area that will be used to assess the impacts and potential effects on ecological features. It includes the predicted Ecological Zone of Influence (EZoI), which is 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.

7.2.2 The extent of the EZoI was defined during the Option Identification assessments. For this stage, the study area has been revised to take into account the final option being taken forward, as described in Section 2 of this report. The revised EZoI is based on the proposed extent of the final option designs, with assumptions made of the potential construction and operation effects based on available information, including an initial review of the landscape surrounding the Scheme.

7.2.3 The EZoI includes the red line boundary to the Scheme (Appendix A), but due to the relative importance of some ecological features and the mobility of some species, the study area was extended to include certain features at different spatial extents (measured from the red line boundary):

- Special Areas of Conservation (SAC) where bats are one of the qualifying species within 30 km[2];
- Records of bat roots within 5 km;
- Other statutory designated sites: SACs, Special Protection Areas (SPA), Ramsar Sites, Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR) and Local Nature Reserves (LNR); within 2 km;
- Non-statutory designated sites: Sites of Nature Conservation Importance (SINC)[3] in Greater London or Local Wildlife Sites (LWS) in Essex; ancient woodland within 1 km;

[2] DMRB guidance on the Assessment of Implications on European Sites recommends this wide search area due to the mobility of bats
[3] In the Great London area SINCs are designated at three levels according to their geographical importance: Sites of Metropolitan, Borough (Grade I), Borough (Grade II) and Local Importance.

- Water bodies that may potentially be used as breeding ponds by great crested newt (*Triturus cristatus*) within 500 m;
- Notable habitats[4] within 500 m;
- Other notable[5] or legally protected species within 500 m; and
- Other habitats within 50 m.

7.2.4 The EZoI and study area will be reviewed during the survey process, and revised if necessary prior to the Environmental Impact Assessment.

7.3 Planning and policy context

7.3.1 Relevant planning policies:

- The National Planning Policy Framework (NPPF) 2012, particularly Chapter 11 'Conserving and enhancing the natural environment';
- National Policy Statement for National Networks 2014;
- Brentwood Borough Council Replacement Local Plan 2005 policies:
  - Policy C3 County Wildlife Sites, LNRs and Other Habitats and Natural Features of Local Value;
  - Policy C4 Management of Woodlands;
  - Policy C7 Development Affecting Preserved Trees, Ancient Woodlands and Trees in Conservation Areas;
- London Borough of Havering Local Development Framework 2008 policies:
  - Policy DC58 Biodiversity and Geodiversity;
  - Policy DC60 Trees and Woodlands;
- Draft Replacement London Plan 2015-2016 policies:
  - Policy 7.19 Biodiversity and access to nature;
  - Policy 7.21 Trees and Woodland;
- The London Mayor's Biodiversity Strategy;
- The London Borough of Havering Biodiversity SPD;
- The UK Biodiversity Action Plan (BAP)
- UK Post-2010 Biodiversity Framework (2012);
- The London BAP;
- London Borough of Havering Nature Conservation and Biodiversity Action Plan (Havering BAP); and
- Essex BAP.

[4] Notable habitats are taken as principal habitats for the conservation of biodiversity listed under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006; habitats listed under the London, Havering or Essex Biodiversity Action Plans (BAPs); and hedgerows identified as being 'important' under the wildlife criteria of the Hedgerow Regulations 1997.
[5] Notable species are taken as principal species for the conservation of biodiversity listed under Section 41 of the NERC Act 2006; any species listed in an IUCN Red Data Book; Birds of Conservation Concern; and any other species listed under the London, Havering or Essex BAPs.

7.3.2 A summary of UK wildlife legislation relevant to the Scheme is provided in Appendix D.

7.4 Baseline conditions

Option Identification and Option Selection data gathering

Option Identification

7.4.1 A desk study was undertaken for Option Identification scoping in April 2016. The MAGIC website (2010) was used to obtain information on statutory designated sites, ancient woodland and notable habitats, including Habitats of Principal Importance[6] (HPI). Desk study records were also requested from Greenspace Information for Greater London, Essex Field Club and Essex Wildlife Trust for non-statutory designated sites, notable species[7], and legally protected species (see Appendix D for a summary of relevant nature conservation legislation).

7.4.2 The Havering BAP, Essex BAP, and local planning policies were reviewed as part of the desk study.

7.4.3 Ordnance Survey maps were used to identify the presence of water bodies within 500 m of the Scheme that could be potential breeding ponds for great crested newts. This species typically uses suitable terrestrial habitat up to 500 m from a breeding pond. Therefore, where there are breeding ponds within 500 m, great crested newts could potentially be present on land within and immediately surrounding the Scheme.

7.4.4 An Extended Phase 1 Habitat Survey of publicly-accessible land was undertaken in February 2016 broadly following the Phase 1 Habitat Survey methodology (JNCC, 2010) and Chartered Institute of Ecology and Environmental Management guidance (CIEEM, 2013) to assess potentially important ecological features identified during the desk study, and to record the general habitats present and their potential to support notable and protected species.

Option Selection

7.4.5 The baseline information described in this section are the results of the desk study and the Extended Phase 1 habitat surveys from Option Identification. Results of detailed surveys of notable habitats and species undertaken in 2017 were incomplete at the time of writing this scoping report and therefore the results are not included.

7.4.6 The desk study and the Extended Phase 1 habitat survey were considered sufficient to identify the types of habitats present and their potential to support notable and protected species in order to identify what further ecology studies would be required for further assessment.

7.4.7 Further ecological surveys required to inform the assessment commenced in May 2016 at Option Selection in order to allow sufficient time to complete the surveys before the start of the assessment.

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

[7] Notable species are those taken as Species of Principal Importance listed under Section 41 of the Natural Environment and Rural Communities Act (2000); any species listed under Schedule 5 of the Wildlife and Countryside Act 1981 (as amended); any species listed under Annex II or Annex IV of the Habitats Directive (1992); any species listed in an IUCN Red Data Book; and any other species listed under the local Biodiversity Action Plan (Essex BAP and London BAP), national or county rare/ scarce.

7.4.8 These include an update to the Extended Phase 1 Habitat Survey in June 2017 and detailed surveys for notable habitats and notable and protected species as listed in Section 7.7 below, between May and November 2017. They form the scope of the data gathering for the assessment.

Designated sites

7.4.9 No international or nationally statutory designated nature conservation sites, including SAC, SPAs, Ramsar sites, NNRs or SSSI are present within 2 km of the Scheme.

7.4.10 One LNR is present within 2 km of the Scheme. A summary is given in Table 7.1 below.

Table 7.1: Summary of statutory designated sites within 2 km of the Scheme

Site name	Approximate distance and direction from Scheme	Description	Area	Grid reference
The Manor Local Nature Reserve (LNR)	400 m to the west	Includes Dagnam Park, Hatter's Wood and Duck Wood. Supports wildflower meadows, ancient coppiced woodland, ponds, scrub, and veteran trees. Species recorded include great crested newts, harvest mouse (Micromys minutus), bumblebees, stag beetle (Lucanus cervus), green woodpecker (Picus viridis), house martin (Delichon urbica), skylark (Alauda arvensis) and song thrush (Turdus philomelos).	60 ha	TQ555923

7.4.11 A summary of eighteen non-statutory designated sites within 1 km of the Scheme is given in Table 7.2 below.

Table 7.2: Summary of non-statutory designated sites within 1 km of the Scheme

Site name	Approximate distance and direction from Scheme	Description	Area	Grid reference
Ingrebourne Valley Site of Metropolitan Importance (SMI)	Within and immediately adjacent to the Scheme	A riparian corridor that leads down to Rainham Marshes, including extensive reedbeds, lakes, wet woodland, and wet grasslands that support an exceptional wetland invertebrate and bird fauna. It includes the Weald Brook and Ingrebourne River. A good population of water vole (Arvicola amphibius) has been recorded throughout.	263 ha	TQ538842
Lower Vicarage Wood Local Wildlife Site (LWS)	Immediately adjacent	A large ancient woodland with overgrown hornbeam (Carpinus betulus) coppice and frequent standards of pedunculate oak (Quercus robur).	6.1 ha	TQ569929
The Oaks LWS	80 m east	Mixed deciduous woodland dominated by pedunculate oak.	14 ha	TQ566930
Jackson's Wood and Tyler's Shaw LWS	90 m east	Ancient woodland formed of hornbeam coppice with scattered ash (Fraxinus excelsior) and pedunculate oak standards.	4.4 ha	TQ574908
Vicarage Wood LWS	100 m north	Ancient woodland with overgrown hornbeam coppice and pedunculate oak standards.	4.2 ha	TQ570932
Tylers Hall Pond Site of Borough Importance (SBI) Grade 2	350 m west	A large pond with a good range of aquatic plants.	0.9 ha	TQ566913
Dagnam Park and Hatter's Wood SMI	400 m west	A historic landscaped park with ancient woodland, a variety of grassland habitats, and ponds. The ponds support important populations of amphibians, including great crested newt. The site is important for its breeding and wintering birds, including skylark, yellowhammer (Emberiza citronella), hawfinch (Coccothraustes coccothraustes), jackdaw (Corvus monedula) and various thrushes.	75 ha	TQ550930
Romford to Harold Wood Railsides SBI Grade 2	400 m south	Marsh/swamp, scrub, secondary woodland, semi-improved neutral grassland, and tall herbs alongside a railway that provide a wildlife corridor.	28 ha	TQ531894
Tylers Common SBI Grade 1	400 m south-west	A large common with a good range of wildlife habitats, with some uncommon plants. Habitats present include acid grassland, hedgerow, lake, scrub, semi-improved neutral grassland, and unimproved neutral grassland. The site supports a range of common butterflies including common blue (Polyommatus icarus), Essex skipper (Thymelicus	29 ha	TQ566905

Site name	Approximate distance and direction from Scheme	Description	Area	Grid reference
		lineola) and meadow brown (Maniola jurtina), and breeding birds including skylark and meadow pipit (Anthus pratensis).		
Duck Wood SBI Grade 1	3800 m west	A large ancient woodland, with a series of ponds that are valuable for amphibians. Breeding birds include sparrowhawk (Accipiter nisus), woodpeckers, bullfinch (Pyrrhula pyrrhula) and hawfinch. In addition, the wood supports several notable invertebrates.	10 ha	TQ555923
Warley Country Park LWS	620 m south-east	Lowland mixed deciduous woodland and scrub interspersed by grassy glades. Marshy grassland is present in the north section.	25 ha	TQ584924
Foxburrow Wood LWS	640 m south	This large ancient wood has suffered losses to the construction of the M25 and also expansion of the grounds of the adjacent Foxburrow house	6.9 ha	TQ575902
Weald Country Park LWS	750 m north-east	Lowland mixed deciduous woodland, lowland dry acid grassland, wood-pasture and parkland.	139 ha	TQ570947
St Faith's/Honeypot Lane Meadows LWS	800 m north-east	This site comprises extensive grassland, hedgerow and streamside habitat.	15.6 ha	TQ586937
Coombe Wood LWS	800 m south	The woodland's diverse habitat structure supports important ancient woodland species.	7.9 ha	TQ579901
Shoulder of Mutton Wood Site of Local Importance (SLI)	590 m west	A small ancient woodland with a wet ditch running from east to west across the site.	2.2 ha	TQ551919
Warley Place LWS	850 m east	A former house and gardens with native trees and woodland ground flora, and exotic trees, shrubs and herbs.	10 ha	TQ583909
Bachelor's Walk Woods LWS	890 m east	Two sections of streamside woodland. The northern section has a canopy dominated by hornbeam coppice with pedunculate oak standards, whilst alder (Alnus glutinosa) is found by the stream. Ground flora is typical of ancient woodland.	1.4 ha	TQ582916

Ancient woodland

7.4.12 There are ten ancient woodlands within 1 km of the Scheme, listed in Tale 7.3 below.

Table 7.3: Summary of ancient woodland parcels within 1 km of the Scheme

Site name	Approximate distance and direction from Scheme	Area (ha)	Grid reference
Lower Vicarage Wood	Immediately adjacent	5.8 ha	TQ570928
Vicarage Wood	100 m north	4.2 ha	TQ571932
Duck Wood	380 m west	9.5 ha	TQ556923
Jackson's Wood	90 m east	4.4 ha	TQ574908
Fir Wood	330 m west	3.4 ha	TQ556930
The Osiers	350 m north-west	4.2 ha	TQ555935
Foxburrow Wood	640 m south	6.9 ha	TQ575902
Folkes Lane Woodland	660 m south	2.1 ha	TQ573902
Coombegreen Wood	820 south-east	17 ha	TQ575902
Shoulder of Mutton Wood	590 m west	1.9 ha	TQ551919

Habitats

7.4.13 The main habitats[8] recorded within the survey area during Extended Phase 1 Habitat Surveys undertaken in February 2016 and June 2017, included:

- Broadleaved semi-natural woodland;
- Scrub (continuous and scattered);
- Scattered trees;
- Hedgerows;
- Semi-improved grassland;
- Improved grassland;
- Tall ruderal;
- Arable;
- Standing water (ponds); and
- Running water (including the Weald Brook and Ingrebourne River).

7.4.14 Notable habitats recorded include broadleaved woodland, hedgerows, ponds and rivers, which are HPI.

7.4.15 Broadleaved woodland is present within the Scheme at several locations, in particular Grove Wood and Alder Wood to the north-west of the junction. Broadleaved woodland is also present on the wider cuttings of the M25 within the

[8] Based on Phase 1 habitat types published in JNCC, 2010

Scheme, north and south of the junction, and adjacent to the northern verge of the A12 west and east of the junction. There is a large section of hedgerow between Grove Wood and Alder Wood, and a few small sections of hedgerow within the Scheme.

7.4.16 There is one pond present within the Scheme, within Grove Wood to the north-west of the junction. The Ingrebourne River and Weald Brook are rivers that flow through the Scheme from the east and north respectively to a point where they meet close to the A12 west of the junction. The Ingrebourne River then continues to the south and west outside of the Scheme.

Notable and protected species

Notable plants

7.4.17 The desk study returned no records for nationally or locally notable[9] plant species within 500 m of the Scheme.

Invertebrates

7.4.18 The desk study returned numerous records for notable invertebrates within 500 m of the Scheme, including wall (*Lasiommata megera*), small heath (*Coenonympha pamphilus*) and white-letter hairstreak (*Satyrium w-album*) butterflies; and shaded broad-bar (*Scotopteryx chenopodiata*) and latticed heath (*Chiasmia clathrata*) moths.

7.4.19 Weald Brook, Ingrebourne River and an unnamed stream have potential to support white-clawed crayfish. However, no records of this species were identified from within 500 m of the junction during the desk study.

7.4.20 The habitats recorded during the Extended Phase 1 Habitat Survey are not considered particularly suitable to support significant assemblages of invertebrates, due to their disturbed and young successional nature. However, individuals of notable species may be present. The tree species on which white-letter hairstreak is known to breed - elm (*Ulmus* species) was not recorded, but it may be present in broadleaved woodland within the survey area.

Amphibians

7.4.21 The desk study returned no records of great crested newt within 500 m of the Scheme. However, the Extended Phase 1 habitat survey identified suitable aquatic habitat for breeding great crested newts, including eight ponds and a number of wet ditches and drains within 500 m of the Scheme. Suitable terrestrial habitat for great crested newts is present within the Scheme.

7.4.22 Suitable habitat, including ponds and terrestrial habitat, is present within the Scheme for other notable amphibians, in particular common toad (*Bufo bufo*), common frog (*Rana temporaria*) and palmate newt (*Lissotriton helveticus*).

Reptiles

7.4.23 The desk study returned records of grass snake and adder from within 500 m of the Scheme. During the Extended Phase 1 Habitat Survey, suitable habitat was

[9] Notable plant species are those determined as Species of Principal Importance, listed under Section 41 of the NERC Act (2006), any species listed under Schedule 8 of the Wildlife and Countryside Act 1981 (as amended); any species listed under Annex II or Annex IV of the Habitats Directive (1992); any species listed in a Red Data Book or Red List using IUCN criteria; and any other species listed under a local Biodiversity Action Plan (London BAP, LB Havering BAP or Essex BAP), or as national or county rare or scarce

identified for reptiles, including slow worm and common lizard, for which no records were identified during the desk study.

Birds

7.4.24 The desk study returned three records of notable birds, within 500 m of the Scheme. These are song thrush, kingfisher (*Alcedo atthis*) and willow warbler (*Phylloscopus trochilus*), for which suitable habitat is present within the Scheme boundary. The habitats within the Scheme are also suitable for a number of other notable birds, records of which were not identified within 500 m during the desk study, including grey partridge (*Perdix perdix*), skylark, dunnock (*Prunella modularis*) and barn owl (*Tyto alba*). The Extended Phase 1 Habitat Survey identified areas of scrub, broadleaved woodland and scattered trees within the survey area that offer highly suitable nesting opportunities for a wide variety of birds.

Bats

7.4.25 The desk study returned records of at least eight bat species within 5 km of the Scheme: Daubenton's (*Myotis daubentonii*), Natterer's (*Myotis nattereri*), Leisler's (*Nyctalus leisleri*), noctule (*Nyctalus noctula*), Nathusius' pipistrelle (*Pipistrellus nathusii*), common pipistrelle (*Pipistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmaeus*), and brown long-eared bat (*Plecotus auritus*). The nearest records were for Natterer's and Daubenton's, recorded approximately 820 m to the north-west of the Scheme.

7.4.26 The Extended Phase 1 habitat survey identified buildings and trees in the north-west quadrant of the Scheme that may have potential to support roosting bats. Habitats within the Scheme also offer foraging and commuting habitat for bats.

Hazel dormouse

7.4.27 The desk study returned no records for hazel dormouse within 500 m of the Scheme. However, the extended Phase 1 habitat survey identified dense and continuous scrub adjacent to the carriageways which offers suitable habitat for hazel dormice. These habitats are connected to hedgerows and parcels of broadleaved woodland in the wider landscape, which have potential to support hazel dormice.

Water vole

7.4.28 The desk study returned two records of water vole within 500 m of the Scheme, the nearest record being approximately 175 m south-west of the Scheme. The Weald Brook and the Ingrebourne River, as well as other tributary streams located within and adjacent to the Scheme boundary have the potential to support water voles.

Otter

7.4.29 No records were provided for otter (*Lutra lutra*) within 500 m of the Scheme. However, the Weald Brook and Ingrebourne River, which are located within the Scheme, have the potential to support otters.

Badger

7.4.30 The desk study returned one record of badger (*Meles meles*) from within 500 m of the Scheme. The Extended Phase 1 habitat survey identified extensive suitable foraging habitat for badgers and potentially suitable habitat for badger setts.

Other mammals

7.4.31 The desk study also returned two records of hedgehog (*Erinaceus europaeus*) within 500 m of the Scheme. The Extended Phase 1 habitat survey identified suitable foraging habitat for hedgehog.

7.4.32 Although there are no records identified from within 500 m of the Scheme, the habitats within the Scheme are suitable for brown hare (*Lepus europaeus*).

Non-native invasive species

7.4.33 No records of non-native invasive species of plants listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) (see Appendix D) were identified within 500 m of the junction during the desk survey or extended Phase 1 habitat survey.

7.4.34 However, there is potential for invasive species to be present if undetected, or if they subsequently colonise.

Value of ecological receptors

Valuation criteria

7.4.35 Nature conservation features have been valued following the framework provided in IAN 130/10 Ecology and Nature Conservation: Criteria for Impact Assessment. This is presented in Table 7.4 below. The evaluation is based on the information available from the Option Identification surveys, and uses professional judgement, as well as accepted criteria (Ratcliffe, 1977) (e.g. diversity, rarity and naturalness). Features are valued in a geographical context.

7.4.36 The evaluation of ecological features will be determined in consultation with the relevant Statutory Environmental Bodies (SEBs) (see section 7.9).

Table 7.4: Evaluation of ecological features

Examples of resource valuation based on geographical context
International or European Value
Natura 2000 sites including: Sites of Community Importance (SCIs); SPAs; potential SPAs (pSPAs); SACs; candidate or possible SACs (cSACs or pSACs); and Ramsar sites. Biogenetic Reserves, World Heritage Sites (designated for their nature conservation value), and Biosphere Reserves. Areas which meet the published selection criteria for those sites listed above but are not themselves designated as such . Resident, or regularly occurring, populations of species which may be considered at International or European level where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this geographic scale; or • The population forms a critical part of a wider population at this scale; or • The species is at a critical phase of its life cycle at this scale.

Examples of resource valuation based on geographical context
UK or National Value
Designated sites including: SSSIs; Marine Protected Areas (MPAs); Marine Conservation Zones (MCZs); and NNRs. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such[10]. Areas of key/priority habitats identified in the UK Biodiversity Action Plan (BAP); including those published in accordance with Section 41 of the NERC Act 2006 and considered to be of principle importance for the conservation of biodiversity[11]. Areas of Ancient Woodland[12], e.g. those listed within the Ancient Woodland Inventory. Resident, or regularly occurring, populations of species which may be considered at International, European, UK or National level[13] where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; or • The population forms a critical part of a wider population at this scale, or The species is at a critical phase of its life-cycle at this scale.
Regional Value
Areas of key/priority habitats identified in the Regional BAP (where available); areas of key/priority habitat identified as being of Regional vale in the appropriate Natural Area Profile (or equivalent); areas that have been identified by regional plans or strategies as areas for restoration or re-creation of priority habitats. Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level, where: • The loss of these populations would adversely affect the conservation status or distribution of the species at this scale; or • The population forms a critical part of a wider population; or • The species is at a critical phase of its life cycle.
Metropolitan, County or Borough Value
Designated sites including: SINCs[14]; LWSs; and LNRs designated in the metropolitan (great London), county (Essex) or borough (London Borough of Havering) context[15]. Areas which meet the published selection criteria for those sites listed above but which are not themselves designated as such[16]. Areas of key/priority habitats identified in the Local BAP; and areas of habitat identified in the appropriate Natural Area Profile (or equivalent). Resident, or regularly occurring, populations of species which may be considered at an International, European, UK or National level where: • The loss of these populations would adversely affect the conservation status or distribution of the species across the County or Unitary Authority Area; or • The population forms a critical part of a wider population; or • The species is at a critical phase of its life cycle.

[10] Valuation to be made in consultation with SEBs, with reference made to the criteria for designation.
[11] Valuation to be made in consultation with SEBs as such listings do not in themselves indicate intrinsic value, but instead indicate a conservation priority.
[12] Valuation to be made in consultation with SEBs, and with use of professional judgement as listing does not in itself indicate intrinsic nature conservation value.
[13] Such species include those listed within Council Directive 79/409/EEC on the conservation of wild birds or animal/plant species listed within Council Directive 92/43/EEC. Species which may be considered at the UK or National level means: birds, other animals and plants which receive legal protection on the basis of their conservation interest; species listed for their principle importance for biodiversity (in accordance with the NERC Act 2006; priority species listed within the UK BAP; or species listed within Red Data Books.
[14] In the Great London area SINCs are designated at three levels according to their geographical importance: Sites of Metropolitan, Borough (Grade I), Borough (Grade II) and Local Importance.
[15] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation.
[16] Valuation to be made in consultation with county ecologist or equivalent.

Examples of resource valuation based on geographical context
Local Value
Designated sites including SINCs[17] or LNRs designated in the local context[18]. Trees that are protected by Tree Preservation Orders (TPOs). Areas of habitat; or populations/communities of species considered to appreciably enrich the habitat resource within the local context (such as veteran trees), including features of value for migration, dispersal or genetic exchange.

Designated sites

7.4.37 Ingrebourne Valley SMI and Dagnam Park and Hatter's Wood SMI have *Metropolitan* value within Greater London.

7.4.38 LWS have *County* value within Essex. SBI Grade 1 and SBI Grade 2 have *Borough* value within the London Borough of Havering.

7.4.39 The Manor LNR and SLI are designated at a local level and are considered to have *Local* value for nature conservation.

Ancient woodland

7.4.40 Ancient woodland is an irreplaceable habitat, which, where not designated, will be valued in consultation with the relevant SEBs.

Veteran trees

7.4.41 Veteran trees, where present, have at least *County* value for nature conservation, which will be confirmed in consultation with the relevant SEBs.

Habitats

7.4.42 There are four potential HPI located within 500 m of the Scheme. These are lowland mixed deciduous woodland, hedgerows, rivers and ponds.

7.4.43 The London Borough of Havering BAP priority habitats: woodlands, hedgerows, and ponds and lakes; and Essex BAP priority habitats: hedgerows, ponds and rivers, were also identified within the survey area.

7.4.44 HPIs and local BAP priority habitats, where not designated, are considered to have County value for nature conservation, which will be confirmed in consultation with the relevant SEBs.

7.4.45 Woodland within the Scheme boundary, where it is not designated and not ancient, has *Local* value for nature conservation. This habitat is an HPI and local BAP priority.

7.4.46 Species-rich hedgerows, where present, are also HPI and a London Borough of Havering BAP priority habitat and have *Local* value for nature conservation.

7.4.47 The Ingrebourne River is included within the Ingrebourne Valley SMI, which has *Metropolitan* Valley. Other rivers and ponds identified have *Local* value for nature conservation.

[17] In the Great London area SINCs are designated at three levels according to their geographical importance: Sites of Metropolitan, Borough (Grade I), Borough (Grade II) and Local Importance
[18] Valuation to be made in consultation with county ecologist or equivalent, with reference made to the criteria for designation.

7.4.48 The habitats within the highway soft estate, including semi-improved neutral grassland and species-poor grassland, often forming a mosaic with tall ruderal and scrub vegetation, are of not more than *Local* value for nature conservation.

Notable species

7.4.49 There are populations of notable species present or potential for notable species to be present as described above. There is insufficient information to value the populations of notable species at this stage. This will be done when all survey information has been collected and analysed.

7.5 Potential impacts

Designated sites

7.5.1 The Scheme would result in direct loss of woodland, scrub, grassland and riparian habitat from Ingrebourne Valley SMI that would have an impact on the conservation status of this designated site valued at the *Metropolitan* level. The Scheme would cross the Weald Brook at two locations within the SMI and new structures would result in permanent shading of the river at these locations.

7.5.2 The widened embankment for the northbound slip-road for the M25 would result in the loss of woodland habitat from Ingrebourne Valley SMI adjacent to the M25.

7.5.3 Proposals to provide a service road and new junction close to Wigley Bush Lane would potentially require construction works and loss of woodland immediately adjacent to Lower Vicarage Wood LWS. These works would expose the LWS to potential adverse impacts from dust, pollution, noise or accidental incursion.

7.5.4 It is considered unlikely that there will be significant effects on The Manor LNR, which is located 400 m west of the Scheme, due to the distance of the site from the Scheme. Similarly, there is unlikely to be significant effects on any other designated sites identified during the desk study from the Scheme.

Ancient woodland

7.5.5 The Scheme will not directly affect ancient woodland. However, the proposals for a service road and new junction at Wigley Bush Lane would potentially result in the loss of woodland immediately adjacent to ancient woodland at Lower Vicarage Wood LWS, which may impact on the southern edge of the ancient woodland, exposing it to increased light or wind. There may also be the impacts during construction described in relation to the LWS above. The impacts of the Scheme on the ancient woodland are as yet unconfirmed will be the subject further assessment for the EIA.

Veteran trees

7.5.6 No veteran trees were identified within the study area during the desk study. Further survey to confirm if veteran trees are present, and will be affected by the Scheme, will be undertaken.

Notable habitats

7.5.7 The Scheme would result in the loss and degradation of notable habitats (outside of designated sites and ancient woodland) within or outside the highway soft estate, including semi-natural broadleaved woodland, broadleaved plantation,

scrub, hedgerows, semi-improved neutral grassland, and watercourses. The impacts of the Scheme on notable habitats are as yet unconfirmed and will be the subject further assessment for the EIA.

Notable and legally protected species

7.5.8 There may potentially be impacts on populations of notable and legally protected species, including European protected species (see Appendix D for a summary of relevant legislation), due to the removal of woodland, scrub, trees, hedgerows, semi-improved grassland and riparian vegetation.

7.5.9 Legally protected species that have been identified from the desk study and Extended Phase 1 Habitat Survey within the Scheme boundary include great crested newts, reptiles, bats, breeding birds and badger.

7.5.10 The impacts of the Scheme could cause an offence in relation to the Conservation of Habitats and Species Regulations 2010 (as amended), the Wildlife and Countryside Act 1981 (as amended), or the Protection of Badgers Act 1992. However, appropriate mitigation measures will be applied to minimise the impacts to notable and legally protected species and avoid offences being committed.

7.5.11 Further detailed surveys are currently being undertaken in order to determine the impacts of the Scheme on notable and legally protected species for the EIA assessment, as described in Section 7.7 below.

7.6 Proposed level and scope of assessment

7.6.1 A DMRB Detailed Assessment[19] will be undertaken with respect to nature conservation.

7.6.2 Data from an updated Extended Phase 1 Habitat Survey and additional detailed surveys to determine the presence and status of notable habitats and species will inform the EIA. The assessment will characterise the impacts of the Scheme on designated sites, notable habitats and notable species, as well as assessing the implication of the Scheme on legally protected species.

7.6.3 A separate Habitats Regulation Assessment (HRA) Screening, formerly referred to as an Assessment of Implications on European Sites (AIES) Screening, was undertaken at the Option Selection stage, which concluded that there were no likely significant effects on European Sites.

7.6.4 The ES will determine the level of significance of residual effects of the Scheme on nature conservation features, and to identify appropriate mitigation that will avoid, reduce and/or compensate for significant effects due to the construction and operation phases of the Scheme.

7.6.5 The nature conservation features that will be the subject of the detailed assessment for the EIA to determine the impacts and subsequent effects of the Scheme, are listed in Table 7.5 below. The table also listed those features scoped out of further assessment.

[19] According to DMRB Volume 11, Section 2, Part 1 General Principles and Guidance of Environmental Impact Assessment.

Table 7.5: Nature conservation effects scoped in and out of further assessment

Effects	Scoped in (✓) / out (✗)	Comment/Justification (summary of nature conservation legislation is found in Appendix D)
Internationally designated statutory sites (SAC, SPA, Ramsar)	✗	The Scheme will not affect internationally designated sites, as there are no internationally designated sites within 2 km of the Scheme, and no internationally designated sites where bats are one of the qualifying features within 30 km of the Scheme. The Scheme is also not crossing, adjacent to, or upstream/downstream of a watercourse designated as an internationally designated site.
Nationally designated statutory sites (SSSI, NNR)	✗	The Scheme will not affect nationally designated sites as there are no nationally designated sites within 2 km of the Scheme.
Locally designated statutory sites (LNR)	✗	The Scheme will not affect LNRs as there are no LNRs subject to direct land take or immediately adjacent to the Scheme.
Non-statutory designated sites (LWS, SMI, SBI)	✓	Ingrebourne River SMI is subject to direct impacts including land take due to the Scheme.
Ancient woodland	✓	The Scheme will not result in any losses of ancient woodland as there is no ancient woodland subject to direct land take. However, there is ancient woodland immediately adjacent to the Scheme.
Notable habitats	✓	Broadleaved woodland, the Weald Brook, the Ingrebourne River, and ponds may be subject to impacts from the Scheme.
Notable terrestrial invertebrates	✓	Suitable habitat for notable terrestrial invertebrates may be affected by the Scheme.
Aquatic invertebrates	✓	The Scheme will impact on the Weald Brook, Ingrebourne River which may be suitable for notable aquatic invertebrate assemblages or white clawed crayfish which is legally protected.
Great crested-newt	✓	The Scheme may affect ponds and potential suitable terrestrial habitat for great crested newts, which is a legally protected species.
Reptiles	✓	The Scheme affects potential suitable habitat for reptiles, which are legally protected species.
Breeding birds	✓	The Scheme affects potential habitat for notable birds. Nesting birds are also legally protected.
Bats	✓	The Scheme may impact on one or more features suitable for roosting bats, and affect bat foraging habitat and/or disrupt commuting routes. Bats are legally protected.
Hazel dormouse	✓	The Scheme affects potential dormouse habitat. Hazel dormouse is a legally protected species.
Water vole	✓	The Scheme will impact on the Weald Brook and Ingrebourne River, which may be suitable for water voles, a legally protected species.

Effects	Scoped in (✓) / out (✗)	Comment/Justification (summary of nature conservation legislation is found in Appendix D)
Otter	✓	The Scheme will impact on the Weald Brook and Ingrebourne River which may be suitable for otter, a legally protected species.
Badger	✓	There is potential for disturbance or damage to setts or harm to badgers, which are legally protected, during construction.
Invasive plants	✓	There is potential to cause certain invasive plants species under Schedule 9 of the Wildlife and Countryside Act 1981 to spread (which is an offence) during construction if present.

7.7 Proposed assessment methodology (including significance criteria)

7.7.1 An Extended Phase 1 Habitat Survey was undertaken in June 2017 to identify the potential for notable and legally protected species and the requirement for further ecological surveys as part of this stage.

7.7.2 The following further detailed ecological surveys are currently being undertaken in order to inform the assessment, and are due to be completed by November 2017:

- Phase 2 vegetation survey using the National Vegetation Classification (NVC);
- Terrestrial and aquatic invertebrate surveys of suitable habitat and the watercourses;
- Habitat Suitability Assessment and eDNA sampling of ponds for great crested newts;
- Reptile presence/absence survey;
- Breeding bird survey (including barn owl survey);
- Ground-level assessment of trees for roosting bats;
- Internal and external building inspections for roosting bats;
- Bat emergence/re-entry surveys of trees/buildings with potential for roosting bats;
- Bat activity surveys;
- Hazel dormouse presence/absence survey;
- Water vole presence/absence survey;
- Otter presence/absence survey;
- Badger activity survey; and
- Invasive plant species survey.

7.7.3 During the Extended Phase 1 Habitat Survey and the Phase 2 vegetation survey, suitable sites or habitat adjacent to, or close to, the Scheme, that could be used

to provide compensation for the loss of designated sites or notable habitat will be identified.

7.7.4 The assessment will follow guidance from the Guidelines for Ecological Impact Assessment in the UK and Ireland (CIEEM, 2016) and IAN 130/10, which supplements the earlier DMRB Volume 11, Section 3, Part 4 Ecology and Nature Conservation.

7.7.5 The assessment will characterise potential impacts on important nature conservation features, and take into account both on-site impacts and those that may occur to adjacent and more distant ecological features, including:

- Direct loss of habitats (including temporary loss);
- Fragmentation or isolation of habitats;
- Changes to the local hydrology, water quality and/or air quality;
- Direct mortality or injury to wildlife through construction activities, and
- Disturbance to species from noise, light or other visual stimuli.

7.7.6 An impact on nature conservation features would be determined as significant if those impacts change the structure and functions of designated sites, notable habitats, or ecosystems; or the conservation status of habitats and species.

7.7.7 Effects are identified at the geographic scale at which they become significant dependant on its value. The residual significance of effects takes into account any mitigation or compensation provided and has been identified using professional judgement. Residual effects on nature conservation features are categorised on the five-point scale in line with IAN 130/10 shown in Table 7.6 below. An effect will be considered to be significant if it falls into the moderate category or above.

Table 7.6: Significance of effects on nature conservation feature

Significance category	Typical descriptors of effect
Very large	An effect on one or more feature(s) of international, European, UK or national value.
Large	An effect on one or more feature(s) of regional value.
Moderate	An effect on one or more feature(s) of county value.
Slight	An effect on one or more feature(s) of local value or features within the survey area.
Neutral	No significant effects on important nature conservation features.

7.8 Vulnerability to major accidents and disasters

7.8.1 Major accidents and disasters that could potentially affect ecological features include: events that could result in direct damage of habitats, and injury of killing of individual animals or populations supported by those habitats; such as:

- severe storms;
- spread of new plant diseases;
- terrorist attacks or plane/rail crashes; and

- other events such as major road traffic accidents, fires or chemical explosions or releases that emit air pollutants.

7.8.2 The potential for change in significance of effects due to direct damage of habitats and harm to species will be discussed as part of the biodiversity assessment. If the assessments for water and noise identify vulnerabilities that could affect valuable biodiversity receptors these will also be discussed as part of the biodiversity assessment. The potential for change in significance of effects on biodiversity receptors through release of pollutants to the air will be discussed as part of the air quality assessment

7.9 Proposed consultation

7.9.1 Consultation will be undertaken with environmental organisations, in order to ensure their input is incorporated into the impact assessment, the final design of the Scheme and its associated mitigation and compensation. These will include (but not be limited to):

- Natural England,
- Environment Agency; and
- Forestry Commission.

7.10 Potential mitigation measures

7.10.1 The following mitigation measures will be incorporated into the design and construction processes to reduce the overall impacts on valuable ecological features and reduce the risk of significant residual effects:

- The design will take into account ecological features including designated sites, and notable habitats[20] (in particular watercourses, ponds, woodland, species-rich hedgerows and semi-improved grassland). Wherever possible the Scheme will be designed to avoid these features, and where there is permanent loss of fragmentation of sites or habitat this will be kept to the minimum possible;
- The Scheme design will avoid any loss of ancient woodland habitat;
- Any loss of designated site or notable habitat will be compensated by the creation of an equal or greater area of similar habitat to that lost in accordance with the principals of No Net Loss and Net Gain of biodiversity. The compensation habitat will be adjacent to, or as close to the relevant designated site as possible.
- Maintenance and, where possible, enhancement of habitat connectivity and commuting routes for species, including underpasses, sensitive culvert design, and maintaining habitat connections;
- The riparian corridor within Ingrebourne Valley SMI will be enhanced to increase the value of the habitat for nature conservation;
- Retention of features with potential to provide bat roosting sites where possible (i.e. mature trees and suitable structures);

[20] HPI, London BAP, London Borough of Havering BAP, and Essex BAP habitats

- Provision of a sensitive lighting design that takes bats and other wildlife into account;
- Creation of log piles and other potential wildlife refuges using material from site clearance where practical.
- Mitigation measures will be implemented as set out in Chapter 5 to reduce the significance of any potential effects caused by air pollution.

7.10.2 In order to avoid or minimise any potential damage, loss and disturbance caused by the construction works, good practice methodology, including a CEMP, would be followed for all construction operations. The CEMP would include the following measures:

- Protection of designated sites, ancient woodland, and other valuable habitats outside the working area from accidental incursion excessive noise or light disturbance, and pollution;
- 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, dormice habitat, great crested newt habitat, or water vole burrows) would be damaged during the works; and
- 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 protected species (i.e. bird breeding season), and provision of Ecological Clerk of Works.

7.11 Assumptions and limitations

7.11.1 For safety reasons, the Extended Phase 1 Habitat Surveys were undertaken from safely accessible land adjacent to the highway network, and therefore complete access to the land affected by the Scheme within the highway boundary was not available.

7.11.2 Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. These factors limit the survey by reducing the effectiveness of certain surveys at certain times of year. The habitat surveys undertaken to support this assessment may not therefore produced a complete list of plants and animals, and the absence of evidence of any particular species should not be taken as conclusive proof that the species is not present or that it will not be present in the future.

7.11.3 The list of invasive plant species included on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended) is extensive and these plants are found in a range of different habitats, including aquatic habitats. The invasive species survey will look for the presence of Japanese knotweed, giant knotweed, hybrid knotweed, giant hogweed, rhododendron, cotoneaster species and Himalayan balsam. Other invasive species, in particular those associated with aquatic habitats may not be recorded, but it is considered that this level of survey is sufficient to identify any constraints posed by invasive species.

7.12 Conclusion

7.12.1 Based on the findings to date, a preliminary assessment of the effects of the Scheme on ecological features has determined that the Scheme may potentially have an effect of slight significance on the Site of Metropolitan Importance and notable habitat, in particular the river and riparian habitat. This is due to the loss and shading of the Weald Brook and Ingrebourne River by new structures. The Scheme may also cause impacts on populations of notable and legally protected species, but residual effects on species after mitigation measures have been put in place are not considered likely to be significant at this stage.

7.12.2 Where potential issues have been identified as a result of the Scheme, these have been scoped in for further assessment. This will involve a thorough and robust series of ecological surveys, and therefore a sufficient baseline dataset in order to inform the EIA will be provided. Appropriate mitigation measures will also be proposed.

8. Road Drainage and the Water Environment

8.1 Introduction

8.1.1 This chapter identifies the study area for road drainage and the water environment, and presents the baseline conditions therein. It identifies the potential impacts on road drainage and the water environment associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

8.1.2 The chapter presents the proposed scope and methodology for the EIA. The road drainage and the water environment assessment identifies the likely potential effects on road drainage and the water environment due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

8.1.3 Previous assessments of the Scheme have been undertaken. These include:

- Road Investment Strategy M25 Junction 28 Improvements Environmental Study Scoping Report. Highways England. April 2016;
- Road Investment Strategy M25 Junction 28 Improvements Environmental Study Report. Highways England. October 2016;
- Road Investment Strategy M25 Junction 28 Improvements Environmental Study Scoping Report. Highways England. March 2017;
- Road Investment Strategy M25 Junction 28 Improvements. Water Framework Directive Assessment (Options Identification Stage) Highways England. March 2017;
- Road Investment Strategy M25 Junction 28 Improvements Environmental Assessment Report. Highways England. April 2017; and
- Regional Investment Programme M25 Junction Preliminary Sources Study Report. Highways England. April 2017.

8.2 Study area

8.2.1 The spatial scope of the assessment includes, features of the water environment within 1km of Scheme. In line with the DMRB Volume 11, Section 3, Part 10 HD 45/09 Road Drainage and the Water Environment, a 1km study area is also deemed appropriate as for the assessment for soluble pollutants, research indicates that beyond 1km it is likely any impacts will be sufficiently diluted, thereby reducing any potential impact. Where appropriate, study area and collection of baseline data may be enlarged where potential effects may extend beyond 1 km (e.g. downstream flood risk or hydromorphological change). For groundwater, the potential zone of impact will be assessed on the underlying Water Framework Directive (WFD) groundwater body.

8.3 Planning and policy context

8.3.1 Relevant legislation is summarised in Table 8.1. This has been reviewed to determine relevance to the Scheme.

8.3.2 Relevant policies will be assessed by identifying the degree of compliance or conflict with the scheme.

Table 8.1: Relevant legislation for road drainage and the water environment

Legislation	Description
European legislation	
Water Framework Directive (WFD) (2000/60/EC)	The WFD requires that all inland waters within defined river basin districts must reach at least good status by 2015 and defines how this should be achieved through the establishment of environmental objectives and ecological targets for surface waters. Any new scheme must not cause deterioration of the water environment or prevent the future attainment of good status.
Environmental Quality Standards Directive (2008/105/EC)	Lists environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 of the Water Framework Directive 2000/60/EC (WFD), with the aim of achieving good surface water chemical status. It includes certain metals that are associated with runoff from highways.
Groundwater Directive (2006/118/EC)	Complements the WFD. It requires measures to prevent or limit inputs of pollutants into groundwater to be operational so that WFD environmental objectives can be achieved.
Habitats Directive (92/43/EEC)	To promote the maintenance of biodiversity by taking measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. Sites or species that come under this Directive will heighten the importance of water features that sustain them.
Floods Directive (2007/60/EC)	The aim is of this Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. It sets the strategic level for flood risk that any development will need to comply with.
National legislation	
Antipollution Works Regulations (1999)	Where pollution occurs or is likely to occur the Environment Agency can serve a works notice under Section 161A of the Water Resources Act on any person who has caused or knowingly permitted the pollution (or risk of pollution) to a water course, requiring them to carry out anti-pollution / preventative works and operations. The Environment Agency can also recover the costs of any investigation and anti-pollution works carried out. The Anti-Pollution Works Regulations prescribe the content of anti-pollution works notices. They also prescribe the particulars of such matters as are required to be placed on the pollution control registers maintained by the Environment Agency.
Environment Act (1995)	The Act provides for the establishment of a body corporate to be known as the Environment Agency, the key regulator for the water environment.
Environmental Damage (Prevention and Remediation) Regulations (2015)	The emphasis of these Regulations is proactively putting in place appropriate pollution prevention measures to reduce risks to the environment.

Legislation	Description
Environmental Protection Act (1990)	This act brings in a system of integrated pollution control for the disposal of wastes to land, water and air.
Flood Risk Regulations (2009) Amended SI2011/2880 transpose directive 2007/60/EC	The Flood Risk Regulations aim to provide a consistent approach to managing flood risk. The Environment Agency are responsible for managing flood risk from main rivers, the sea and reservoirs. LLFAs are responsible for local sources of flood risk, in particular surface water, groundwater and ordinary watercourses.
Flood and Water Management Act 2010 and Commencement Orders	The key areas covered by this Act are: • Roles and responsibilities for flood and coastal erosion risk management; and • Improving reservoir safety.
Groundwater (England and Wales) Regulations (2009)	These transpose the Groundwater Directive (2006/118/EC) into law in England & Wales. These powers are implemented in though the Environmental Permitting Regulations (2016).
Highways Act 1980 (HA 1980)	
National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012)	The NPPF sets strict tests to protect people and property from flooding which all local planning authorities are expected to follow. It forms the basis of assessment of flood risk for schemes.
National Planning Practice Guidance (NPPG) 2014 Policy 10: Meeting the challenge of Climate Change, Flooding and Coastal Change Policy 11: Conserving and Enhancing the Natural Environment	In 2014, accompanying the NPPF, the National Planning Practice Guidance (NPPG) (DCLG, 2014) was published. This advises on how Local Planning Authorities can ensure water quality and the delivery of adequate water infrastructure and take account of the risks associated with flooding in the plan-making and the planning application process
The Environmental Permitting (England and Wales) Regulations 2016	Provide a consolidated system of environmental permitting in England and Wales and transpose provisions of fifteen EU Directives which impose obligations requiring delivery through permits or which are capable of being delivered through permits. Covers Environment Agency permits for flood risk (on Main River) and certain discharges to watercourses.
The Water Resources (Environmental Impact Assessment) (England and Wales) Regulations 2003	Impose procedural requirements in relation to the consideration of applications or proposals for an abstraction or impounding licence under Chapter II of Part II of the Water Resources Act 1991 and require consent in other cases.
Water Act 2003 and Water Act 2014	Aims to improve water conservation, protect public health and the environment, and improve the service offered to consumers. The Act is in three parts relating to water resources, regulation of the water industry and other provisions.
Water Framework Directive (Standards and Classification) Directions	These Directions set out the environmental standards to be used for the second cycle of river basin plans. They transpose

Legislation	Description
(England and Wales) 2015	Directive 2013/39/EC on environmental quality standards for priority substances.
Water Industry Act (1991) (Amendment) (England and Wales) Regulations (2009)	Sets out the responsibilities of the Environment Agency of England and Wales in relation to water pollution, resource management, flood defence, fisheries, and in some areas, navigation. The Act regulates discharges to controlled waters, namely rivers, estuaries, coastal waters, lakes and groundwaters
Water Resources Act 1991	Act to regulate water resources, water quality and pollution, and flood defence. Sets out standards for Controlled Waters.
Water Environment (Water Framework Directive) (England and Wales) Regulations 2003	Outline the duties of regulators (Environment Agency in England) in relation to environmental permitting, abstraction and impoundment of water.
The Land Drainage Act 1991	Requires that a watercourse be maintained by its owner in such a condition that the free flow of water is not impeded. The 1994 Act amends it in relation to the functions of internal drainage boards and local authorities.
The Control of Pollution (Oil Storage) (England) Regulations 2001	Applicable for storage of more than 200 litres of oil above ground at an industrial, commercial or institutional site. The Regulations apply only in England.
NN NPS	Government strategy document that outlines the requirements for the water environment (flood risk, water quality and resources) when applying for planning for a transport scheme. Expected information for decision making and mitigation requirements are included.
Local planning policies	
Brentwood Borough Council, Local Plan	Includes the policies for Energy and Water Conservation and the Use of Renewable Sources of Energy in New Development (IR5), General Development criteria (CP1) that includes impacts to water, Retention and Provision of Landscaping and Natural Features in Development (C5) which includes reference to the water environment.
London Borough of Havering	Adopted documents from the Local Development Framework include, Protecting the Borough's Biodiversity 2009, Sustainable Design and Construction 2009. The Local Plan is being drafted for the period 2017-19.
London Plan	Includes the following policies relevant to the water environment. These include the following: • Policy 5.12 Flood risk management; • Policy 5.13 Sustainable drainage; and • Policy 5.14 water quality and wastewater infrastructure.

8.4 Baseline conditions

8.4.1 This section sets out the baseline conditions of the water environment. At this stage, a high- level desk-based assessment has been undertaken using publicly available spatial data under the Open Government Licence and from open sources including the EA. As no new information has become available since the Option Selection Stage, this section largely echoes that of the baseline reported

in the previous stage. However, the baseline reported in the previous stage has been revisited to confirm any updates to baseline/existing conditions. WFD full walkover surveys of the affected watercourses and lakes will be undertaken as part of this stage.

Surface water

8.4.2 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).

8.4.3 One Water Framework Directive (WFD) (2000/60/EC) surface waterbody has been identified across the study area. This is the River Ingrebourne (GB106037028130), see Table 8.2 for details. This is not designated as an artificial or heavily modified waterbody (A/HMWB) or as a Protected Area.

8.4.4 The River Ingrebourne runs parallel and north of the A12. It flows south and at Putwell Bridge, the Weald Brook (designated as a Main River) joins it. The Weald Brook lies to the west of the M25 and runs parallel to the motorway.

8.4.5 Other watercourses, not designated or classified under the WFD or as Main Rivers lie within the study area. The exact number and status is unknown at the time of reporting due to the small-scale of these features and the dependence on only publicly available data for this stage of the assessment. These non-WFD watercourses will be identified and assessed as part of the ES.

WFD compliance assessment / channel morphology

8.4.6 A WFD compliance assessment is required for new developments and schemes to demonstrate that the 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 (2021 or 2027).

8.4.7 The Environment Agency is the competent authority for WFD. However, as the Scheme has the potential to also affect other watercourses not designated as a Main River watercourse, Brentwood District Council (the Lead Local Flood Authority) has a duty to ensure the Scheme complies with WFD legislation.

8.4.8 A WFD preliminary assessment was undertaken in March 2017 (Highways England. March 2017). The preliminary assessment was based on the preliminary option drawings. This assessment has been updated the Ingrebourne WFD water body and other surface watercourses (including the Weald Brook) are potentially affected by the Scheme. The WFD assessment suggests that the Scheme would be compliant with the requirements of the WFD because it is not considered to cause deterioration at the water body scale and should not prevent future attainment of good status. However, the Scheme does include design components (e.g. culverts) that generate minor or localised adverse effects.

Lakes and other surface water features

8.4.9 There are no WFD designated lakes within the study area and therefore these are scoped out and will not be considered further.

8.4.10 Hydraulically isolated ponds are considered only in an ecological context as owing to their isolation they would not be affected by changes in flow or quality.

Potential ecological effects on these features will be considered in the Chapter 7: Biodiversity.

Groundwater

8.4.11 The site is underlain by superficial aquifers, including Alluvium associated with the Ingrebourne River and Weald Brook and Head. Groundwater within the Alluvium is likely to be in continuity with the rivers.

8.4.12 There are no designated WFD groundwater bodies within the study area.

8.4.13 There are no Source Protection Zones (SPZ) within the study area and therefore these are scoped out and will not be considered further.

Abstractions and discharges

8.4.14 The EA website indicates there are numerous surface water abstractions within the study area. Details of these abstractions are being obtained (still to be received in full).

8.4.15 Based on the Highways Agency Drainage Data Management System there are numerous highway outfalls across study areas for the options. The status of these and the implications for the Scheme will be assessed during this stage.

8.4.16 Details will also be sought for discharge consents in the study area.

Flood risk

8.4.17 Flood zones 2 and 3 are within the study area and adjacent to the existing motorway. These zones are associated with both the River Ingrebourne and Weald Brook watercourses, both adjacent to the Scheme.

8.4.18 With reference to the Preliminary Sources Study Report (Highways England, April 2017), groundwater flooding mapping included within the Envirocheck report indicates that the potential for groundwater flooding across the study area. Further information from the Environment Agency is necessary to delineate the floodplain more accurately in the study area and to understand other forms of flooding, including surface water and groundwater flooding.

Aquatic ecology

8.4.19 Aquatic ecology has been considered in the Ecology chapter.

Designated sites

8.4.20 There are no statutory designated sites or any sites which are likely to be affected by water within the study area. Designated sites will not be considered further in the context of water resources.

Value of the environmental resources and receptors

8.4.21 The criteria used in this assessment to determine the value of each water resource and feature are set out in Table 8.2 below, based on the Department for Transport TAG guidance (WebTAG) (Department for Transport. December 2015). It was felt appropriate to use WebTAG for assigning the importance and potential magnitude of impact, as it provides more of a qualitative assessment using professional judgment in the absence of specific quantitative data, such as drainage catchment areas is unavailable at the time of reporting.

Table 8.2: Value of water resources and their features

Resource	Features	Indicator of quality (taken from WebTAG table 13)	Measure (taken from WebTAG table 13)	Importance
River Ingrebourne (GB106037028130)	Water Supply	Chemical water quality	Chemical classification/status under the WFD. Currently good	Medium
	Biodiversity	Biological water quality	Ecological classification/status under the WFD. Currently moderate	Low
	Conveyance of flow and material	Number, size and flow of watercourses and potential for material transport	Changes to volumetric flow or material transport	Medium
River Ingrebourne (GB106037028130) floodplain	Conveyance of flood flows	Presence of flood zones	Existing flood risk/flood return period - River Ingrebourne has Flood Zone 2 and also Flood Zone 3 areas	High*
Weald Brook	Water Supply	Chemical water quality	Chemical classification/status and objective under. Currently is good	Medium
	Conveyance of flow and material	Number, size and flow of watercourses and potential for material transport	Abnormal changes to volumetric flow or material transport	Medium
Weald Brook floodplain	Conveyance of flood flows	Presence of flood zones	Existing flood risk/flood return period - Weald Brook has Flood Zone 2 and also Flood Zone 3 areas	High
Drainage ditches	Conveyance of flow and material	Number, size and flow of watercourses and potential for material transport	Abnormal changes to volumetric flow or material transport	Medium
Groundwater Secondary A Aquifer (superficial)	Water Supply	Use for water supply (potable, industrial or agricultural)	Volume and quality of water abstracted	Medium

Resource	Features	Indicator of quality (taken from WebTAG table 13)	Measure (taken from WebTAG table 13)	Importance
	Conveyance of flood flows	Groundwater quality and levels	Charges in groundwater flow regime and levels	Medium

Key* On the assumption the floodplain is protecting at least up to 100 properties and the scheme is adjacent and downstream of a significant population the floodplain has been assigned a high importance.

8.5 Potential impacts

8.5.1 Potential temporary effects during the construction phase for the Scheme include, but are not limited to:

- 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 mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff. These risks could result in sediment and/or other contaminants entering watercourses or groundwater affecting the quality of the water which could have implications for abstractions and WFD compliance;
- Risks to the groundwater environment (principally associated with cuttings) and potential contamination risk to the underlying Secondary Aquifer and subsequent effects on existing abstractions. Both level of groundwater and the quality of groundwater for supply and reliant surface water sites could be affected; and
- Risk of an increase in flood risk, both to the scheme itself and surrounding land uses, 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.

8.5.2 Potential permanent effects during the operational phase for the Scheme include, but not limited to:

- Surface water quality impacts arising from: pollutants (e.g. oils from fuel combustion/accidental spillages and salts or herbicides from road maintenance); and new areas of hard standing that could increase road runoff and affect the water quality in the river;
- Direct physical impacts of watercourse crossings. Channels will need to be realigned. On the assumption (worst case) that the crossings would be culverts this will have potential impacts of less dynamic flow, loss of sediment continuity, habitat severance, a potential barrier to fish movement and loss of habitat for macrophytes through shading. However, the river realignment could present a potential and practical opportunity to improve the existing channel (though this would need to be confirmed by survey);
- Any discharge to ground may have implications for groundwater quality; and

- Potential impacts to flood risk. The scheme will encroach onto flood zone 3, potentially reducing floodplain capacity and therefore will require some element of floodplain compensation.

8.6 Proposed level and scope of assessment

8.6.1 Table 8.3 presents the scope of assessment which has been established using the baseline data, the water resource value and the potential construction and operation implications of the Scheme on the water environment.

Table 8.3: Proposed level and scope of assessment

Item	Scope
Surface water	Surface water quality tests to be undertaken using the Highways Agency Water Risk Assessment Tool (HAWRAT) Assessment of pollution impacts on surface waters from accidental spillages in line with HD45/09
Groundwater	The assessment will consider both groundwater level and quality impacts in accordance with the requirements of the WFD. Consideration will be given to the potential changes to water flow, volumes and quality during both the construction and operation phases. Further information on licenced and unlicensed private water supplies will be identified in consultation with the Environment Agency and the local authority.
Abstractions and discharges	The assessment will consider the location of the abstraction points and the quality impacts from both the construction and operation phases.
Flood Risk	The assessment will consider the impacts of the scheme on all sources of flood risk. An assessment of floodplain compensation is likely to be required due to loss of natural floodplain storage. The analysis will form the basis of a detailed Flood Risk Assessment (FRA) supporting the Scheme.
WFD detailed assessment	Walkover surveys to record the current ecological and geomorphological assemblages, to understand the sensitivity of those assemblages to the Scheme and to identify the location and type of potential measures to mitigate the local adverse effects of the Scheme. A geomorphological assessment to understand the natural angle of repose of river banks to inform channel realignment or re-profiling works.

8.7 Proposed assessment methodology

Surface water

8.7.1 The Highways Agency Design Manual for Roads and Bridges (DMRB) (HD 45/09) (Highways Agency, November 2009) provides guidance on the assessment of likely significance of effects on the water environment associated with highway schemes. This guidance in conjunction with WebTAG (Department for Transport, December 2015) will be used for assigning the importance and potential magnitude of impact.

8.7.2 The assessment will use drainage information and Annual Average Daily Traffic (AADT) data to establish potential impacts of the Scheme on the water environment within the study area and the requirement for mitigation measures to adequately reduce the risk.

8.7.3 The potential ecological impacts of routine runoff on surface water will be assessed using the water quality model (HAWRAT) as advised in the DMRB (Highways Agency, November 2009). Spillage risk tests will also be undertaken in accordance with the DMRB (HD45/09) (Highways Agency, November 2009).

Groundwater

8.7.4 At the time of reporting, it is unknown if discharge to ground will be required and the suitability of this method. Once confirmed, the assessment of the potential pollution impacts from runoff to groundwater may be required. This will be in accordance with Method C as outlined in HD45/09 (Highways Agency, November 2009).

Flood risk

8.7.5 The Flood Risk Assessment (FRA) will be produced in accordance with the requirements of the National Planning Policy Framework (NPPF) (Department for Communities and Local Government, 2012) and its accompanying Technical Guidance (Department for Communities and Local Government, 2014), the National Policy Statement for National Networks (DfT,2015) and the Environment Agency's 'Climate change allowances for planners' NPPF supporting guidance (Environment Agency, 2017).

WFD

8.7.6 The approach to the WFD compliance assessment will follow the Planning Inspectorate guidance on preparation of WFD assessments for a Nationally Significant Infrastructure Project (The Planning Inspectorate, 2017). It will be based on a format that was originally developed in close consultation with the Environment Agency for a large transport infrastructure scheme (HS2, 2016). This format was subsequently promoted by the Environment Agency as an example of best practice, particularly for large schemes that affect many water bodies. It captures the core requirements of a compliance assessment whilst being transparent and simple to interpret. Assessment can be readily updated, creating a clear audit trail of WFD compliance as a scheme progresses through its lifecycle from options assessment to design and environmental permitting.

8.8 Vulnerability to major accident and disasters

8.8.1 Major accidents and disasters comprise man-made and natural risks which are considered likely, and anticipated to result in substantial harm that the normal functioning of the Scheme is unable to cope with/ rectify – i.e. risks with the potential to have a significant effect.

8.8.2 Despite the limited nature of natural risks the UK is exposed to, the potential of natural circumstances such as extreme rainfall or major droughts impacting on groundwater for example, are considered to have the potential to have a direct, reductive effect on the future effectiveness of the drainage system of the Scheme and subsequent effects on the water environment. Assessment under

this section would therefore consider storm events and the possibilities for extreme drought, the potential consequences for effects of the Scheme on drainage and the water environment.

8.8.3 In terms of man-made risks, the most pertinent for water would be the impacts of a major chemical spill and how this would affect the Scheme and pass through to the wider water environment.

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

8.8.5 No new baseline information will be required as part of the vulnerability assessment, and therefore no additional baseline surveys with respect to drainage and the water environment will be undertaken.

8.9 Proposed consultation

8.9.1 Consultation with regulators, in the form of introductory meetings and follow up specific technical meetings on site (principally with the Environment Agency, plus Lead Local Flood Authorities (LLFAs) and other interested parties) will continue regularly throughout the design process to ensure that the Scheme is designed to be compliant with the objectives of the WFD and that feasible opportunities for improvements to the water environment are integrated into the Scheme.

8.10 Potential mitigation and monitoring measures

8.10.1 Should the assessment undertaken 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, such as oil interceptors or downstream defenders) and measures within the Construction Environmental Management Plan (CEMP) to control and prevent polluted run-off.

8.10.2 Key considerations/principles guiding WFD compliant design include but are not limited to the following:

- Single span bridges are the preferred type of crossing because they minimise impact on the water environment if designed appropriately;
- Culverts are, however, generally cheaper and easier to build than single span structures because their construction process tends to be less complex. Key considerations in environmentally sensitive culvert design include; minimising the length, adopting an open arc structure that avoids disturbing the natural bed of the river is preferred to a box culvert and incorporating a natural bed substrate.

8.11 Assumptions and limitations

8.11.1 The assumptions and limitations at the time of reporting are as follows:

- Data quality - desk study, using mainly web-based data and previous assessment reports only has been reported;

- Data quantity - as per quality, only open, freely licensed data has been reported at this stage and therefore the amount of detail on certain topics is limited;
- Site visits – no site visits have been undertaken at the time of reporting so site specific, ground truth data is limited (targeted site visits for walkover surveys are planned as part of this stage); and
- Where impacts are uncertain a conservative approach has been adopted.

8.11.2 For the stage 3 assessment, assumptions are that:

- Environmental Data will be up to date and available from accessible sources (mainly web-based);
- Data for the Scheme will be available including traffic and road catchment data to allow water quality modelling assessments to be made and the flood risk and WFD assessments; and
- Access will be acquired to enable site visits to be undertaken.

8.12 Conclusion

8.12.1 In line with the DMRB an assessment will be required where there is a potential for any road project to adversely affect the water environment.

8.12.2 The Scheme does have this potential and further assessment is required. This will use appropriate methodology to assess the likely effects upon the water environment as a result of the Scheme whilst also proposing appropriate mitigation measures that are proportionate to the likely impacts.

8.12.3 Road drainage and the water environment is scoped in to this stage of assessment and all aspects should be included (flood risk, groundwater and surface water). This is summarised in Table 8.4 below. In addition, standalone Flood Risk Assessment and WFD compliance assessment will be undertaken.

Table 8.4: Water resources and their features scoped in and out for further assessment

Effects	Scoped in (✓) / out (✗)	Comments/Justification
Surface Water	✓	To consider the potential effects from construction activities (largely sedimentation and spillage risk) and operational changes to receiving water shape and quality (changes to profile at watercourse crossings and discharge outfalls). Includes assessment against WFD criteria.
Groundwater	✓	For construction and operation, to assess potential effects on groundwater levels and quality (from cuttings and infiltration from the drainage system) and whether this would impact other water users local to the scheme. Includes assessment against WFD criteria.
Flood Risk	✓	For construction and operation, to assess the potential effects from flood risk, both to the Scheme itself and wider land uses. Flood risk can manifest in many forms, including for example, storage of material in floodplains, intercepting groundwater or permeant alterations of a watercourse and its floodplain from the structure itself. Includes a formal Flood Risk Assessment.

9. Landscape and Visual

9.1 Introduction

9.1.1 This chapter identifies the study area for landscape and visual impacts, and presents the baseline conditions therein. It identifies the potential impacts on landscape and visual receptors associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

9.1.2 The chapter presents the proposed scope and methodology for the EIA. The landscape and visual impact assessment identifies the likely potential effects on landscape and visual receptors due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

9.2 Study area

Landscape scope

9.2.1 It is recognised that potentially significant landscape effects would be restricted to the land required or directly adjacent to the Scheme. Following the review of the Scheme and in the context of available Ordnance Survey (OS) mapping and aerial photography and topographical data, it has been considered that a study area of 1.5 km from the perimeter of the Scheme would be sufficient to identify potentially significant landscape effects. Any effects on landscape receptors located beyond the study area are unlikely to be significant and are scoped out from further assessment.

Visual scope

9.2.2 The visibility of the Scheme is restricted by a network of intervening hedgerows, woodland belts and woodland areas in close proximity to the Scheme, as well as by vegetation along the approaches to the junction including the A12 and M25 roads. Visibility is also further restricted by landform around the junction that broadly slopes down towards the junction from adjacent areas. When considering the scale of the Scheme in the context of natural and man-made screening elements present around the M25 Junction 28 Junction (including landform), it is envisaged that a study area of 1.5 km from the perimeter of the Scheme would be sufficient to identify potentially significant visual effects. Any effects on visual receptors beyond the study area are unlikely to be significant and are scoped out from further assessment.

9.3 Planning and policy context

9.3.1 This section of the report summarises key relevant regulatory and policy frameworks.

European Landscape Convention

9.3.2 The European Landscape Convention (Florence, 2000) sets out an internationally agreed definition of landscape: “The landscape is part of the land, as perceived by local people or visitors, which evolves through time as a result of being acted upon by natural forces and human beings”. It also sets out the key

actions that countries should follow and provides an integrated, holistic approach and international context for landscape, under the headline banner that "All Landscapes Matter".

National policies

9.3.3 The NPPF sets out the Government planning policies for England and how these are expected to be applied. The NPPF sets out 13 aspects relating to the delivery of sustainable development, including 'Conserving and enhancing the natural environment' which is of particular importance to the proposed development.

National Policy Statement for National Networks

9.3.4 The National Networks National Policy Statement, sets out the need for, and Government's policies to deliver Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England. It provides planning guidance for promoters of nationally significant infrastructure projects on the road and rail networks, and the basis for the examination by the Examining Authority and decisions by the Secretary of State.

9.3.5 Guidance relevant to the landscape and visual effects of the Scheme include the following summarised below:

- Avoid and mitigate environmental and social impacts in line with the principles set out in the NPPF and planning guidance;
- Consider reasonable opportunities to deliver environmental and social benefits;
- Good design should be an integral consideration from the outset of the project;
- Visual appearance is a key factor in considering the design of new infrastructure and should be sensitive to place;
- Take aesthetics into account as far as possible (bearing in mind fitness for purpose and sustainability), including siting, design measures relating to existing landscape and historical character and function, landscape permeability, landform and vegetation;
- 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;
- Strong presumption against any significant road widening or new roads in a National Park;
- Where an EIA is required a landscape and visual assessment should be included in the EIA. The Secretary of State will want to judge whether visual effects on a sensitive receptor outweighs the benefits of development;
- Mitigate adverse landscape and visual effects through appropriate siting, design and landscape scheme; and
- Public rights of way and National Trails are important recreation facilities for walkers, cyclists and horse riders. Take appropriate mitigation measures to

address adverse effects on national trails, other rights of way and open access land.

National legislation

9.3.6 Key relevant national legislation for the Scheme includes The Town and Country Planning Act 1990, Countryside and Rights of Way Act 2000, and the Planning Act 2008, 'Part 7 - Orders granting development consent', including PRoW and Green Belt, 'Schedule 8 - Tree Preservation Orders: further amendments'. These pieces of legislation are particularly relevant to landscape as they provide legislative control relating to managing resource, access to the countryside and conservation.

Local policies

9.3.7 At a local level, local Plans set out a vision and a framework for the future development of the area within boundaries of the local authorities, in this case the London Borough of Havering and Brentwood Borough Council. In addition, the Scheme is located partially within the area that is covered by policies of the London Plan (Greater London Authority, 2016).

London Borough of Havering: Local Development Framework

9.3.8 The London Borough of Havering's LDF is a portfolio of different documents that have been prepared to provide for the future planning of the Borough. The Core Strategy, so called because it sets the Council's approach to the planning of the whole borough up to 2020, and sets the framework for the Action Plans and topic specific planning documents that compliment it and address other planning issues in the borough.

9.3.9 Relevant policies of the London Borough of Havering's LDF are listed below:

- Policy CP14 – Green Belt;
- Policy DC32 – The Road Network;
- Policy DC34 – Walking;
- Policy DC35 – Cycling;
- Policy DC45 – Appropriate Development in the Green Belt;
- Policy DC60 – Trees and Woodlands; and
- Policy DC69 – Other areas of special townscape or landscape character.

Brentwood Borough Council: Replacement Local Plan

9.3.10 The Brentwood Replacement Local Plan was formally adopted by the Council in August 2005, and provides a comprehensive statement of land use policies and proposals for the Borough. The Council is currently preparing a Local Development Plan for the Borough, which, once adopted, will supersede saved policies in the current Replacement Local Plan (2005).

9.3.11 Relevant policies of the Brentwood Borough Council are listed below:

- Policy CP1 – General Development Criteria;
- Policy GB1 – New Development;

- Policy GB2 – Development Criteria;
- Policy C4 – Management of Woodlands;
- Policy C5 – Retention and Provision of Landscaping and Natural Features in Development; and
- Policy C12 – Landscape Improvements.

9.4 Baseline conditions

Landscape features

9.4.1 The Scheme is partially surrounded by blocks of woodland and small scale arable and pasture fields. The fields are bound by hedgerows with intermittent trees and linear woodland belts. Semi-mature woodland belts are present along the on and off slip roads of the M25 as well as along the A12 toward the urban fringe of Romford to the west.

9.4.2 The majority of the inner perimeter of the Junction 28 roundabout is filled with existing mature woodland with some areas of scrub vegetation. The junction is set between largely residential areas of Brentwood and Romford and between these urban areas there are some linear settlement along the local road corridors i.e. Nag's Head Lane or mixed-use development areas along Brook Street to the east of the junction. There are also a number of land uses that are typically associated with suburban areas like Maylands Golf Course or Thames Water Sewage Works.

Landscape character

9.4.3 The study area is located within National Character Area (NCA) No.111 - Northern Thames Basin. An assessment against the NCA will be undertaken with consideration given to environmental opportunities. The assessment will also focus on local landscape character areas as described below.

9.4.4 The Scheme is located wholly within the London Borough of Havering, but directly adjacent to the boundary of Brentwood Borough Council. The landscape character of Brentwood Borough Council is described in the Braintree, Brentwood, Chelmsford, Maldon and Uttlesford Landscape Character Assessments (sections 3-7) prepared by Chris Blandford Associates in September 2006 (Chris Blandford Associates, 2006a, 2006b, 2006c, 2006d, 2006e).

9.4.5 The majority of the landscape surrounding the M25 Junction 28 is located within the Wooded Farmland Landscape Character Type. This landscape type is subdivided into two landscape character areas, F13 Great Warley Wooded Farmland Landscape Character Area located to the south and south east of Junction 28 and the A12, and F15 Weald Wooded Farmlands to the north east of the M25 Junction 28.

9.4.6 There are currently no published landscape character assessments within the London Borough of Havering. Therefore, a brief description of key characteristic and attributes of the landscape within the London Borough of Havering has been presented in Table 9.1, below; the extent of these characteristics are restricted to the study area, and the key attributes of landscape character surrounding M25 Junction 28 are presented.

Table 9.1: Summary of key characteristics of relevant landscape character areas

Key characteristics of relevant landscape character areas		
Brentwood Borough Council		**London Borough of Havering**
F13 Great Warley Wooded Farmland	**F15 Weald Wooded Farmlands**	**Urban character of Havering**
• Strongly undulating wooded farmland/ wooded hills; • Extensive patches of woodland; • Small-scale field pattern with mature treed field boundaries; • Small-scale settlement pattern comprising small historic farmsteads and hamlets; • Narrow, quiet sinuous rural lanes; • Noise and movement associated with the M25 and A127 road corridors; and • Strong sense of place and orientation provided by views across Thames Chase to the west towards London and North Kent.	• Swathe of relatively open commons; • Wooded rolling hills and slopes; • Narrow, tree-lined roads; • Intricate network of woodland and grassland within Weald Country Park; and • Sense of tranquillity away from main road corridors.	• Raised landform of Maylands Golf Course to the west of Weald Brook; • Presence of sports club and Dagnam Park as well as Maylands Golf Course create recreational character of urban fringe; • Large woodland blocks are present between the M25 and residential edge of the London Borough of Havering; • Proximity of the M25 and the A12 results in noise intrusion; • The M25 creates natural boundary for the urban character of Havering. • Predominantly inter war semi-detached and terraced houses; and • Materials: red brick, pebbledash, white render to walls.

9.4.7 The above key landscape characteristics will be identified within the baseline section, and further refined to highlight the most relevant attributes of landscape character.

Landscape designations

9.4.8 There are no statutory designated landscapes within the study area that have the potential to be directly and indirectly affected by the Scheme. The Scheme will directly affect Alder Wood as the alignment cuts through a section of this Semi-Natural Woodland.

Visual receptors

9.4.9 Visual receptors are the people who live in or visit the landscape, and who will experience views of the Scheme.

9.4.10 The main receptors include some of the residential properties at the eastern edges of Romford (approximately 1.1 km from the centre of the junction) and receptors to the south of the junction along Brook Street/ A1023 that have restricted visibility.

9.4.11 With consideration given to the nature of the Scheme and with receptor sensitivity categorised as per DMRB IAN 135/ 10, most of the identified receptors will be of high sensitivity, that is to say:

- Residential properties;
- Users of Public Rights of Way or other recreational trails (e.g. National Trails, footpaths, bridleways etc.); and
- Users of recreational facilities where the purpose of that recreation is enjoyment of the countryside (e.g. Country Parks, National Trust or other access land etc.).

9.4.12 There are a number of woodlands adjacent to Junction 28 and along the road corridors that screen, either fully or partially, views of the junction. The views are additionally screened by the local variations of terrain, the road corridors of the M25 and A12, existing railway line, and by the overlapping network of hedgerows with trees.

9.5 Potential impacts

Landscape

9.5.1 An assessment of landscape effects deals with the effects of change and development on landscape resource. The key landscape effects expected as a result of the Scheme are loss of vegetation, alteration to the landform and field pattern, as well as the introduction of man-made features. It is expected that sections of Alder Wood will be lost to the Scheme. Considerable loss of trees is also expected along the on and off slip roads along the M25 and A12.

9.5.2 The area around the junction has undulating topography; therefore the introduction of on and off slip roads is likely to result in landform alteration as earthworks balancing cut and fill will be required. The field pattern will be altered between the Grove Farm and the Maylands Golf Course.

9.5.3 The Scheme would affect the existing levels of tranquillity in the local area. All these changes combined may potentially affect the local landscape character.

9.5.4 It is expected that the relatively small scale of the Scheme would not result in significant effects for landscape character at the national level. The effects on the local landscape character will be particularly focused around the Grove Farm, Alder Wood and Maylands Golf course due to woodland and footprint of the loop road. The full nature of effects will be considered in detail, including identified mitigation/ environmental design measures.

9.5.5 A baseline assessment will be undertaken through a desk study and site visit to determine the existing landscape and visual context, thereby allowing an understanding of the likely magnitude and change and resulting significance of impact on the landscape character and key visual receptors within the study area.

Visual

9.5.6 Visual effects will occur during both the construction and operational stage. During construction, effects are likely to occur as a result of the introduction of construction machinery, compounds and vegetation removal with the potential to

create new sightlines and views of the existing M25 Junction 28. The existing views will also be affected through the introduction of new elements of the Scheme.

9.5.7 The visual receptors will also be affected by views of heavy goods vehicle (HGVs) and other tall machinery used within the construction site. However, the potential effects of construction activities would be temporary, short term, and reversible.

9.5.8 It is expected that the greatest construction impact will occur in the area between Grove Farm and Maylands Golf Course, where the loop lane and the overbridge at the A12 eastbound exit road would be introduced. It is expected that widening of the existing road corridors and the introduction of on and off slip roads would be less visible due to a sequential progress of construction works.

9.5.9 The change in the views is likely to include:

- earthmoving operations;
- the formation of temporary spoil areas;
- road formation/ construction;
- creation of new earthworks; and
- proposed overbridges/structures.

9.5.10 The significance of effects will vary between receptors located around the junction. The operational effects will be long term and permanent, although it is expected that the proposed planting will mature gradually following the construction. The Scheme will provide an opportunity to introduce environmental design measures and/ or mitigation measures designed to help reduce adverse effects and provide landscape and visual enhancements where possible. This is expected to be particularly relevant in the area between Grove Farm and Maylands Golf Course, where the loop lane and the overbridge at the A12 eastbound exit road would be introduced.

9.6 Proposed level and scope of assessment

Detailed assessment

9.6.1 As potential significant effects associated with landscape and visual impacts of the Scheme are anticipated, a DMRB Detailed Assessment will be carried out.

9.6.2 As a result, further studies are required to assess the significance of effects on landscape and visual receptors. Further detailed desk and fieldwork studies will be undertaken to identify the character of the landscape, including its condition and value, and the nature and sensitivity of the visual receptors that may be affected by the project. The assessment of landscape and visual effects will take into consideration any mitigation/ environmental design measures to avoid, reduce or remedy the changes of the Scheme.

9.6.3 The assessment will be extended to explain any additional evaluation methodologies with differentiation of construction and operational stages. Winter photographs will also be provided to illustrate key viewpoints.

9.6.4 The nature of effects on each receptor will be assessed for both construction and operational phases of the Scheme. A night time assessment of effects will not be undertaken due to current levels of highways lighting.

9.6.5 The assessment will be accompanied by illustrative plans typically showing:

- Local Designations;
- Landscape character;
- Topography;
- Tranquillity;
- Zone of Visual Influence (ZVI) with colour coded height of Scheme elements;
- Viewpoint locations;
- Panoramic photographs (between 6-12);
- Representative Photographic Viewpoints (1:25,000); and
- Outline Landscape Design Plans including landscape and environmental mitigation measures (1:2,500).

Landscape scope

9.6.6 Table 9.2 below lists landscape receptors proposed for further assessment, based on the findings of the Option Selection stage report.

Table 9.2: Landscape resources scoped in and out of further assessment

Resources	Scoped in (✓) / out (✗)	Comments/Justification
Areas of vegetation including; semi mature and mature planting local to the highway corridors and Junction areas, off site woodland belts, and blocks and hedgerow and individual trees	✓	The Scheme is likely to result in loss of vegetation along the existing road corridors, and in addition sections of Alder Wood are likely to be lost.
Local landscape character features i.e. landform, landscape pattern	✓	These landscape features are likely to be affected by the Scheme as cuttings and earth mounds will be introduced, mainly along the loop lane for traffic travelling from the M25 to A12.
Alder Wood, The Grove – semi natural woodlands	✓	Landscape effects on Alder Wood require further assessment as the Scheme cuts through sections of these woodlands.
Landscape character areas, F13 Great Warley Wooded Farmland Landscape Character Area and F15 Weald Wooded Farmlands	✓	Effects on landscape character require further assessment. The effects on landscape character would take into consideration key attributes of landscape character areas and above listed effects on loss of vegetation, effects on landscape character
Landscape character at regional and national level	✓	Effects on landscape character require further assessment.

Resources	Scoped in (✓) / out (×)	Comments/Justification
Warley, St Faith's and Weald Country Park (located within (1000 m)	×	There will be no direct or indirect landscape effects on these Country Parks as the Scheme is too distant (both Warley and St Faith's are greater than 1000 m distance) and any potential links with the Parks are broken by the presence of the railway line, intervening vegetation, and built development.
Weald Park (Grade II) Registered Park and Garden (located within 1000 m)	×	There will be no direct or indirect effects primarily as there is a dense woodland that forms a buffer between the Scheme and Weald Park. Therefore, the attributes and qualities of this designation will not be affected.
Effects on Ancient & Semi-Natural Woodlands in landscape effects Lower Vicarage Wood, Vicarage Wood Duck Wood, Fir Wood	✓	Landscape effects on Lower Vicarage Wood require further assessment as the Scheme boundary is adjacent to the woodland.

Visual scope

9.6.7 Table 9.3 lists visual receptors scoped in and out of further assessment.

Table 9.3: Visual receptors scoped in and out of further assessment

Resources	Scoped in (✓) / out (×)	Comments/Justification
Users of the A12 dual carriageway to the west of Junction 28 (located within 500 m)	✓	It is expected that views of road users along the A12 are likely to change considerably during construction and operation.
Maylands Golf Course to the north west of Junction 28 (located within 500 m)	✓	The golf course is located in close proximity to the Scheme and as such, views of golf players will be affected in both construction and operational phases.
Residential receptors at Maylands Cottages and Harold Park to the west of Junction 28 (located within 500 m)	✓	The views from these receptors are likely to change as views from the edges of residential areas to the west are likely to include partial views of construction activities and introduced elements of highway infrastructure.
Users of Grove Farm immediately north west of Junction 28 (located within 50 m)	✓	Grove Farm will be surrounded by loop road and other new proposed elements of the Scheme.
Open access land including Tyler's Common to the south of Tyler's Hall Farm and open access land near Harold Court (located up to 1500 m)	✓	Tyler's Common is a large area of open access land and although it is located at considerable distance from the Scheme, the effects on views from the Common are carried forward for further assessment.

Resources	Scoped in (✓) / out (✗)	Comments/Justification
Residential receptors located along Dark Lane (located within 1500 m)	✓	There are some isolated houses located along elevated sections of Dark Lane that may have views of construction activities and operation of the Scheme.
Users of bridleway that follows Nags Head Lane and along the section of the bridleway section that follows the crest of the cutting along the existing M25, close to Dark Lane (located within 1500 m)	✓	Views of construction operations or the operation of the Scheme are likely to be available from sections of bridleway.
Putwell Bridge Farm and Oak Farm (located within 500 m)	✓	These residential receptors are located close to the Scheme, and are likely to sustain a change in view.
Employees within business parks (group receptor) adjacent to Brook Street near Junction 28 (located within 1500 m)	✓	These receptors are located close to the Scheme and are likely to have partial views of construction activities or newly introduced elements of the Scheme.
Residential receptors located on Brook Street near Junction 28, just to the west of Vicarage Close (located within 1500 m)	✓	These receptors are located close to the Scheme and may have views of construction activities or newly introduced elements of the Scheme.
Residential receptors in Brentwood (located within 1500 m)	✗	Scoped out as the Scheme is located at a distance which is unlikely to significantly affect views from these receptors.
Employees at Telecommunications Head Office and nearby residential properties in Brentwood (located within 2000 m)	✗	The views from these receptors are distant and the Scheme will not be visible from most locations however should the views be available these would be partial and would not give rise to significant effects.
Boyles Court, Grade II Listed building (located within 2000 m)	✗	Situated to the south east of the M25 Junction 28 is surrounded by a dense woodland that would block views towards the Scheme, therefore there will be no change to the baseline view.
Residential receptors to the north east including Lake House, Colmar Farm, Colmar, Park Farm and Halfway House (located within 1500 m)	✗	The views from these properties are blocked by intervening blocks of existing woodland Vicarage Wood, Lower Vicarage Wood and The Oaks.
Residential receptors located on Nag's Head Lane linking Brook Street area with Tyler's Common to the south of Junction 28 (located within 1000 m)	✗	The views from these receptors are blocked by garden vegetation, belt of trees and vegetation along the existing railway line.
Residential receptors to the north east of the M25 in South Weald situated along Wigley Bush Lane (located within 1000 m)	✗	The views blocked completely by Vicarage Wood and Lower Vicarage Wood as well as by wide belt of vegetation along the A12.

9.7 Proposed assessment methodology

9.7.1 The landscape and visual assessment will be carried out following published guidance including IAN 135/10 Landscape and Visual Effects Assessment and DMRB Volume 11, Section 2 Environmental Impact Assessment, but also with consideration of the Guidelines for Landscape and Visual Impact Assessment (GLVIA) 3rd edition, published by the Landscape Institute and Institute of Environmental Management and Assessment, 2013.

9.7.2 The assessment of significant effects for both landscape and visual effects will be based on a combination of magnitude with sensitivity using the assessment matrix included in the guidance IAN 135/10 Landscape and Visual Effects Assessment.

9.7.3 The Scheme will be assessed in the context of landscape and visual effects. The report will follow the format of a Detailed Assessment.

Value and sensitivity of landscape resources/ receptors

9.7.4 The sensitivity of landscape resources/ receptors combines judgements of their susceptibility to the type of change or development proposed with the value attached to the landscape (as per the GLVIA 3rd edition).

9.7.5 For the purposes of the assessment, and in accordance with the relevant guidance contained in IAN 135/10 the landscape sensitivity is divided into three categories: High, Moderate and Low.

Table 9.4: Landscape sensitivity and typical examples

Sensitivity	Typical descriptors and examples
High	Landscapes which by nature of their character would be unable to accommodate change of the type proposed. Typically, these would be; • Of high quality with distinctive elements and features making a positive contribution to character and sense of place; • Likely to be designated, but the aspects which underpin such value may also be present outside designated areas, especially at the local scale; • Areas of special recognised value through use, perception or historic and cultural associations; and • Likely to contain features and elements that are rare and could not be replaced.
Moderate	Landscapes which by nature of their character would be able to partly accommodate change of the type proposed. Typically, these would be; • Comprised of commonplace elements and features creating generally unremarkable character but with some sense of place. locally designated, or their value may be expressed through non-statutory local publications; • Containing some features of value through use, perception or historic and cultural associations; and • Likely to contain some features and elements that could not be replaced.
Low	Landscapes which by nature of their character would be able to

Sensitivity	Typical descriptors and examples
	accommodate change of the type proposed. Typically these would be; • Comprised of some features and elements that are discordant, derelict or in decline, resulting in indistinct character with little or no sense of place. • Not designated. • Containing few, if any, features of value through use, perception or historic and cultural associations. • Likely to contain few, if any, features and elements that could not be replaced.

Table Source: IAN 135/10, Annex 1, Table 2

Value and sensitivity of visual receptors

9.7.6 Visual receptors are the people who live in or visit the landscape, and who will experience views of the Scheme. The sensitivity of the visual receptors (people) combines judgements of their susceptibility to the type of change in views and visual amenity with the value attached to particular views (as per IAN 135/10 and GLVIA 3rd edition).

9.7.7 The following groups of people are considered to be visual receptors:

- Local communities (e.g. villages and settlements) and isolated residential properties - these receptors are generally considered to be High sensitivity; views of residents are particularly susceptible to changes in visual amenity;
- People engaged in the outdoor sport activity at playing fields or pitches, (e.g. Maylands Golf Course) - these receptors are generally considered to be Moderate sensitivity as views of people engaged in outdoor sports activities are usually focused on the sports activity which usually does not depend upon appreciation of views into adjacent landscape;
- Road users - these receptors are generally considered to be Low sensitivity as their views are focused mainly on the road corridor whilst views into adjacent landscape are usually transient and glimpsed; and
- People in their places of work - these receptors are generally considered to be Low sensitivity as they are orientated primarily on the work activities.

Magnitude and significance of effects

9.7.8 Landscape and visual impact significance will be determined by combining the sensitivity of the landscape and visual receptor, in conjunction with the magnitude of change. The magnitude of impact can be either adverse or beneficial.

9.7.9 The following tables describe the magnitude and significance categories and descriptors for landscape and visual receptors.

Table 9.5: Landscape - magnitude and nature of impact and typical descriptors

Magnitude of impact	Typical criteria descriptors
Major adverse	Total loss or large-scale damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic conspicuous features and elements.
Moderate adverse	Partial loss or noticeable damage to existing character or distinctive features and elements, and/or the addition of new but uncharacteristic noticeable features and elements.
Minor adverse	Slight loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
Negligible adverse	Barely noticeable loss or damage to existing character or features and elements, and/or the addition of new but uncharacteristic features and elements.
No change	No noticeable loss, damage or alteration to character or features or elements.
Negligible beneficial	Barely noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Minor beneficial	Slight improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic features and elements, or by the addition of new characteristic elements.
Moderate beneficial	Partial or noticeable improvement of character by the restoration of existing features and elements, and/or the removal of uncharacteristic and noticeable features and elements, or by the addition of new characteristic features.
Major beneficial	Large scale improvement of character by the restoration of features and elements, and/or the removal of uncharacteristic and conspicuous features and elements, or by the addition of new distinctive features.

Table Source: IAN 135/10, Annex 1, Table 1

Table 9.6: Landscape and Visual – significance of effects categories

Landscape Value (Sensitivity)	Magnitude of impact (degree of change)				
	Major	Moderate	Minor	Negligible	No change
High	Large or very large	Moderate or large	Slight or moderate	Slight	Neutral
Moderate	Moderate or large	Moderate	Slight	Neutral or slight	Neutral
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight	Neutral

Table Source: adapted from IAN 135/10, Annex 1, Table 3

Table 9.7: Landscape - typical descriptors of significance of effect categories

Significance category	Typical descriptors of effect
Very Large Beneficial (Positive) Effect	The project would: • Greatly enhance the character (including quality and value) of the landscape; • Create an iconic high-quality feature and/or series of elements; and • Enable a sense of place to be created or greatly enhanced.
Large Beneficial (Positive) Effect	The project would: • Enhance the character (including quality and value) of the landscape; • Enable the restoration of characteristic features and elements lost as a result of changes from inappropriate management or development; and • Enable a sense of place to be enhanced.
Moderate Beneficial (Positive) Effect	The project would: • Improve the character (including quality and value) of the landscape; • Enable the restoration of characteristic features and elements partially lost or diminished as a result of changes from inappropriate management or development; and • Enable a sense of place to be restored.
Slight Beneficial (Positive) Effect	The project would: • Complement the character (including quality and value) of the landscape; • Maintain or enhance characteristic features and elements; and • Enable some sense of place to be restored.
Neutral Effect	The project would: • Maintain the character (including quality and value) of the landscape; • Blend in with characteristic features and elements; and • Enable a sense of place to be retained.
Slight Adverse (Negative) Effect	The project would: • Not quite fit the character (including quality and value) of the landscape; • Be at variance with characteristic features and elements; and • Detract from a sense of place.
Moderate Adverse (Negative) Effect	The project would: • Conflict with the character (including quality and value) of the landscape; • Have an adverse impact on characteristic features or elements; and • Diminish a sense of place.
Large Adverse (Negative) Effect	The project would: • Be at considerable variance with the character (including quality and value) of the landscape;

Significance category	Typical descriptors of effect
	• Degrade or diminish the integrity of a range of characteristic features and elements; and • Damage a sense of place.
Very Large Adverse (Negative) Effect	The project would: • Be at complete variance with the character (including quality and value) of the landscape; • Cause the integrity of characteristic features and elements to be lost; and • Cause a sense of place to be lost.

Table Source: IAN 135/10, Annex 1, Table 4

Table 9.8: Visual – magnitude of impact and typical descriptors

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

Table Source: IAN 135/10, Annex 2, Table 2

Table 9.9: Typical descriptors of the significance of effect categories

Significance	Typical descriptors of effect
Very large beneficial	The project would create an iconic new feature that would greatly enhance the view
Large beneficial	The project would lead to a major improvement in a view from a highly sensitive receptor.
Moderate beneficial	The proposals would cause obvious improvement to a view from a moderately sensitive receptor, or perceptible improvement to a view from a more sensitive receptor.
Slight beneficial	The project would cause limited improvement to a view from a receptor of medium sensitivity, or would cause greater improvement to a view from a receptor of low sensitivity.
Neutral	No perceptible change in the view.
Slight adverse	The project would cause limited deterioration to a view from a receptor of medium sensitivity, or cause greater deterioration to a view from a receptor of low sensitivity.
Moderate adverse	The project would cause obvious deterioration to a view from a moderately sensitive receptor, or perceptible damage to a view from a more sensitive receptor.

Significance	Typical descriptors of effect
Large adverse	The project would cause major deterioration to a view from a highly sensitive receptor, and would constitute a major discordant element in the view.
Very large adverse	The project would cause the loss of views from a highly sensitive receptor, and would constitute a dominant discordant feature in the view.

Table Source: IAN 135/10, Annex 2, Table 4

9.8 Vulnerability to major accident and disasters

9.8.1 Major accidents and disasters comprise man-made and natural risks which are considered likely, and anticipated to result in substantial harm that the normal functioning of the Scheme is unable to cope with/ rectify – i.e. risks with the potential to have a significant effect.

9.8.2 Natural circumstances such as high winds and/ or species specific diseases (such as Ash Dieback) could have a direct, reductive effect on the future effectiveness of existing planting in screening the Scheme. Climate change could cause additional system stress on vegetation, making it vulnerable to windblow, flooding or disease. Assessment under this section would therefore consider storm events and the spread of plant diseases, and the potential consequences for the effects of the Scheme on landscape character and visual amenity.

9.8.3 Further assessment would be informed by other topics, as assessing the adverse effects of a major accident or disaster on landscape and visual amenity will require interaction with other sections of the formal ES.

9.8.4 No new baseline information will be required as part of the vulnerability assessment, and therefore no additional baseline surveys with respect to landscape and visual amenity will be undertaken.

9.9 Proposed consultation

9.9.1 Consultation with the appropriate stakeholders will be undertaken throughout the assessment process, this will ensure that the Scheme is designed with appropriate mitigation proposals that reflect the impacts and sensitivities of the respective receptors. 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 Brentwood Borough Council and London Borough of Havering.

9.10 Potential mitigation and monitoring measures

Potential mitigation measures

9.10.1 The assessment will consider the mitigation/environmental design mitigation measures proposed at the Option Selection stage, however these will be defined in detail and agreed with the client (Highways England) and consulted with the relevant consultees as required. Typically, these measures may include planting, formation of mounds, field pattern reinstatement and integration of the junction into the existing landscape.

Monitoring of significant adverse effects

9.10.2 Identified monitoring measures at the Option Selection stage will be reviewed to ensure that all relevant methods of reduction of effects in projects lifecycle have been considered and are relevant at this stage. As further information from additional surveys (e.g. arboricultural surveys) becomes available, the methods and techniques of monitoring will be more specific and detailed.

9.11 Assumptions and limitations

9.11.1 Assessment will be based on the professional judgement of a chartered Landscape Architect, and shall consider both the adverse and beneficial contributions that new developments can have upon the existing landscape character and the visual amenity of visual receptors.

9.11.2 Although distant views from outside of the study area may be possible, it is considered that any effects on these views are unlikely to be discernible given the distances involved (i.e. greater than 1.5 km). Where direct access to visual receptors is not possible, the likely magnitude of visual effect(s) on these receptors as a result of the Scheme will be based on professional judgement(s) made from the nearest publicly accessible location to the receptor.

9.11.3 The following limitations of the assessment are identified:

- The landscape and visual impact assessment will be based on a preliminary geometric layout of the highways and drainage design;
- Where direct access to visual receptors is not possible, the likely magnitude of visual effect(s) on these receptors will be based on professional judgements made from the nearest publicly accessible location to the receptor; and
- In the absence of detailed construction information being available at the time of the assessment, such as haul roads, construction compounds and storage, generic assumptions will be made about the construction process.

9.12 Conclusion

9.12.1 There is potential for significant impacts upon both the landscape character and visual amenity during the construction and operational phases as a result of the Scheme. Where potential issues have been identified, these have been scoped in for further assessment which will include, a detailed Landscape and Visual Assessment incorporating all aspects of the development.

9.12.2 Baseline assessment will be undertaken through a desk study and site visit to determine the existing landscape and visual context, thereby allowing an understanding of the likely magnitude and change and resulting significance of impact on the landscape character and key visual receptors within the study area.

9.12.3 Consideration of appropriate mitigation measures will also be incorporated within the assessment process.

9.12.4 Tables 9.2 and 9.3, above, respectively summarise the landscape and visual receptors that have been scoped in and out of the EIA.

10. Geology and Soils

10.1 Introduction

10.1.1 This chapter identifies the geology and soils study area and presents the baseline conditions therein. It identifies the potential impacts on geology and soils associated with the Scheme during construction and operation and presents the effects scoped in and out for further assessment. It also discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

10.1.2 Soils and geology, including their physical and chemical properties, are key factors contributing to the environmental character (landscape) and quality of a geographical area. They influence landforms, topography, vegetation type, biodiversity, agricultural potential and quality, flood risk, water storage capacity and mineral resource potential.

10.1.3 Highway construction can have significant effects on geology and soils and associated hydrogeology, hydrology and soil resources. Further, underlying geology and soils can be key constraints on scheme design, depending on their characteristics. Construction work also has the potential to mobilise pollutants from land contaminated by historical and/or recent activities or incidents.

10.1.4 This chapter summarises identified ground conditions, historical land uses and potential sources of contamination relevant to the scheme. Where applicable, geological designated sites, active and historical landfill sites and the quality of soils/agricultural land classification (ALC) within the study area have been identified. The chapter outlines where further assessment is required in order to ensure that the risks and effects associated with the geology and soils are fully understood and appropriately eliminated or mitigated where possible, and presents the proposed scope and methodology for the EIA.

10.2 Study area

10.2.1 The assessment of geology and soils will consider the study area, which includes a study area extending 250 m from the extent of the red line boundary for the Scheme (see section 2.4). A study area of 250 m was selected based on professional judgement and was deemed appropriate for a linear feature such as a highway and considering the full extent of the Scheme. Herein ‘on site’ refers to the extent of the Scheme within the red line boundary and off site refers to locations within the study area but not within the extent of the red line boundary.

10.3 Planning and policy context

10.3.1 Relevant legislation and guidance documents include:

- National Networks National Policy Statement (NN NPS), which sets out policy with regard to assessment of the historic environment effects of nationally significant transport infrastructure (DfT, 2014);
- The National Planning Policy Framework (NPPF), which states that local planning policies and decisions: should ensure that a site is suitable for its new use and should not be capable of being determined as Contaminated Land as defined under part 2A of the Environmental Protection Act (as

amended); and that they take into account the economic and other benefits of best and most versatile (BMV) agricultural land (DCLG, 2012);

- Technical Information Note 049 (TIN049), 'Agricultural Land Classification: protecting the best and most versatile agricultural land' which states that, for planning applications, specific consultations with Natural England are required under the Development Management Procedure Order in relation to BMV agricultural land (Natural England, 2012);
- Part 2A of the Environmental Protection Act (as amended), which provides a statutory regime for the identification and remediation of 'Contaminated Land' (UK Parliament, 1990);
- Contaminated Land Report 11 (CLR11), which provides primary guidance for assessing and managing land contamination and provides a technical framework for the identification and remediation of contamination through the application of a risk management process (Environment Agency, 2004);
- Guiding principles for land contamination (GPLC) which provides primary guidance for assessing and managing land contamination (Environment Agency, 2010);
- The Water Framework Directive (WFD), the purpose of the WFD is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater (European Parliament, 2000);
- The Water Resources Act (WRA) 1991 (as amended), which regulates water resources, water quality and pollution, and flood defence (UK Government, 1991) Chapter 57 Part III;
- Guidance for the Safe Development of Housing on Land Affected by Contamination (R&D66), which provides technical guidance on the identification and assessment of land contamination development and the process of managing such land contamination (National House-Building Council, 2008);
- Environment Agency's approach to groundwater protection, which contains position statements on groundwater Source Protection Zones (SPZs), areas identified as drinking water protected areas and aquifer designations (Environment Agency, 2017);
- River Basin Management Plan, which is designed to protect and improve the quality of the water environment (DEFRA, 2009);
- The London Borough of Havering Core Strategy and Development Control Policies (CSDCP), which contains core policies regarding minerals, green belt, and environmental management (London Borough of Havering, 2008); and
- Brentwood Borough Council Draft Local Plan, which sets out local policies regarding conservation and protection of the natural environment (Brentwood Borough Council, 2016).

10.4 Baseline conditions

Geology

10.4.1 The study area is located within the geological area known as the London Basin, with the north-east to south-west trending London Basin Syncline located 1-2 km south of the study area (BGS, 2017). BGS mapping does not indicate the presence of any faults within the study area although Royse et al. (2012) suggest that faulting is more extensive than shown on previous BGS data and maps (Royse, et al., 2012).

10.4.2 Localised superficial deposits of Alluvium and Head are expected within the Scheme extent (BGS, 2017a). Throughout the study area, the bedrock geology is anticipated to comprise London Clay Formation of the Thames Group (BGS, 2017a).

10.4.3 Made Ground is likely to be present within the study area, associated with the Brook Street Landfill to the north-west of the Junction 28 roundabout, infilled ponds and alterations to the alignment of Weald Brook and Ingrebourne River. It is also likely to be associated with the construction of the A12, M25, utilities infrastructure, London and North Eastern railway line, and buildings located immediately south of the Brook Street Landfill.

10.4.4 Made Ground, Alluvium and London Clay Formation have the potential to contain naturally occurring elevated concentrations of sulphates and sulphides; the London Clay Formation is one of the principal sulphate and sulphide bearing strata in England. Made Ground and Head Deposits may also contain elevated concentrations of sulphates and sulphides depending on the materials they have been derived from.

10.4.5 The Scheme is not located in an area affected by mining or quarrying (BGS, 2017b; BGS, 2017c).

10.4.6 There are no geological SSSIs or Local Geological Sites located within the study area (GeoEssex, 2014).

10.4.7 The potential for ground instability within the study area has been assessed as follows (Landmark, 2016):

- Compressible ground: moderate potential where Alluvium is anticipated, and very low where Made Ground is anticipated;
- Collapsible ground: very low across the site; however, the presence of Made Ground and the superficial deposits may present potential instability issues;
- Landslide risk: Very low across the majority of the study area and low within the vicinity of the M25 cutting to the north of Junction 28, the M25 anticlockwise off-slip and slopes adjacent to the A12 eastbound lane;
- Running sands: Very low where Made Ground or Head deposits are mapped, low where Alluvium is mapped; and
- Shrinking or swelling clay: Moderate potential across the site.

10.4.8 A review of HAGDMS database identified two geotechnical features within the scheme extents, both of which are categorised as Feature Class 1D ‘Minor defect’.

Hydrogeology

10.4.9 The Alluvium and Head Deposits are designated as a superficial Secondary A Aquifer and a superficial Secondary (undifferentiated) Aquifer, respectively (Environment Agency, 2017c). The London Clay Formation is designated as an Unproductive Stratum (Environment Agency, 2017c).

10.4.10 There are no groundwater abstractions or groundwater SPZ located within the study area.

10.4.11 The aquifer within the Alluvium is designated as a Minor Aquifer with High Groundwater Vulnerability. No other aquifers identified within the study area are designated as groundwater vulnerability zones (Environment Agency, 2017c).

Hydrology

10.4.12 The surface water features which have the greater potential to be impacted by the Scheme are those watercourses within the study area which cross the A12 and M25 carriageways: The Ingrebourne River and Weald Brook. Other surface water features are also present, including several land drains, four ponds west of the Junction 28 roundabout and six ponds north-east of the Junction 28 roundabout (Natural England, 2017). These surface water features could be impacted in the event that contaminated shallow groundwater migrates towards them. They could also be impacted by surface waste transport, such as runoff or flooding events

10.4.13 No surface water abstraction licences are recorded within the study area (Environment Agency, 2017c).

Agricultural soils

10.4.14 The published Ministry of Agriculture, Fisheries and Food (MAFF) 1:250,000 Provisional ALC Map, available on the government's MAGIC website shows that the area around Junction 28 is classified as Grade 3 (good to moderate quality) (Natural England, 2017).

10.4.15 It is possible that there are small pockets of lighter, better drained soils but these will be of small extent and would not affect the overall assessment of the area being of non- best and most versatile (BMV) quality.

Land Contamination

10.4.16 The main potential contamination source within the Scheme extent is associated with Brook Street Landfill, an historical inert landfill site. Limited data are publicly available on this landfill.

10.4.17 Made Ground is considered likely to be present in areas of existing development, i.e. along the M25 and A12 and within the area of the buildings to the north-west of the Junction 28 roundabout. The source of Made Ground that might have been used as fill material during construction is unknown; therefore, it has been considered that contamination may be encountered within these materials.

10.4.18 Both the Alluvium and the Brook Street Landfill, represent potential sources of ground gas. Further, asbestos containing material may also be present in Made Ground, particularly where soils are associated with areas where historical mapping indicates buildings have been demolished.

10.4.19 Three industrial land uses are recorded on site; a waste disposal site operating at the location of the Brook Street Landfill, a waste management facility and a vehicle service garage. Active and historical land uses within the study area include, filling stations, an electrical substation, a sewage treatment works, railway line, vehicle service and repair garages, farms and vehicle cleaning services.

10.4.20 Thirteen pollution incidents with impacts to controlled waters have been recorded within the study area, of which three occurred on site. Unrecorded spills or leaks of fuels, oils or chemicals associated with the operation and maintenance of the M25 and A12 also present potential contamination sources.

Unexploded Ordnance

10.4.21 There is a potential to encounter unexploded ordnance at the site.

10.5 Potential impacts

10.5.1 The environmental impacts are likely to be greatest during construction with reduced impacts likely during operation. Contamination risks identified during the ground investigation surveys will be assessed and where possible reduced during detailed design. The need for mitigation measures, should these be required, will be assessed during detailed design at PCF Stage 5.

10.5.2 There is potential that new sources of contamination may be introduced associated with the accidental loss/spillage of fuels and oils as well as the potential to disturb and mobilise existing sources of contamination.

10.5.3 There is also potential to exacerbate existing areas or to create new areas of ground instability and compressible ground as a result of ground disturbance during the works.

10.5.4 The Scheme will introduce additional receptors in the form of construction workers, future site workers and proposed foundations. It is understood that there will be no buildings constructed as part of the scheme, however there may be confined spaces, such as man holes and service chambers / ducts, within which ground gas has the potential to accumulate.

10.5.5 There is a risk that new piling or excavation during construction could create new pathways between any contaminated soils and any underlying groundwater.

10.5.6 Additionally, any dewatering activities associated with the construction phase or the proposed diversion of Weald Brook have potential to mobilise further contamination.

10.6 Proposed level and scope of assessment

10.6.1 Ground Investigation (GI) information is currently limited for the scheme and the assessment of potential impacts associated with the Scheme to date has been qualitative.

10.6.2 A GI is required to characterise ground conditions, inform the Scheme design and determine appropriate mitigation measures. A GI specification has been drafted which informs the design and appropriate mitigation measures. At this stage, it is envisaged that the GI will:

- target areas of identified potential contamination sources;

- provide an assessment of geological boundaries, thickness of strata and geotechnical testing to provide geotechnical parameters for design;
- characterise the groundwater regime within the study area;
- sample identified surface water receptors to derive site specific environmental quality standards;
- determine the extent and nature of fill materials (Made Ground); and
- determine the aggressivity of the ground towards buried concrete.

10.6.3 The ES will review the soils and geology issues at baseline, albeit based on desk based information only in the absence of GI data and identify potential impacts which construction and operation of the scheme could bring about to the existing ground conditions and in turn, impact upon identified receptors. The assessment will in accordance with the (archived) EIA: Guide to Good Practice (DCLG, 2006).

10.6.4 Note that no mineral resources, geological sites of special scientific interest (SSSIs) or local geological sites (LGS) have been identified within the study area. Thus, this topic does not require further consideration.

10.6.5 The government good practice guides to EIA 29 (DCLG, 2006) also specifies that the effects associated with re-use of soils and waste soils is considered within soils and geology. However, Chapter 12 Materials and Waste considers these effects and therefore this is not covered in this section.

10.6.6 Specifically, the following topics have therefore been considered:

- Direct impacts on geology as a valuable resource; i.e. mineral resource sterilisation, damage or loss of special protection areas (SPA) or revealing new geological exposures of scientific interest;
- Direct impacts on groundwater as a valuable resource, such as the prevention of aquifer recharge or contamination of groundwater which is currently abstracted for potable supplies or act as baseflow for rivers;
- Direct impacts on agricultural soils as a valuable resource, including loss of Best and Most Versatile (BMV) agricultural land (excluding woodland) and deterioration of soil quality;
- Effects associated with pre-existing soil and groundwater contamination; i.e. mobilising contamination, introducing new or changing existing contamination migration pathways, or changing the types of contamination receptors;
- Effects associated with the potential for polluting substances used during the construction or operational phases, to cause new ground contamination issues on site – for example introducing / changing the source of contamination;
- Physical effects such as changes in topography, ground collapse, soil erosion compressible ground, aggressive ground and ground stability.
- The expected significant effects arising from the vulnerability of the proposed development to major accidents or disasters relevant to the Scheme.

10.7 Proposed assessment methodology

10.7.1 The assessment of the potential impacts of the scheme on soils and geology will be undertaken over two stages and in consultation with the Environment Agency:

- Stage 1 – land Contamination Risk Assessment; and
- Stage 2 – Impact Assessment.

Stage 1 – Land Contamination Risk Assessment

10.7.2 The approach adopted for the land contamination risk assessment is based on guidance document CLR11 (Environment Agency, 2004) and the (archived) EIA Guide to Good Practice (Department for Communities and Local Government, 2006). These documents are considered as key guidance in the United Kingdom and provide a technical framework for the application of a risk management process through the following steps:

- Develop a Preliminary Conceptual Site Model (PCSM): A desk study of available documentary information will be undertaken to develop the PCSM, which describes the linkages between potential contamination hazards / sources, pathways and receptors relevant to the site. Where all three are present, or considered likely to be present, they are described as potential contaminant linkages (PCLs) which can then be subject to the risk assessment process;
- Gather site specific information: limited previous GI has been undertaken at the site of the proposed development. The available information will be used to assess the potential for existing contamination. Once these data have been reviewed, recommendations for further GI will be made if required;
- Risk Assessment: Generic quantitative risk assessments (GQRAs) for human health and groundwater receptors to inform a judgement as to whether the concentrations of contaminants in soil, soil leachate and groundwater represent a potential risk to identified receptors. GQRAs will be carried out through the comparison of the GI results to appropriate generic assessment criteria (GAC). GAC are concentrations of a contaminant in soil or groundwater, below which the level of risk is considered acceptable. Using the information from the GI and the GQRA, the PCSM will be updated to include an assessment of the level of risk associated with each PCL identified during the baseline, construction and operational phases. Where risks are identified, consideration will be given as to whether these would be appropriately mitigated through design and / or the development of a remediation strategy and its subsequent validation, as necessary. The residual risks will be determined and assessed based on estimation of likelihood and consequence; and
- The risk assessment applies the principles given in the National House Building Council (NHBC, 2008) and Environment Agency report R&D66 (NHBC, 2008), which provides guidance on the development and application of the consequence and probability matrix (as presented in Table 10.1) for contaminated land risk assessment.

Table 10.1: Land Quality Estimation of the Level of Risk

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

10.7.3 Based on R&D66 (NHBC, 2008), the descriptions of the classified risks are as follows:

- Very high risk: There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the site without remediation action OR there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to the site owner / or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term;
- High risk: Harm is likely to arise to a designated receptor from an identified hazard at the site without remediation action. Realisation of the risk is likely to present a substantial liability to the site owner/or occupier. Investigation is required as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term;
- Moderate risk: It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner/occupier. Some remediation works may be required in the longer term;
- Low risk: It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the site owner/or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited;
- Very low risk: It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor; and
- No potential risk: There is no potential risk if no pollution linkage has been established.

Stage 2 – Impact Assessment

10.7.4 The approach to the impact assessment will entail undertaking land contamination risk assessments for each of the following:

- Baseline stage: Development of a CSM for the site based on its current sources, pathways and receptors and an assessment of the current land contamination risks;
- Construction stage: Development of the predicted CSM and risk assessment for the construction phase, addressing the potential for new sources of contamination to be introduced to the site and the change in pathways and receptors; and
- Operational stage: The predicted CSM for the developed site, reflecting the final site conditions including the status of contamination sources and the changes in pathways and receptors.

10.7.5 The impact assessment requires comparison of the baseline risk assessments with the construction phase and the operational phase risk assessments. This approach enables changes in the contaminated land status during the construction and operational phases to be identified, an assessment of the effects of the scheme to be made and appropriate mitigation measures to be specified. The changes in contamination status are described as either beneficial or adverse and consideration is made of whether they are major, moderate, minor or negligible, on the basis of the area over which the effect may occur, duration (short, medium or long term) and whether the effect is permanent or temporary.

10.7.6 In addition to these criteria, an assessment will be made as to the value and / or sensitivity of each of the receptors (provided in Table 10.2). The value of a receptor is considered when determining consequence of an effect in the risk assessment. The classification of the magnitude of effects is based on the criteria defined in Table 10.3, whilst the classification of significance of effects has been based on the criteria as defined in Table 10.4.

Table 10.2: Criteria for classifying the value and / or sensitivity of environmental resources/receptors

Value / Sensitivity	Criteria	Examples
High	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a very low capacity to accommodate the proposed change.	Principal Aquifer providing potable water to a large population, within an inner or outer groundwater source protection zone (Source Protection Zone (SPZ) 1 or SPZ 2). WFD high status water body (surface water) providing potable water to a small population. Sensitive human health receptors, e.g. young children. Buildings, including services and foundations but of high historic value or other sensitivity e.g. Statutory designations, schools, residential dwellings. Ecological statutory designations with high sensitivity e.g. SSSI, LNR, SPA, RAMSAR etc.

Value / Sensitivity	Criteria	Examples
Medium	Attribute possesses key characteristics which contribute significantly to the distinctiveness, rarity and character of the site/receptor. Attribute has a low capacity to accommodate the proposed change.	Principal Aquifer beyond a SPZ, or secondary aquifer. Secondary aquifer providing abstraction water for agricultural or industrial use. WFD good status water body (surface water). Buildings, including services and foundations.
Low	Attribute only possesses characteristics which are locally significant. Attribute has some tolerance to accommodate the proposed change.	Unproductive strata or Secondary aquifer without abstraction. WFD moderate - poor status (surface water). Infrastructure (roads, bridges, railways). Non-statutory designated sites of regional importance that are not highly sensitive to damage from coastal change.

Table 10.3: Classification of magnitude of effect

Classification of magnitude	Criteria
High	Total loss of major alterations to one of more of the key elements, features or characteristics of the baseline. The post-development situation will be fundamentally different.
Medium	Partial loss or alteration to one of more of the key elements or characteristics of the baseline. The post-development situation will be partially changed.
Low	Minor loss or alteration to one or more of the key elements, features or characteristics of the baseline. Post-development, the change will be discernible but the underlying situation will remain similar to the baseline.
Negligible	Very minor loss or alteration to one of more of the key elements, features or characteristics of the baseline, such that post-development, the change will be barely discernible, approximating to the “no change” situation.

Table 10.4: Classification of significance of effects

Classification of significance	Effect
Major adverse effect	An increase in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very low contamination risk in the baseline becomes a high or very high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined as Contaminated Land under Part 2A of the Environmental Protection Act 1990.
Moderate adverse effect	An increase in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate or high risk. Land that does not meet the statutory definition of Contaminated Land in the existing baseline becomes capable of being determined as

Classification of significance	Effect
	Contaminated Land under Part 2A of the Environmental Protection Act 1990.
Minor adverse effect	An increase in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a low contamination risk in the baseline becomes a moderate/low risk.
Negligible	Negligible change in contamination risks.
Minor beneficial	A reduction in contamination risk from the existing baseline conditions of one risk level in the risk matrix, e.g. land that has a moderate/low contamination risk in the baseline becomes a low risk.
Moderate beneficial	A reduction in contamination risk from the existing baseline conditions of two or three risk levels in the risk matrix, e.g. land that has a high contamination risk in the baseline becomes a moderate/low or low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined as contaminated Land under Part 2A of the Environmental Protection Act 1990.
Major beneficial	A reduction in contamination risk from the existing baseline conditions of four or five risk levels in the risk matrix, e.g. land that has a very high contamination risk in the baseline becomes a low or very low risk. Land that meets the statutory definition of Contaminated Land in the existing baseline is no longer capable of being determined as contaminated Land under Part 2A of the Environmental Protection Act 1990.

10.7.7 Following the classification of an effect, as detailed in Table 10.3 and Table 10.4, a clear statement will be made as to whether the effect is ‘significant’ or ‘not significant’. As a general rule, major and moderate effects are considered to be significant and minor and negligible effects are considered to be not significant. However, professional judgement is also applied, where appropriate.

10.7.8 The assessment will consider the effects of the proposed construction and operational phases on the following receptors:

- Potential human health and property receptors associated with:
  - nearby residential properties, commercial/industrial premises, nearby workers including industrial, agricultural and commercial premises.
  - property receptors include historical features, underground services, foundations, utilities; and
  - construction workers and future site workers.
- Potential controlled waters receptors include:
  - Secondary A Aquifer and Secondary (undifferentiated) Aquifer associated with the Superficial Deposits and the Head Deposits respectively within the study area; and
  - surface water, the Ingrebourne River and Weald Brook.

Agricultural soils assessment methodology

10.7.9 The assessment of agricultural soils follows the approach of the DMRB Environmental Assessment (DMRB, 2001). This identifies six main areas that need to be covered in any assessment of effects on agricultural land. These are agricultural land quality, designated agricultural areas, land take, type of husbandry, severance and major accommodation works for access, water supply and drainage.

10.7.10 Atkins has completed no fieldwork for agricultural soils at this stage and soils and the presence of BMV land are assessed using data from a published soil map.

10.7.11 The significance criteria address both magnitude of impact and sensitivity of the resource and consideration of the characteristics of the impact and the receptor, namely.

- Type of impact - direct or indirect;
- Nature of impact – beneficial, adverse or neutral;
- Duration of impact - short or long term, reversible or not; and
- Frequency of impact - continuous or intermittent, changing with time or constant.

10.7.12 There is no nationally recognised set of criteria for assessing the impact of infrastructure Schemes on loss of BMV land and so a bespoke system has been developed to reflect the issues significant to this project.

10.7.13 All Scheme effects are considered adverse and are assessed on a scale of very large, large, moderate and slight.

10.8 Vulnerability to major accident and disasters

10.8.1 Major accidents and disasters which have the potential to adversely affect human health, property and controlled waters receptors include both man-made and naturally occurring events which may occur during either construction or operation.

10.8.2 It is considered that the proposed level and scope of assessment detailed in Section 10.6 will be sufficient to assess baseline ground conditions within the study area and no additional baseline surveys will be undertaken as part of the vulnerability assessment.

10.8.3 Mitigation with respect to soils and geology will rely on appropriate design and construction and also operational protocols and security measures put in place for the Scheme (Section 10.10).

10.8.4 Assessment of potential impacts under this section will therefore consider the potential for release of contamination, soil erosion or ground collapse/settlement as a result of major accidents and disasters. 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.

10.9 Proposed consultation

10.9.1 Proposed consultations with the relevant statutory authorities (notably the Environment Agency, local authorities and, where appropriate, Natural England)

are planned. Each relevant body will be consulted separately to discuss specific information, issues and concerns as appropriate in relation to soils and geology.

10.9.2 In addition, 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.

10.10 Potential mitigation measures

10.10.1 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, include (but are not limited to):

- Health and safety risk assessments, method statements and appropriate Personal Protective Equipment (PPE) for the protection of construction workers in accordance with the Control of Substances Hazardous to Health regulations (HSE, 2013);
- Implementation of appropriate dust suppression measures to prevent migration of potential contaminated dust;
- 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 (now withdrawn) Pollution Prevention Guideline: Working at Construction and Demolition Sites (Environment Agency, 2016);
- Implementation of appropriate pollution incident control e.g. plant drip trays and spill kits;
- Implementation of appropriate and safe storage of fuel, oils and equipment during construction;
- If unexpected contamination is encountered during construction, further assessment followed by appropriate mitigation will be required. Following assessment further mitigation measures may be required;
- Land occupied or disturbed during the construction process, that is not permanently acquired for engineering and landscaping, should be restored to a condition equivalent to its original;
- If spoil is to be spread on land intended for farming, addition of topsoil will be undertaken and the land will need an aftercare period of at least five years to rectify settlement and compaction;
- The quality and quantity of soil on site should be maintained by implementing appropriate techniques for stripping, stockpiling and reinstatement. Disturbed soils should be reinstated to their original quality using a Soil Handling and Management Strategy; and
- Mitigation measures relating to buried ordnance and munitions, including a detailed desk study and recommendations from a UXO specialist.

10.10.2 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 post-construction will minimise the generation of dust, direct contact and ingestion pathways and minimise infiltration. If soil contamination is identified, laying of a clean capping layer and importation of suitable clean soil may be required in areas of proposed soft landscaping. With regard to contamination, 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.

10.10.3 It is assumed the scheme will be operated in accordance with the relevant regulations and guidance for good practice in applying Best Available Techniques and pollution prevention.

10.10.4 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 Chapter 8.5: Road Drainage and the Water Environment.

10.11 Assumptions and limitations

10.11.1 Based on information available to date, assessment of baseline conditions within the study area has been largely qualitative, with only limited ground investigation data to assess ground conditions on site.

10.11.2 A phase of ground investigation is to be undertaken to inform the design and to confirm the appropriate mitigation measures. The ground investigation is currently being procured. Again, given the timescales associated with the procurement process and the scale of the ground investigation which is expected to take several months to complete with a subsequent monitoring programme, laboratory analysis, and assessments and reporting, it is currently envisaged that the works and subsequent reporting will not be included within the ES and DCO submission. In light of this, the associated assessments and reporting will subsequently be made available during the examination stage of the DCO process. In the absence of ground investigation data, the ES will be based on a qualitative assessment of desk based information only. The assessment will in accordance with the (archived) EIA: Guide to Good Practice (DCLG, 2006).

10.11.3 It is currently assumed that the red line boundary for the Scheme includes the likely locations of any enabling works, such as construction compounds, haul roads and engineering features such as attenuation ponds and false cuttings. Further assessment may be required following detailed design should amendments to the red line boundary be necessary.

10.12 Conclusion

10.12.1 Further assessment of geology and soils with respect to the Scheme is required and a phase of ground investigation is to be undertaken to inform the design and to confirm the appropriate mitigation measures. Topics that are scoped into the ES are those that can potentially impact the geology and soils at the Scheme and require further consideration. A summary of the topics and potential issues to be scoped into the ES and those scoped out of further assessment is presented in Table 10.5.

Table 10.5: Geology and soils topics scoped in and out of further assessment

Topic	Scoped in (✓) / out (✗)	Comments/Justification
Geology as a valuable resource	✗	No mineral resources, geological SSSIs or LGS have been identified within the study area.
Soils and agricultural land	✓	Soils around Junction 28 are designated as Grade 3, it is possible that there are small pockets of BMV quality land in the area therefore further assessment is required.
Land contamination including human health, groundwater and surface water	✓	Potential impacts to human health, groundwater and surface water have been identified. Further assessment will be carried out including, but not limited to, production of a CSM and a ground investigation will be completed to ensure these are appropriately understood and mitigated.
Construction and operational phase pollution effects	✓	The development has the potential to introduce new sources of contamination associated with the accidental loss/spillage of fuels and oils.
Physical effects	✓	Physical effects including ground instability and topography will be assessed.
Re-use of soils and waste soils	✗	Addressed in the waste section.

11. Cultural Heritage

11.1 Introduction

11.1.1 This chapter identifies the cultural heritage study area and presents the known historic environment resource therein. It identifies the potential impacts on cultural heritage assets associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

11.1.2 The chapter presents the proposed scope and methodology for the EIA. The cultural heritage assessment identifies the likely potential effects on cultural heritage due to the Scheme during construction and operation and present the effects scoped in and out for further assessment.

11.1.3 The historic environment baseline outlined in this chapter has been informed using data accessible via Historic England's National Heritage List for England (NHLE) (NHLE, 2017) and searches of the Historic Environment Records (HER) of Essex Historic Environment Record (EHER) (Heritage Gateway, 2017) and Greater London Historic Environment Record (GLHER) in September 2017, as the Site and Study Area fall within both administrative areas.

11.1.4 A site visit was undertaken on 1 August 2017. A detailed account of this shall not be presented here, but, where appropriate, heritage assets or the potential of archaeological remains may be discussed in context of the site visit and its preliminary findings.

11.1.5 Furthermore, no additional consultation with Historic England, the Greater London Archaeology Advisory Service (GLAAS) or the Essex County Council's Historic Environment Officer have been undertaken as part of this Scoping Report. Consultation will be required as part of the ES.

11.2 Study area

11.2.1 A 500 m Study Area surrounding the Site construction boundary has been applied for the purpose of this report and can be seen on Figures F-1 and F-2 in Appendix F. This distance was established by professional judgement and relevant guidance, in particular guidance recommended by the DMRB, Volume 11, Section 3, Part 2 HA 208/07 Cultural Heritage.

11.3 Planning and policy context

11.3.1 The following guidance and policies are applicable to this proposed development:

- National Networks National Policy Statement (NN NPS) (DfT, 2014);
- National Planning Policy Framework (NPPF), in particular Section 12 which deals with 'Conserving and Enhancing the Historic Environment';
- Associated NPPF Practice Guidance;
- Brentwood Borough Council, Brentwood Replacement Local Plan (BBC, 2005);
- London Borough of Havering Local Development Framework; and

- London Plan.

National Planning Policy Framework

11.3.2 The National Planning Policy Framework (NPPF) (DCLG 2012) sets out 12 Core Planning Principles of which the conservation of historic environment is one. One of the NPPF's core principles is that "planning should conserve heritage assets in a manner appropriate to their significance, so that they can be enjoyed for their contribution to the quality of life of this and future generations" (DCLG 2012, Para 17).

11.3.3 The DCLG published Planning Practice Guidance online in 2014, to expand upon the NPPF. '18a: Conserving and Enhancing the Historic Environment' was published in April 2014. The Guidance notes that "conservation is an active process of maintenance and managing change. It requires a flexible and thoughtful approach to get the best out of assets as diverse as listed buildings to as yet undiscovered, undesignated buried remains of archaeological interest".

11.3.4 The NPPF and the PPG identifies two categories of non-designated sites of archaeological interest:

- "Those that are demonstrably of equivalent significance to scheduled monuments and are therefore considered subject to the same policies as those for designated heritage assets" (PPG citing National Planning Policy Framework Paragraph 139); and
- "Other non-designated heritage assets of archaeological interest. By comparison this is a much larger category of lesser heritage significance, although still subject to the conservation objective. On occasion. the understanding of a site may change following assessment and evaluation prior to a planning decision and move it from this category to the first" (PPG).

National Policy Statement for National Networks

11.3.5 In addition to the overarching regulatory and policy framework discussed above, the impacts and effects of the Scheme have been reviewed in light of relevant historic environment legislation and policy.

11.3.6 Policy with regard to assessment of the historic environment effects of nationally significant transport infrastructure is set out in the National Policy Statement for National Networks (NPSNN).

11.3.7 Historic Environment Policy is set out in paragraphs 5.120 to 5.142 of the NPSNN. The key aspects which should be addressed are as follows:

- The significance, setting and viability of the heritage assets likely to be affected by the proposed development should be considered;
- When considering the impact of a proposed development on the significance of a designated heritage asset great weight should be given to the asset's conservation. The more important the asset, the greater the weight should be; and
- Harm or loss affecting any designated heritage asset should require clear and convincing justification - substantial harm to or loss of a grade II Listed building or grade II Registered Park or Garden should be exceptional;

substantial harm to or loss of designated assets of the highest significance should be wholly exceptional.

11.3.8 There is no definition of what constitutes 'substantial harm' in the NPSNN or other published policy documents. However, guidance in National Planning Policy Guidance (NPPG), supporting policy advice and case law indicates that whilst clearly a step down from total loss, substantial harm still represents a considerable degree of change to the significance of an asset. This could, for example, be as the result of removal of significant elements of fabric or the degradation/removal of key aspects of an asset's setting that notably contribute to its significance.

11.3.9 When considering the consequences of substantial harm there is a strong presumption against development.

11.3.10 NPSNN embodies an underlying principle of balancing harm and benefit which places greater weight on the conservation of more important assets. Where less than substantial harm would occur, there is a need to ensure that harm is justified and minimised and that the wider public benefits of the proposed are appropriately articulated.

Brentwood Borough Council Local Plan

11.3.11 The relevant local policies are found in the Brentwood Replacement Local Plan and Saved Policies (2008). Policies C8 'Ancient Landscapes and Special Landscape Areas' and C9 'Ancient Landscapes and Historic Parks and Gardens' regard historic landscapes, parks and gardens and states "The Council will seek to conserve, enhance and manage ancient landscapes and designated parks and gardens of special historic interest. Development which would damage the character or appearance of an ancient landscape, or of a park or garden of special historic interest or its setting will not be permitted".

11.3.12 Policy C14 'Development Affecting Conservation Areas', regulate that "When considering applications for development within and in the vicinity of conservation areas, special attention will be given to the need to preserve or enhance their character or appearance. Development proposals will be permitted only where the council is satisfied that:

(i) the proposals preserve or enhance the townscape character of the area
(ii) the materials to be used are sympathetic to the surrounding buildings and appropriate to the area
(iii) the mass of the building is in scale and harmony with the adjoining buildings and the area as a whole
(iv) the design of the building is such that the proportions of the parts relate satisfactorily to each other and to adjoining buildings
(v) the proposal does not affect any buildings, open spaces, trees, views or other aspects which contribute to the special character of the area
(vi) where demolition is proposed, the structure to be demolished makes no material contribution to the character or appearance of the area, and there are satisfactory proposals for the re-use of the site including any replacement building or other structure
(vii) where a change of use is proposed, the new use will not require any changes in the appearance or setting of the building other than those which will preserve or

(viii) enhance its contribution towards the character or appearance of the area
(ix) where an alteration is proposed, it is appropriate and sympathetic in design, scale, materials and colour to the rest of the building.

Outline planning permission will not be given for new buildings in a conservation area.

11.3.13 Policy C16 'Development within the Vicinity of a Listed Building' notes that "Proposals for development in the vicinity of a listed building will not be permitted where the proposals would be likely to detract from its character or setting."

11.3.14 Policy C18 'Ancient Monuments and Archaeological Sites' concerns impacts to archaeological sites and states "*Where important archaeological sites and monuments, whether scheduled or not, and their settings are affected by a proposed development, there will be a presumption in favour of their preservation in situ. In situations where there are grounds for believing that the proposed development would affect important archaeological sites and monuments, developers will be required to arrange for an archaeological field assessment to be carried out before the application can be determined thus enabling an informed and reasonable planning decision to be made. In circumstances where preservation is not possible or feasible, then development will not be permitted until satisfactory provision has been made for a programme of archaeological investigation and recording prior to the commencement of the development.*"

London Borough of Havering Local Development Framework

DC67 - Buildings of Heritage Interest

11.3.15 Planning permission involving Listed Buildings or their setting will only be allowed where:

- it does not involve the demolition of a Listed Building; and
- it does not adversely affect a Listed Building or its setting.

11.3.16 A change of use which is contrary to other Development Control policies may be considered more favourably if it is necessary in the interests of conserving a Listed Building.

11.3.17 When dealing with planning applications the Council will also take into account the contribution that other buildings of historical and/or architectural interest make to heritage.

DC70 - Archaeology and Ancient Monuments

11.3.18 The Council will ensure that the archaeological significance of sites is taken into account when making planning decisions and will take appropriate measures to safeguard that interest. Planning permission will only be granted where satisfactory provision is made in appropriate cases for preservation and recording of archaeological remains in situ or through excavation. Where nationally important archaeological remains exist there will be a presumption in favour of their physical preservation. Particular care will need to be taken when dealing with applications in archaeological 'hotspots' where there is a greater likelihood of finding remains.

11.3.19 Planning permission will not be granted for development which adversely affects the three Ancient Monuments in the Borough or their settings.

London Plan

Policy 7.8 Heritage assets and archaeology:

Strategic

11.3.20 London's heritage assets and historic environment, including listed buildings, registered historic parks and gardens and other natural and historic landscapes, conservation areas, World Heritage Sites, registered battlefields, scheduled monuments, archaeological remains and memorials should be identified, so that the desirability of sustaining and enhancing their significance and of utilising their positive role in place shaping can be taken into account.

11.3.21 Development should incorporate measures that identify, record, interpret, protect and, where appropriate, present the site's archaeology.

Planning decisions

11.3.22 Development should identify, value, conserve, restore, re-use and incorporate heritage assets, where appropriate.

11.3.23 Development affecting heritage assets and their settings should conserve their significance, by being sympathetic to their form, scale, materials and architectural detail.

11.3.24 New development should make provision for the protection of archaeological resources, landscapes and significant memorials. The physical assets should, where possible, be made available to the public on-site. Where the archaeological asset or memorial cannot be preserved or managed on-site, provision must be made for the investigation, understanding, recording, dissemination and archiving of that asset.

LDF preparation

11.3.25 Boroughs should, in LDF policies, seek to maintain and enhance the contribution of built, landscaped and buried heritage to London's environmental quality, cultural identity and economy as part of managing London's ability to accommodate change and regeneration.

11.3.26 Boroughs, in consultation with English Heritage, Natural England and other relevant statutory organisations, should include appropriate policies in their LDFs for identifying, protecting, enhancing and improving access to the historic environment and heritage assets and their settings where appropriate, and to archaeological assets, memorials and historic and natural landscape character within their area.

11.4 Baseline conditions

11.4.1 This chapter has been informed by the Option Selection stage Road Investment Strategy M25 Junction 28 Improvements Scoping Report produced by Atkins for Highways England in March 2017, and the Road Investment Strategy M25 Junction 28 Improvements Environmental Assessment Report produced in May 2017.

11.4.2 The following section provides an overview of the existing historic environment resource present within the Site and Study Area including designated and non-designated assets. The Site refers to the extent of the proposed construction working area, whereas the Study Area incorporates a wider surround (500 m corridor) to help characterise and thereby anticipate the potential for additional as yet unknown heritage assets within the Site. The Study Area also assists with identifying potential setting impacts to assets outside of the Site. Heritage assets are associated with a unique ID and these are provided in the gazetteer of heritage assets (see Appendix F). Designated assets are referred to by their NHLE entry numbers, whilst non-designated assets are referred to by their EHER or GLHER numbers (prefixed with either “MEX” or “MLO” respectively).

11.4.3 Designated and non-designated heritage assets are also presented in Figures F-1 and F-2 in Appendix F.

11.4.4 The following heritage designations and assets have been considered as part of this assessment:

- World Heritage Sites;
- Scheduled Monuments;
- Listed Buildings;
- Registered Parks and Gardens;
- Conservation Areas;
- Registered Battlefield;
- Buildings and structures of historic interest (not listed);
- Known archaeological sites and areas of archaeological potential; and
- Findspots.

11.4.5 There are no World Heritage Sites, Scheduled Monuments or Registered Battlefields within the Site or Study Area.

Listed Buildings

11.4.6 There are eight Listed Buildings within the Study Area. The majority of these are Grade II listed, with the exception of 2 Grade II* buildings off Brook Street [1279743, 1197231]. Five are located on or off Brook Street within the eastern extent of the Study Area [1279743, 1197231, 1297259, 1205707 and 1197190]. Two are situated on the outskirts of the southern part of the Study Area, east of Nags Head Lane [1079905 and 1183938]. The remaining building, Stony Hill Farm [1297215], can be found south-west of Great Warley, north of Warley Road. Glimpses of the M25 can be seen from Stony Hills Farm [1297215] as the landscape slopes towards the motorway. Existing tree lines bordering field boundaries already provide screening, however, any potential setting impacts should be assessed in the next stages of the EIA process. As none of the remaining Listed Buildings share intervisibility to and from the Scheme, and as such do not contribute to the setting or significance of the asset, it is not anticipated that there will be a requirement for further, detailed assessment of Listed Buildings in the next stages of the EIA process.

Registered Parks and Gardens

11.4.7 Grade II Weald Park [1000747] Registered Park and Garden is present within the north-eastern boundary of the Study Area. It is a late 17th and early 18th century park and woodland sited on an earlier 12th century medieval deer park. The site visit in August has shown that partial, distant views to a small portion of the southern boundary of the park can be glimpsed from a short section of the existing M25 motorway, north of Junction 28. However, the location of the Scheme on the westbound side of the motorway, and the gently sloping topography from the motorway to Weald Brook, would result in very restricted visibility to and from the scheme to the asset. As such, while it is thought that this is not a significant impact on the Registered Park and Garden, further assessment will be undertaken as part of the supporting desk-based assessment for the EIA.

Conservation Areas

11.4.8 Two Conservation Areas associated with the historic town core of South Weald and Weald Park are present within the north-eastern extent of the Study Area. The Weald Park Conservation Area follows the same boundaries as the Grade II listed Weald Park Registered Park and Garden, and therefore, although no significant impacts are anticipated, further assessment will be undertaken as part of a desk-based assessment to inform the EIA.

11.4.9 Similarly, although the South Weald Conservation Area lies adjacent to the Weald Park Conservation Area on Wigley Bush Lane and has no direct views to and from the Scheme, it will be included as part of a desk-based assessment to inform the EIA.

Non-designated heritage assets

11.4.10 The HER searches identified 19 non-designated heritage assets within the Site and Study Area. One of these is a building, three are findspots, and the remainder are monuments.

11.4.11 A Roman Road [MEX2262/MLO106812] is present along Colchester Road/Brook Street and the site of a Roman building [MLO23390] has been recorded east of Nag's Head Lane at Tyler Hill Farm.

11.4.12 In general, the non-designated assets primarily consist of medieval and post-medieval features such as those associated with South Weald historic settlement [MEX1032780] sited within the historic core of South Weald Conservation Area, a medieval hospital [MEX2254] and a moat [MEX2256], both located off Brook Street, and other buildings of medieval origin [MLO15564], either sited west of Nag's Head Sewage Works or within Maylands Golf Course, including The Golden Fleece [MEX40795] on Brook Street. An early medieval settlement [MLO12476] has also been recorded east of Nag's Head Lane north of Tylers Common.

11.4.13 Post-medieval assets include a brick chamber [MEX40800] and a boundary post [MEX1035292].

11.4.14 The findspots consist of a Roman finger ring [MEX2346], pottery and flint of unknown date [MEX1036570] and a small collection of post medieval pottery [MEX1036565].

11.4.15 Based on the potential for geoarchaeological deposits associated with the brook, further detailed assessment will be included as part of the supporting desk-based assessment to inform the EIA.

Other archaeological assets

11.4.16 There are four Archaeological Priority Areas (APAs) within the Site and Study Area west of the M25. APA DLO33196 has potential for important prehistoric deposits, which may survive beneath alluvial deposits associated with Weald Brook. A further two areas containing potential for survival of prehistoric deposits lie east of Nag's Head Lane [DLO33197] and south of Dagnam Park [DLO33198]. The remaining APA is associated with the Roman Road [MLO106812/MEX2262] on Colchester Road [DLO33238].

11.4.17 Based on the known heritage resource, there is a prevalence of Roman to post-medieval remains within the area with a strong emphasis on the medieval period. In general, the EHER records are located east of the M25 and the GLHER records are located west of the motorway and both datasets present strong evidence of Roman to post-medieval activity. Based on the presence of APA DLO33196, there is also potential for geoarchaeological and early prehistoric remains to be present within the Site.

11.4.18 A desk-based assessment [ELO14836] carried out by Cotswold Archaeology in 2014 on Maylands Golf Course covers part of the western extent of the Site. The assessment identified potential for prehistoric and palaeoenvironmental remains to survive within alluvial deposits along the eastern boundary of the golf course. However, to date no such evidence is recorded on the GLHER.

11.4.19 A wider detailed assessment of archaeological potential will form part of the desk-based assessment to inform the EIA for the Scheme.

Historic Landscape

11.4.20 The EHER records 10 separate Historic Landscape Character (HLC) Broad Group Names, represented by 73 individual parcels, within the Site and Study Area. There are as follows:

- 19th-20th century plantation;
- Ancient woodland;
- Built up areas;
- Informal medieval parkland;
- Later enclosure (18th century or later);
- Motorways;
- Post 1950 boundary loss;
- Post 1950's enclosure;
- Pre 18th century 'irregular' enclosure; and
- Water reservoir.

11.4.21 In comparison, the GLHER records five HLC areas. These are divided into open countryside, residential and industry.

11.4.22 As the Scheme is to improve an existing junction that has already had a significant visual impact on the historic character of the area and will reflect the existing character of the highway, no additional adverse effects are anticipated. As such no further assessment of the effects from this scheme on these assets is recommended.

11.5 Potential impacts

11.5.1 Following the DMRB methodology, potential impacts on the cultural heritage resource are defined as changes to the resource caused by the mitigated Scheme. The type of impacts that can occur include:

- Direct physical impacts, such as truncation or removal of a heritage asset; and
- Settings impacts which include changes to visual appreciation of assets such as alteration of lines of sights, air and noise pollution.

11.5.2 As part of this Scoping Report, significant effects have been broadly considered in terms of construction and operation effects.

Construction

11.5.3 The construction of the proposed route is not likely to result in permanent significant effects on designated heritage assets. However, it will have an adverse effect on known non-designated heritage assets and any unknown buried archaeological remains surviving within the Site construction footprint.

11.5.4 The known heritage assets that could be directly impacted by the scheme are presented in Table 11.1.

Table 11.1: Known heritage assets potentially directly impacted by the Scheme

HER Reference	Description	Impact
GLHER MLO106812/ EHER MEX2262	Roman road	Permanent physical impact
EHER MEX1049359	Five ditches found during previous M25 works	Permanent physical impact
GLHER MLO104464	Post-medieval park at Dagnam	Temporary setting impact

11.5.5 There is also the potential to effect as yet undiscovered archaeological and palaeoenvironmental remains where construction will have an impact on the Weald Brook and Maylands Golf Course.

Operation

11.5.6 The operation of the proposed route is not likely to result in permanent significant effects on designated heritage assets. However, it will have an adverse effect on known non-designated heritage assets and any unknown buried archaeological remains surviving within the Site construction footprint.

11.5.7 The known heritage assets referred to in the baseline that will be impacted by the Scheme are outlined in Table 11.2.

Table 11.2: Known heritage assets referred to in the baseline that will be impacted by the Scheme

HER Reference	Description	Impact
GLHER MLO104464	Post-medieval park at Dagnam	Permanent setting impact

11.5.8 The operation of the proposed route is not likely to result in permanent significant effects on designated heritage assets or any other non-designated heritage assets not listed above.

11.6 Proposed level and scope of assessment

11.6.1 Based on this assessment and in line with DMRB Volume 11, Section 1, Part 1 HA 200/08 Aims and Objectives of Environmental Assessment; DMRB HA204/08 and IAN 125/15, it is considered that a detailed assessment of potential impacts on cultural heritage should form part of the EIA. This should assess impacts within a 500 m study area surrounding the Site. Table 11.3 contains a summary of what is scoped in and out for the cultural heritage resource.

Table 11.3: Cultural heritage topics scoped in and out of further assessment

Effects	Scoped in (✓) / out (✗)	Comments/Justification
Designated heritage asset	✓	Assessment of the potential effects on designated assets due to physical changes or changes to setting.
Non-designated heritage assets	✓	Assessment of the potential effects on non-designated assets due to physical changes or changes to setting.
Potential for undiscovered archaeology	✓	Assessment of the potential for effects on previously undiscovered archaeological remains due to the Scheme. Emphasis should be placed on the potential of geoarchaeological and/or prehistoric remains at Weald Brook.
Historic landscape	✗	Significant effects on the historic landscape character of the wider area are not anticipated due to the localised changes to an existing road corridor and junction.

11.7 Proposed assessment methodology

11.7.1 The assessment criteria and the likely impact of the Scheme on individual heritage assets will be determined through the identification of the value of the heritage asset and assessing the scale of impact the route would have on the significance of the asset. This is in line with the guidance provided in the Design Manual for Roads and Bridges (DMRB) which can be found in Volume 11, HA 208/07, Annex 5.

11.7.2 Following such guidelines, this provides a score ranging from Very High, High, Medium, to Low or Negligible in terms of heritage value. Table 11.4 sets out the

criteria for assessing the value of heritage assets, as identified in the DMRB Volume 11, Section 3, Part 2 HA 208/07 Cultural Heritage.

Table 11.4: Value of heritage assets

Value	Description	Example
Very High	Internationally important or significant heritage assets.	World Heritage Sites, or buildings recognised as being of international importance.
High	Nationally important heritage assets generally recognised through designation as being of exceptional interest and value.	Grade I and II* Listed Buildings, Grade I and II* Registered Parks and Gardens, Scheduled Monuments, Protected Wreck Sites, Registered Historic Battlefields, Conservation Areas with notable concentrations of heritage assets and undesignated assets of national or international importance.
Medium	Nationally or regionally important heritage assets recognised as being of special interest, generally designated.	Grade II Listed Buildings, Grade II Registered Parks and Gardens, Conservation Areas and undesignated assets of regional or national importance, including archaeological remains, which relate to regional research objectives or can provide important information relating to particular historic events or trends that are of importance to the region.
Low	Assets that are of interest at a local level primarily for the contribution to the local historic environment.	Undesignated heritage assets such as locally listed buildings, undesignated archaeological sites, undesignated historic parks and gardens etc. Can also include degraded designated assets that no longer warrant designation.
Negligible	Elements of the historic environment which are of insufficient significance to merit consideration in planning decisions and hence be classed as heritage assets.	Undesignated features with very limited or no historic interest. Can also include highly degraded designated assets that no longer warrant designation.
Unknown	The importance of an asset has not been ascertained.	

11.7.3 The assessment criteria and the likely impact of the proposed development on each individual heritage asset will be determined through the identification of value of the heritage asset and assessing the scale of impact the proposed development would have on the significance of the asset. This is in line with the mechanism reflected in the Design Manual for Roads and Bridges (DMRB), Volume 11, HA 208/07, Annex 5.

11.7.4 Table 11.5 identifies the criteria for establishing the magnitude of impacts on heritage assets.

Table 11.5: Magnitude of impact

Magnitude of Impact	Description of Nature of Change
Major Adverse	Substantial harm to, or loss of an asset's significance as a result of changes to its physical form or setting. For example, this would include demolition, removal of physical attributes critical to an asset, loss of all archaeological interest or the transformation of an asset's setting in a way that fundamentally compromises its ability to be understood or appreciated. The scale of change would be such that it could result in a designated asset being undesignated or having its level of designation lowered.
Moderate Adverse	Less than substantial harm to an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical alterations that remove or alter some elements of significance, but do not substantially alter the overall significance of the asset; notable alterations to the setting of an asset that affect our appreciation of it and its significance; or the unrecorded loss of archaeological interest.
Minor Adverse	Limited harm to an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical changes that alter some elements of significance but do not noticeably alter the overall significance of the asset; and small-scale alterations to the setting of an asset that hardly affect its significance.
Negligible	Very minor changes to setting or form of the asset.
No Change/ Neutral	No appreciable change to an asset's significance.
Minor Beneficial	Limited improvement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical changes that reveal or conserve some elements of significance but do not noticeably alter the overall significance of the asset; or small-scale alterations to the setting of an asset that improve our ability to appreciate it.
Moderate Beneficial	Notable enhancement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: physical alterations that conserve or restore elements of significance; notable alterations to the setting of an asset that improve our appreciation of it and its significance; or changes in use that help safeguard an asset.
Major Beneficial	Substantial enhancement of an asset's significance as a result of changes to its physical form or setting. For example, this could include: major changes that conserve or restore elements of high significance; alterations to the setting of an asset that very substantially improve our appreciation of it and its significance; or changes in use that safeguard an asset, e.g. by taking it off the At Risk Register.

11.7.5 Table 11.6 shows how the significance of effect is determined. This combines the value of the heritage asset and the scale of change (impact) to provide the measure of effect.

Table 11.6: Significance of effects

Sensitivity of receptor	Magnitude of impact				
	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

11.8 Vulnerability to major accident and disasters

11.8.1 There is potential for man-made major accidents to affect the scheme, and thus potentially result in harm to the historic environment resource. Major accident events largely include, but are not restricted to, major road traffic accidents. Other man-made risk may include chemical spillages which could directly affect above ground archaeological remains by damaging their fabric or buried archaeology remains by altering their condition and state of preservation. Due to the nature of archaeological remains within the Study Area, and their distance to the Scheme, the harm as a result of such accidents is considered to be low at this stage.

11.8.2 Disasters, which for the purpose of this section are deemed to be 'natural' disasters, e.g. major flooding events, are possible within the Study Areas, and therefore have the potential to pose harm to the Scheme and its historic environment resource. Flooding events, high winds, storm events or extreme drought would be considered to have a direct impact on the Scheme, as these could contribute to the partial or full erosion of archaeological remains, or substantially alter the conditions surrounding it, thus affecting their level of preservation.

11.8.3 A more detailed assessment of major accidents and disasters shall be considered in more detail in the following stages in the EIA process. No additional baseline data is required as part of such an assessment.

11.9 Proposed consultation

11.9.1 It is recommended that Essex County Council's Heritage Conservation Team and the Greater London Archaeology Advisory Service (GLAAS) are consulted to inform further detailed assessment, especially with regard to understanding potential and likely significance and risk to as yet undiscovered archaeological remains.

11.9.2 Historic England will be consulted regarding the Scheme's impacts to designated heritage assets, including registered parks & gardens, listed buildings, and scheduled monuments.

11.10 Potential mitigation measures

11.10.1 The impact of physical damage to or removal of known and unknown archaeological remains may be mitigated through investigations designed to take into account the nature of the impacts, as well as the character of the archaeological asset. Such investigations may include a programme of strip, map and record, area excavation, and/or watching briefs during construction activities, following an evaluation programme of geophysical survey and trial trenching. Additional mitigation measures may be identified during detailed design and consultation activities.

11.10.2 Due to the potential for geoarchaeological remains, it is also recommended that a watching brief be placed on all geotechnical work within the Study Area, and a geoarchaeological assessment be undertaken of the subsequent borehole records.

11.10.3 Setting impacts can be mitigated through sympathetic design, such as through planting of trees to provide screening from the scheme.

11.11 Assumptions and limitations

11.11.1 For the purposes of scoping, the following assumptions have been made:

- Any additional heritage assets identified through an update of HER data will be of local to regional importance, thus having a low to negligible value, per the methodology described above;
- Following development of red line boundary, at the southern extent of Scheme, additional baseline data will be obtained for the PEIR from GLHER and EHER. As these changes are restricted to the existing road cutting it is not felt that the absence of this data will alter the scope at this stage;
- Any previously unidentified archaeological remains identified through consultations and/or surveys completed for the EIA will be of local or regional importance, and have a low to negligible value, per the methodology described above; and
- Any construction compounds, soil storage, flood alleviation, habitat mitigation or other auxiliary works necessary for the completion of the Scheme will be restricted to within the study area and will avoid heritage assets of medium to very high value and would have at most a neutral to negligible adverse impact.

11.11.2 Limitations to the EIA scoping include the following:

- The construction compound locations, as well as areas for soil storage, ecological mitigation and water management, have not yet been confirmed. These auxiliary works have the potential to have both direct and indirect impacts on heritage assets.

11.12 Conclusion

11.12.1 The Scoping Report has shown that further detailed assessment is required and where potential issues have been identified these have been scoped in as part of the following EIA stages, in particular relating to known non-designated heritage assets and the potential of buried unknown archaeological remains. An area of

geoarchaeological and/or prehistoric potential has also been identified for further assessment.

11.12.2 Consultations with GLAAS and EHCT should be undertaken as part of the EIA stage to inform understanding of heritage risks and appropriate assessment and field investigations. Following statutory consultation and EIA, a full understanding of the impacts to cultural heritage can be determined and a programme of mitigation developed for agreement with consultees.

12. Materials and Waste

12.1 Introduction

12.1.1 This chapter identifies the study area for materials and waste, and presents the baseline conditions therein. It identifies the potential materials and waste impacts associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

12.1.2 The chapter presents the proposed scope and methodology for the EIA. The materials and waste assessment identifies the likely potential effects due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

12.2 Study area

12.2.1 For material resources and waste, the study area extends outside of the Scheme area. For material resources, the study area includes the demand for key construction materials nationally. For waste, the study area includes the waste arisings and waste infrastructure capacity within the county of Essex (with the exception of hazardous waste which is considered at a national level). It is acknowledged that both Greater London and Thurrock are situated within the vicinity of the Scheme, however as there is typically a net importation of waste into Essex from Greater London and smaller waste authorities that border Greater London, only waste infrastructure within Essex has been considered.

12.3 Planning and policy context

European Directives

12.3.1 All European directives applicable to the Scheme have been transposed into national legislation. However, a number of legislative proposals on waste have been adopted as part of the Circular Economy Package (as supported by the Circular Action Plan), which focuses on “closing the loop of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy”. Regarding the Scheme, the relevant legislative proposals include:

- Proposed directive on waste;
- Proposed directive on packaging waste;
- Proposed directive on landfill; and
- Proposed directive on electrical and electronic waste, on end-of-life vehicles, and batteries and accumulators and waste batteries and accumulators.

National legislation and policy

12.3.2 It should be noted that The National Planning Policy Framework does not contain specific waste policies and so it is not included in the section below. Section 12.3 summarises the Waste Management Plan for England (2013) which it is considered as most relevant to the Scheme.

Environmental Protection Act 1990 (c. 43)

12.3.3 The Environmental Protection Act 1990 (c. 43) as amended in 1996 and 1999 implements integrated pollution control for the disposal of waste to air, land and water, including solid waste disposal.

12.3.4 As part of this, under Section 34, the Act imposes Duty of Care on anyone who produces, imports, keeps, stores, transports, treats or disposes of waste.

12.3.5 This will mean that Highways England and all contractors must take all reasonably practical steps to ensure that:

12.3.6 Waste is consigned only to a registered waste carrier, licensed waste contractor, local authority waste collector or person dealing with waste in ways that are exempt from licensing;

- Waste that is disposed of is accompanied by a detailed written description of the waste to ensure its safe handling, treatment and disposal (waste transfer notes are to be kept for a minimum of two years and hazardous waste consignment notes are to be kept for a minimum of three years);
- Waste is securely contained to prevent it escaping to the environment;
- Appropriate measures are taken to ensure that others involved in the handling and disposal of waste do so in accordance with the all applicable Regulations;
- Copies of registration certificates should be obtained for all waste contractors and waste carriers used as part of the Scheme and it should be ensured that they are on the Environment Agency's 'Public Register of Waste Carriers, Brokers and Dealers'; and
- Checks should be made on the final destination of each waste, ensuring that each waste disposal facility is licensed to accept the waste. Duty of Care audits of carriers and waste disposal facilities are advisable.

12.3.7 The generation of waste from the Scheme shall be managed in accordance with all applicable legislation and policy and in accordance with good practice.

Clean Neighbourhoods and Environment Act 2005 (c. 16)

12.3.8 Chapter 16 of the Clean Neighbourhoods and Environment Act 2005 (c. 16) prescribes the correct transportation, collection, disposal and management of waste and prohibits fly tipping.

Waste (England and Wales) Regulations 2011 (SI 2011/988)

12.3.9 The Regulations 2011 (SI 2011/988), as amended in 2012 (SI 2012/1889) and in 2014 (SI 2014/656), transpose the Revised EU Waste Framework Directive (2008/98/EC) into English law and require organisations to manage waste in alignment with the waste hierarchy (see Figure 12.1), in order to prevent waste going to landfill.

12.3.10 Waste management contractors working on the Scheme will be required to provide evidence that the waste hierarchy has been applied. This evidence can be in the form of waste transfer notes and hazardous waste consignment notes, which themselves must be kept for two and three years, respectively.

The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005/894)

12.3.11 The Regulations, as amended in 2009 (SI 2009/507), 2015 (SI 2015/1360) and 2016 (SI 2016/336) applies to all wastes listed as hazardous in the European Waste Catalogue (2000/532/EC) and the CLP (Classification, Labelling and Packaging) Regulation (EC 1272/2008). Hazardous waste will be produced throughout all lifecycle stages of the Scheme. Hazardous waste should be disposed of in accordance with the Regulations. including a hazardous waste consignment note.

Waste Electrical and Electronic Equipment (WEEE) Regulations 2013 (SI 2013/3113)

12.3.12 The Regulations revoke the previous WEEE Regulations (2006 (SI 2006/3289), 2007 (SI 2007/3454), 2009 (SI 2009/2957) and 2010 (SI 2010/1155)) and have a key objective to reduce the amount of WEEE that goes to landfill. This is to be achieved by making producers responsible for the collection, treatment and recovery of WEEE, including the associated costs.

12.3.13 For the Scheme being considered, all WEEE produced in the CD&E and operational phases must be segregated and managed separately from other wastes, with relevant paperwork provided as described above.

The Waste Batteries and Accumulators Regulations 2009 (SI 2009/890)

12.3.14 The Regulations, as amended in 2015 (SI 2015/1935), main requirements are that producers of batteries and accumulators must either take back waste batteries and accumulators, or fund the collection and recycling of them. The 2015 amendment removed several additional requirements, inclusive of the provision of operational plans and independent audit reports.

12.3.15 For the Scheme being considered, all batteries produced in the CD&E and operational phases must be segregated and managed separately from other wastes.

The CLP (Classification, Labelling and Packaging) Regulation (EC 1272/2008)

12.3.16 The CLP Regulation (within the UK and EU) was introduced in a staggered manner between 1999 and 2015. It should be noted that within the UK and EU, the CLP Regulation, has replaced the Dangerous Substances Directive (67/548/EEC) and the Dangerous Preparations Directive (1999/45/EC). To summarise, the Regulation provides guidance on the application of the CLP criteria for hazards (physical, health and environmental). With specific reference to the Scheme, the Regulation should be used to support the classification of both waste and materials. All waste should be classified by a six-digit code, which must be recorded on all waste transfer notes and hazardous waste consignment notes for the movement of waste from the CD&E and operational phases of the Scheme.

Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) Regulations 2000 (SI 2000/1043)

12.3.17 The Regulations, as amended in 2000 (SI 2000/3359), require the safe disposal or decontamination of all equipment that contains polychlorinated biphenyls (PCBs). Contaminated equipment containing over 5 litres or more of PCB

substance or mixture is also covered by the Regulations. PCBs are often present in areas of historical industrial use.

The Environmental Permitting (England and Wales) Regulations 2016 (SI 2016/1154)

12.3.18 The Environmental Permitting Regulations 2016 (SI 2016/1154) replace the 2010 Regulations (SI 2010/675) (as amended in 2011 (SI 2011/2043), 2012 (SI 2012/630) and 2014 (SI 2014/255)). The Regulations put in place requirements to ensure that sites that produce certain materials and undertake certain activities (such as the storage, use or treatment of waste) have a permit or exemption from the regulator (i.e. the Environment Agency).

12.3.19 Permit or exemption details of all sites that manage waste from the Scheme will be checked to ensure waste is being managed legally.

Environmental Damage (Prevention and Remediation) Regulations 2009 (SI 2009/153)

12.3.20 The Regulations, as amended in 2010 (SI 2010/587), introduce obligations to ensure the polluter pays for any environmental damage caused. The Regulations are applicable to all economic activities and therefore cover businesses. The Regulations require caution to be taken when managing sites in order to prevent damage to water, land and biodiversity. Such damage could be caused by poor waste management practices and as such the generation of waste from the Scheme must be managed in accordance with all applicable legislation and policies and in accordance with good practice.

The Control of Asbestos Regulations 2012 (SI 2012/632)

12.3.21 The Regulations require notification to the appropriate authority of all notifiable asbestos works (as specified in the Regulations), the medical surveillance (from April 2015) and health records for employers dealing with asbestos, the provision of the correct equipment and training for working with asbestos; and the documentation of the method, storage and disposal of asbestos waste. Any waste containing asbestos (e.g. insulation or lagging) must be stored and disposed of, in suitable packaging to prevent fibre release, in line with the Regulations. All asbestos must be removed by a licensed contractor who has undergone the appropriate training for the removal of asbestos and must wear the appropriate Personal Protective Equipment (PPE). Written records must be kept of the workers and the likely level of exposure. The asbestos must only be disposed of at an appropriately permitted disposal site.

12.3.22 These regulations will be adhered to during the construction of the Scheme in order to minimise harm to human health due to asbestos exposure.

Waste Management Plan for England 2013

12.3.23 DEFRA drew on issues from the previous Waste Strategy for England (WS2000), the Waste Strategy for England (WS2007), European Directives and Legislation to create the Waste Management Plan for England 2013. The Plan continues to focus on the importance of driving waste management up the waste hierarchy and states the importance of considering the Government's ambition of achieving a zero waste economy. The Plan puts a strong emphasis on waste prevention through making products using fewer natural resources. The targets outlined in

WS2007 remain relevant, including the target to recover 70% of construction and demolition waste by 2020. This target shall be considered a minimum requirement the Scheme.

National Planning Policy for Waste 2014

12.3.24 The National Planning Policy for Waste is the formal replacement for Planning Policy Statement 10 (PPS10). It follows the principles set out in PPS10, which states that waste should be managed in line with the principles of the waste hierarchy. It is important to ensure that, where possible, waste production is minimised to reduce environmental impacts and to ensure an assessment is made of the local waste infrastructure type and capacities, to include, but not be limited to, an assessment of the local policies.

Waste Planning Practice Guidance 2015

12.3.25 The Planning Practice Guidance website details how to adhere to the National Planning Policy for Waste 2014. The guidance should be followed in order to satisfy the local planning authority that impacts introduced by a proposed development on the existing waste management facilities are acceptable and do not prejudice the implementation of the waste hierarchy (see Figure 12.1).

National Policy Statement for National Networks 2014

12.3.26 The National Policy Statement outlines of the importance of managing resources and wastes in order to prevent and minimise environmental impacts. The resource and waste management measures outlined in the 'Waste Management' chapter 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), the correct management of waste both on-site and off-site and ensuring the appropriate waste infrastructure for waste treatment and disposal.

Regional policy

12.3.27 The Scheme sits within a development area covered by the Essex County Council & Southend-On-Sea Borough Council Waste Local Plan (2017) and the London Plan (2016). The overarching purpose of the Waste Local Plan is to ensure both Essex and Southend-On-Sea have good provision to deal with waste arisings which prevents/ reduces damage to the environment and provide the best possible quality of life.

12.3.28 It is important to note the Essex and Southend-on-Sea Waste Local Plan (2017) was adopted by Essex County Council on the 11th July 2017 (it is due to be adopted by Southend-on-Sea on the 19th October 2017). However, the Local Plan had not yet been amended to account for the independent examination comments. Once amended and fully adopted by both Council's the Local Plan will cover the period until 2032.

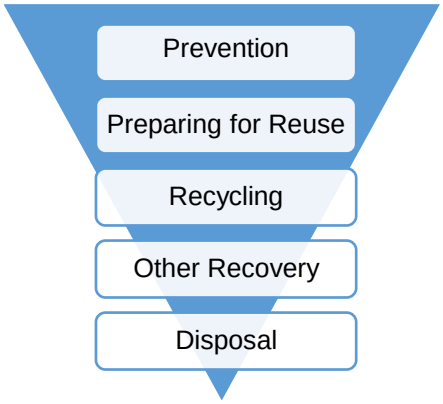
12.4 Baseline conditions

12.4.1 The scoping report has been written in accordance with IAN 153/11 (2011), titled 'Guidance on the Environmental Assessment of Material Resources'. IAN 153/11 (2011) provides guidance on the identification and assessment of impacts

associated with the use of material resources and waste arisings for construction and improvement schemes.

12.4.2 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, shown below in Figure 12.1.

Figure 12.1: Waste hierarchy



12.4.3 Desk based information will/ has been gathered from the sources listed in Chapter 18: References, in order to identify the existing baselines that may be impacted by the use of material resources and the generation of waste from the Scheme.

12.4.4 With regards to material resources associated with construction, demolition and excavation (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 to assess at a high-level, the impact of the Scheme on the national baseline.

12.4.5 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 baseline for all CD&E waste, with the exception of hazardous waste, has been collated relating to the amount of waste that is produced/ is estimated to be produced and the infrastructure capacity at a regional level.

12.4.6 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 east of England which has been transferred to the north west of the country). Therefore, the baseline has been collated from data relating to the amount of hazardous CD&E waste that is produced/ is estimated to be produced and the infrastructure capacity at a national level. Both the baselines 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 to assess the impact of the Scheme.

12.4.7 Less impact is envisaged during the operational stage of the Scheme due to minimal material resource 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 resource use and waste generated by highway Schemes is not readily available and as such will not be assessed as part of the EIA.

12.4.8 The baseline for materials resources and waste are presented below.

Materials resources baseline

12.4.9 The national demand (baseline) will be estimated for the key construction materials associated with the development. Both the key construction materials and the national demand are shown below in Table 12.1. The national baseline has been sourced from data published by the Mineral Products Association, UK Steel and the Forestry Commission.

12.4.10 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.

Table 12.1: National Material Resources Baseline

Construction Material	National Baseline
	Tonnes per Annum (tpa)
Aggregate	• 225,000,000
Asphalt	• 24,000,000
Cement	• 13,000,000
Concrete*	• 81,000,000
Steel	• 10,448,200
Timber**	• 3,225,920

*Sum of concrete and other concrete related products.
**Converted from cubic meters (9,488,000 m^3) using a conversion rate of 1 m^3 to 0.34 tonnes.

Waste baseline

12.4.11 The amount of CD&E and hazardous waste arisings for Essex will fluctuate year on year based on the number, type and size of construction projects underway. This in turn is heavily influenced by factors such as the economic situation, investment levels and legislative and policy variations. The Essex County Council & Southend-On-Sea Borough Council Waste Local Plan (2017), provides the most recent figures for the regional CD&E waste arisings for Essex, as shown in Table 12.2.

12.4.12 The national baseline for hazardous waste arisings is taken from the Environment Agency Hazardous Waste Integrator Tool (2015) 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 projects underway.

Table 12.2: Waste Arisings Baseline

Waste Stream	Tonnes per Annum (tpa)
CD&E (regional)	• 3,620,000
Hazardous (national)	• 368,700

Waste infrastructure baseline

12.4.13 The regional CD&E waste infrastructure capacity, interpreted from the Essex County Council & Southend-On-Sea Borough Council Waste Local Plan (2017) is presented in Table 12.3.

12.4.14 The national hazardous waste infrastructure capacity, interpreted from the Environment Agency list of permitted facilities (2015), is presented in Table 12.3.

Table 12.3: Waste infrastructure baseline

Waste Stream	Tonnes per Annum (tpa)
CD&E	• 7,256,556
Hazardous	• 9,271,631**

*Total of transfer, non-inert materials recovery, inert materials recovery, energy recovery and disposal (landfill (excluding hazardous)). Landfill was estimated from the total of 17.9 million tonnes of capacity available over the period 2016 – 2032 (sixteen-year period).
**Hazardous landfill capacity has been interpreted from the stated total landfill capacity on the EA permitted list (available on request). The total landfill capacity is considered to be reflective of the tonnes per annum capacity based on a review of hazardous landfill permits which showed that the stated total capacity on the EA list to be below the permitted annual capacities.

12.5 Potential impacts

12.5.1 Potential impacts are related to the potential impacts on the existing baseline (see Section 12.4).

12.5.2 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 12.1;
- 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 12.2; 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 12.3.

12.5.3 As aforementioned, less impact is envisaged during the operational stage of the Scheme.

12.6 Proposed level and scope of assessment

12.6.1 A Detailed Assessment, as defined in IAN 153/11, is considered necessary to assess the impacts of material resources and waste arisings from the Scheme.

12.6.2 For the purposes of the assessment, material resources are defined as per the IAN 153/11 as *"the materials and construction products required for the construction, improvement and maintenance of the trunk road network. Material resources include primary raw materials such as aggregates and minerals, and manufactured construction products. Many material resources will originate off site, purchased as construction products, and some will arise on site such as excavated soils or recycled road planings."* Whilst waste is defined in line with the Waste Framework Directive (2008/98/EC) as *"any substance or object which the holder discards or intends or is required to discard."*

12.6.3 The following tasks are proposed to determine the impact of material resources and waste from the Scheme:

- Ongoing review of the relevant waste legislation, national, regional and local planning policies and guidance;
- Review the proposed construction materials and materials quantities, and estimate the quantities and types wastes to be generated during CD&E. Operational wastes will be limited to ad hoc waste arisings and/or scheduled maintenance which cannot be quantified;
- Identify and evaluate the impacts of the Scheme against the national demand for key construction materials, the regional CD&E waste arisings, the national hazardous waste arisings, the regional waste infrastructure capacity and the national hazardous waste infrastructure capacity; and
- Identify opportunities to reduce, re-use, recover and/or recycle materials and wastes through a review of the proposed development (including proposed building materials, construction methods and design, where available) and in accordance with industry best practice.

12.6.4 Whilst not mandatory, it is best practice to produce a Site Waste Management Plan (SWMP) and a Construction Environmental Management Plan (CEMP) during each stage of the design. The SWMP will be produced as an appendix to the ES and should be updated throughout the Scheme development. It should include the anticipated types and quantities of waste generated on site, and actions undertaken to minimise waste generated on site. A CEMP is an overarching environmental management document. Its purpose is to identify stakeholder requirements, ensure compliance with legislation, and minimise potential adverse environmental impacts during construction via mitigation measures. It is proposed that both a SWMP and a CEMP be produced as part of the EIA (references will be included within the PEIR).

12.6.5 Table 12.4 contains a summary of what is scoped in and out for materials resources and waste impacts in the EIA.

Table 12.4: Materials resources and waste topics scoped in and out of further assessment

Effects	Scoped in (✓) / out (✗)	Comments/Justification
Change in demand for key construction materials during the CD&E phases.	✓	Assessment required to identify and evaluate the impacts of the Scheme against the national demand for key construction materials during the CD&E phases.

Effects	Scoped in (✓) / out (✗)	Comments/Justification
Change in demand for key construction materials associated planned/unplanned maintenance with during the operational phase.	✗	Minimal impact is envisaged during the operational phase of the Scheme due to minimal material resource use (associated with planned/unplanned maintenance). Data related to operational material resource use by highway Schemes is not readily available and as such will not be assessed.
Change in baseline waste arisings during the CD&E phases.	✓	Assessment required to identify and evaluate the impacts of waste arisings from the Scheme against the waste arisings baseline during the CD&E phases. The baseline for CD&E waste will be on a regional level and the baseline for hazardous CD&E waste will be on a national level.
Change in baseline regional waste arisings during the operational phase.	✗	Minimal impact is envisaged during the operational stage of the Scheme due to minimal waste generation (through littering and planned/unplanned maintenance). Most of these wastes would likely be non-hazardous municipal type wastes during normal operation, and non-hazardous/inert and hazardous wastes from planned/unplanned maintenance. Data related to waste generated by highway Schemes is not readily available and as such will not be assessed.
Change in capacity of waste infrastructure during the CD&E phase.	✓	Assessment required to identify and evaluate the impacts of waste arisings from the Scheme against the regional waste infrastructure baseline during the CD&E phases. The baseline for CD&E waste will be on a regional level and the baseline for hazardous CD&E waste will be on a national level.
Change in capacity of regional waste infrastructure during the operational phase.	✗	Operational waste arisings from the Scheme will not be assessed as it is envisaged that this will be minimal and no data related to waste generated by highway schemes is readily available. Therefore, an assessment will not be made of the potential effect of the operational waste arisings on operational waste infrastructure.

12.7 Proposed assessment methodology

12.7.1 The general methodology and criteria described below will be applied during the EIA to determine the significance of the effects associated with material resources and wastes during the construction phase of the Scheme.

12.7.2 The magnitude of the anticipated material resources used and waste arisings generated by the Scheme will be determined by assessing the Bill of Quantities (or equivalent). The Bill of Quantities (or equivalent) will include (but is not limited to) information on the removal of excavated materials, and materials/ equipment to be installed by sub-contractors.

12.7.3 There are a number of assumptions and limitations that will be applicable to the proposed assessment methodology as outlined in Section 12.11.

12.7.4 The results of the assessment will be tabulated and presented in the ES as data will not be available within the timeframes of the PEIR submission. Additional

detail will be provided in the SWMP which will be prepared, as an appendix to the ES, and will contain a breakdown of waste types.

12.7.5 The magnitude and sensitivity of the receptors will be assessed for the Scheme based on sensitivity (waste infrastructure capacity) and magnitude (national demand for key construction materials and waste arisings). As aforementioned, operational material resource use and waste arisings cannot be estimated and as such a quantitative assessment will not be undertaken. Table 12.5, below summarises how magnitude and sensitivity effects have been defined with regard to material resources, waste arisings and infrastructure capacity. The criteria are based on Atkins' prior experience, given there is no specific industry assessment standard. Sensitivity of key construction materials cannot be assessed due to a lack of publicly available data. As baseline data relating to operational material resource use and waste generated by highway schemes is not readily available, it will not be assessed for significance as part of the EIA.

Table 12.5: Criteria for classifying the magnitude of environmental effects

Level	Sensitivity Criteria	Magnitude Criteria
High	The Scheme meets one or more of the following criteria: • High volumes of waste generated such that it may have a high impact on estimated CD&E waste infrastructure within the regional study area (greater than 10% of the regional baseline); and • High volumes of hazardous waste generated such that it may have a high impact on estimated hazardous waste infrastructure within the national study area (greater than 1% of the national baseline).	The Scheme meets one or more of the following criteria: • Significant volumes of key construction materials required such that it has a high impact on current market demand, greater than 10% of the national baseline (for any one material); • Generation of large volumes of CD&E waste, greater than 10% of the regional baseline; and • Generation of large volumes of hazardous waste, greater than 1% of the national baseline.
Medium	The Scheme meets one or more of the following criteria: • Moderate volumes of waste generated such that it may have a moderate impact on estimated CD&E waste infrastructure within the regional study area (5% to 10% of the regional baseline); and • Moderate volumes of hazardous waste generated such that it may have a moderate impact on estimated hazardous waste infrastructure within the national study area (0.5% to 1% of the national baseline).	The Scheme meets one or more of the following criteria: • Moderate volumes of key construction materials required such that it has a moderate impact on current market demand, 5% to 10% of the national baseline (for any one material); • Generation of medium volumes of CD&E waste, 5% to 10% of the regional baseline; and • Generation of moderate volumes of hazardous waste, 0.5% to 1% of the national baseline.
Low	The Scheme meets one or more of the following criteria: • Low volumes of waste generated such that it may have a low impact on estimated CD&E waste infrastructure within the regional	The Scheme meets one or more of the following criteria: • Low amounts of key construction materials required such that it has a moderate impact on current market demand, 1% to 5% of the national baseline (for any one material);

Level	Sensitivity Criteria	Magnitude Criteria
	study area (1% to 5% of the regional baseline); and • Low volumes of hazardous waste generated such that it may have a low impact on estimated hazardous waste infrastructure within the national study area (0.1% to 0.5% of the national baseline).	• Generation of low volumes of CD&E waste, 1% to 5% of the regional baseline; and • Generation of low volumes of hazardous waste, 0.1% to 0.5% of the national baseline.
Negligible	The Scheme meets one or more of the following criteria: • Negligible volumes of waste generated such that it may have a negligible impact on estimated CD&E waste infrastructure within the regional study area (less than 1% of the regional baseline); and • Negligible volumes of hazardous waste generated such that it may have a negligible impact on estimated hazardous waste infrastructure within the national study area (less than 0.1% of the national baseline).	The Scheme meets one or more of the following criteria: • Negligible amounts of key construction materials required such that it has a negligible impact on current market demand, less than 1% of the national baseline (for any one material); • Generation of negligible volumes of CD&E waste, less than 1% of the regional baseline; and • Generation of negligible volumes of hazardous waste, less than 0.1% of the national baseline.

12.7.6 The assessment of significance combines the magnitude and sensitivity of the environmental effects to determine whether the effects are major, moderate, minor, negligible or no change, as shown in Table 12.5. Very large to moderate effects are considered to have the potential to be significant, while slight and neutral effects are not considered significant.

12.7.7 Throughout the design process and following the assessment of significance, mitigation measures associated with material use and waste generation will be identified. It is likely that the mitigation measures will incorporate the following themes:

- Management of waste within the context of the waste hierarchy;
- Management of the waste in accordance with local and national policy and legislation and, where applicable, guidance documents;
- Safe management of the waste generated, as determined by its physical and chemical characteristics (e.g. bulky or hazardous wastes);
- Potential environmental effects or human health risks associated with the waste arisings throughout the lifecycle of the Scheme; and
- Use of materials and management of waste in accordance with the Proximity Principle, which promotes the procurement of materials and management of wastes locally.

12.7.8 The overall aim of the process of identifying mitigation measures is to achieve a high reuse, recycling and recovery rate throughout all phases of the Scheme. Achieving this will minimise environmental burdens in terms of:

- Impacts to the environment and human health;
- Energy and carbon impacts;

- The overall sustainability of the Scheme; and
- Reduce costs associated with excessive material procurement and waste storage, collection and disposal.

12.8 Vulnerability to major accident and disasters

12.8.1 A review of major accidents and disasters that could affect the Scheme has been undertaken and are considered not to have a significant effect on material resources and waste. Mitigation measures identified in Section 12.10 would be used to manage any impacts resulting from major accidents and disasters.

12.9 Proposed consultation

12.9.1 It proposed that Essex County Council, as the author/ owner of the Essex County Council & Southend-On-Sea Borough Council Waste Local Plan (2017) will be consulted on the proposed assessment methodology post submission of the PEIR.

12.10 Potential mitigation measures

12.10.1 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.

12.10.2 The design of the development will ensure that wastage is minimised throughout its lifecycle. During the design stage, the potential effects will be addressed using the following mitigation measures which will then follow through to the construction phase:

- Waste will be designed out where possible;
- Opportunities to use waste as a resource will be sought where practicable; and
- Where waste re-use and recovery is not possible, waste will be disposed of in a way that is least damaging to the environment and to human health (i.e. in accordance with the waste hierarchy, shown in Figure 12.1).

12.10.3 Further details on mitigation measures will be provided as part of the PEIR and the ES.

12.11 Assumptions and limitations

12.11.1 There are a number of assumptions that will be applicable to the proposed assessment methodology as outlined below:

- Should a detailed construction programme not be available, it will be assumed that material resource use and waste generation will be spread equally across the construction period;
- Any new/ unused equipment will be fed back into the supply chain for use on alternative Schemes and as such will be excluded;

- All material quantities will be converted into tonnes using industry standard conversion rates;
- All material resources will be grouped according to main material types, as shown in Table 12.1;
- Wastage rates, published by the Construction Resources and Waste Platform, will be applied to all material resource tonnages in order to determine the likely waste arisings (offcuts, damaged and surplus materials);
- An additional 1% will be added to the total waste arisings (excluding soil, aggregate and granular fill) to account for packaging waste, based on experience from previous projects. It will be assumed that 0.01% of all packaging waste arisings will be hazardous in nature (e.g. associated with sealants, paints and solvents); and
- Hazardous waste arisings will comprise of oils, sealants, paints, solvents and contaminated soil. Contaminated soil will be considered separately.

12.11.2 The key limitation to the proposed assessment methodology is the availability of data within the timeframes of the PEIR and ES submission (i.e. the availability of Bill of Quantities (or equivalent).

12.12 Conclusion

12.12.1 Table 12.6 below outlines the potential issues likely to occur as a result of the Scheme during the construction and operation phases for each topic. Where potential issues have been identified these have been scoped in.

12.12.2 As aforementioned, less impact is envisaged during the operational stage of the Scheme due to minimal material resource use (associated with planned/ unplanned maintenance) and waste generation (through littering and planned/ unplanned maintenance) and as such this has been scoped out and will not be assessed as part of the EIA.

12.12.3 As part of the ES, a Detailed Assessment, as defined in IAN 153/11 (2011), will be undertaken to assess the potential issues which have been scoped in.

Table 12.6: Potential issues scoping in and out for further assessment

Effects	Construction: Scoped in (✓) / out (×)	Operation: Scoped in (✓) / out (×)	Comments
Materials and waste			
Waste	✓	×	Design to ensure wastage is minimised throughout lifecycle. Waste to be used as a resource where practicable and designed out where possible.
Material resources	✓	×	Assessment to identify and evaluate the impacts of the Scheme against national demand for key construction materials and raw material resources.

Key: ✓ = potential impact likely; × = no potential impact likely

13. People and Communities

13.1 Introduction

13.1.1 This chapter identifies the study area and relevant receptors in the local community, including all travellers, land and property, and severance. The chapter identifies the potential impacts associated with the Scheme during construction and operation, and discusses mitigation measures that may be applied to mitigate any potentially significant adverse effects.

13.1.2 The chapter presents the proposed scope and methodology for the EIA. The people and communities assessment identifies the likely potential effects on relevant receptors due to the Scheme during construction and operation and presents the effects scoped in and out for further assessment.

13.2 Study area

13.2.1 In absence of prescriptive guidance for people and communities assessments, the study area is that determined likely to encapsulate the people and communities effects of the Scheme, by professional judgement and knowledge of the Scheme.

13.2.2 The study area for effects on travellers comprises the roads, connecting roads, Public Rights of Way (PRoW), cycle paths, footpaths and bridleways located within 500 m of the Scheme, whilst the study area for land and property considers the area of, and immediately adjacent to, the Scheme.

13.2.3 The assessment of community severance, which brings together impacts on travel routes with land use, takes a wider study area encompassing land and properties which are accessed via affected roads and paths.

13.3 Planning and policy context

National Planning Policy

13.3.1 There is no specific legislation or planning policy relating to people and communities assessment, however national and local policy provides direction on relevant issues, particularly transport and land use.

National Policy Statement for National Networks (NPSNN) December 2014

13.3.2 The NPSNN sets out the need for development of road, rail and strategic rail freight interchange projects on the national networks and the policy against which decisions on major road and rail projects will be made.

13.3.3 The Government's vision and strategic objectives for the national networks include improving overall quality of life, journey quality, reliability and safety and linking up communities. Junction improvement is cited as a measure which will be used to enhance the existing national road network towards this vision (Paragraph 2.23).

13.3.4 The NPSNN establishes the expectation that delivery of new schemes will improve quality of life and avoid and mitigate environmental and social impacts in line with the principles set out in the NPPF and the Government's planning guidance (Paragraph 3.3). Schemes will also be expected to improve

accessibility and inclusivity and reduce community severance, to contribute to a network that provides a range of opportunities and choices for people to connect with jobs, services and friends and family (Paragraph 3.19).

13.3.5 Although it does not provide specific guidance for people and communities impacts, the NPSNN outlines the approach to land use which is of relevance to this assessment. Applicants should identify existing and proposed land uses, including best and most versatile agricultural land, in the vicinity of the Scheme and the likely effects on these (Paragraphs 5.165 and 5.168). Access to high quality open spaces, Public Rights of Way, the countryside and opportunities for sport and recreation can be a means of providing mitigation and/or compensation requirements for developments (Paragraphs 5.162 and 5.184).

National Planning Policy Framework (NPPF) March 2012

13.3.6 The NPPF establishes national planning policy to achieve sustainable development, through themes which include promoting sustainable transport, supporting a prosperous rural economy and promoting healthy communities, with a presumption in favour of sustainable development.

13.3.7 On transport, the NPPF states that the system needs to be balanced in favour of sustainable transport modes to give people 'a real choice about how they travel' (Paragraph 29). Encouragement should also be given to solutions which reduce congestion (Paragraph 30). Paragraph 75 includes a requirement that planning policies should protect and enhance (PRoWs) and access.

13.3.8 To support a prosperous rural economy, planning should promote the sustainable growth and expansion of businesses and enterprise in rural areas, the diversification of agricultural and land-based rural businesses, and the retention and development of local services and community facilities (Paragraph 28).

13.3.9 Social interaction, health and inclusivity are priorities for communities. Planning should thus promote safe, accessible environments and use of public areas and shared space, and protect valued facilities and services including open space, sports venues, public houses and local shops (Paragraphs 69-70).

Local Planning Policy

London Plan March 2016

13.3.10 The London Plan's key objectives include supporting a city of diverse, strong secure and accessible neighbourhoods, where it is easy, safe and convenient for everyone to access opportunities and facilities with an efficient and effective transport system (Paragraph 1.53).

13.3.11 Quality of life constitutes a fundamental theme underpinning the Plan (Paragraph 1.56). The Plan establishes the vital role of transport infrastructure in supporting a good quality of life (Paragraph 1.39), which also depends upon readily accessible community and cultural facilities, networks of green and open spaces, and local sense of safety (Paragraph 1.44).

London Borough of Havering Local Plan Proposed Submission August 2017

13.3.12 Havering's vision, which will direct the Borough's development following adoption of the Proposed Submission Local Plan, focuses on four cross-cutting priorities:

Communities, Places, Opportunities and Connections. Of particular relevance to people and communities are aims to help all residents 'make positive lifestyle choices' and ensure residents 'have access to vibrant culture and leisure facilities, as well as thriving town centres'. The Borough is supportive of walking and cycling provision, including shared use routes; tackling key congestion and road safety hotspots; and enhancing strategic transport links to capitalise on its location, including through the M25/Junction 28 improvement scheme.

London Borough of Havering Core Strategy 2008

13.3.13 Havering's adopted Core Strategy aims to 'protect and strengthen what is best about Havering, to create places of real quality which are enjoyable and fulfilling to live in, and to improve social, economic, and environmental opportunities for the whole community.' To assist in meeting the Borough's aims, Development Control policies protect high quality agricultural land (DC47), existing arts and entertainment facilities (DC17), public open space, recreation, sports and leisure facilities (DC18) and access to these (DC20), and increase opportunities for countryside recreation (DC22).

13.3.14 Regarding transport, the Borough seeks to 'provide choice, reduce the need to travel and promote healthier lifestyles [through walking and cycling provision] and improve the quality of life for all sections of the community, including those who are less mobile and people with impairments' as well as maintain its 'excellent road links' - the A12, A13, A127 and M25. Developers are required to take account of the needs of pedestrians (DC34) and cyclists (DC35).

Brentwood Replacement Local Plan August 2008

13.3.15 Strategic aims of relevance to people and communities are: improving the relationship between where people live and their place of work or their proximity to community facilities and shopping; protecting public and private open space and other land of recreational or amenity value; extending equality of opportunity and social integration; enhancing quality of life and community safety and reducing the fear of crime; and protecting the amenities of those living, working and visiting from the potential negative impacts of development.

13.3.16 Regarding transport, objectives include assisting in the provision of an integrated, energy efficient, safe and convenient transport system for people and goods without unacceptable detrimental impact upon people, the environment or the local economy; minimising conflict between different modes of travel; and encouraging alternative forms of transport to the private motor car and lorry. Rights of way, including footpaths, and their amenity will be safeguarded.

Brentwood Community Plan

13.3.17 The Council's Mission Statement and core values are: "The Council's Mission is to serve the needs of local people and work in partnership with the whole community in order to ensure that the Brentwood Borough remains a pleasant and healthy place in which to live, work and relax for the benefit of current and future generations.

13.4 Baseline conditions

Effects on all travellers

Motorised Travellers (MT)

View from the road

13.4.1 The study area contains a varying degree of screening elements along the M25 and A12 that obscure or block the views completely. In general, views over the surrounding landscape from the road for MT on the study area's road network are intermittent and comprise a mixture of agricultural, residential and commercial properties, planted vegetation and engineering structures.

13.4.2 The view from the M25, which crosses over the top of the Junction 28 roundabout north west to south east, is screened by vegetation on the east and west on both approaches to the junction. Far distance views of the undulating landscape of Essex, comprising agricultural land and wooded areas, are afforded when traveling clockwise on the M25 above the junction. When traveling along the motorway south of the junction, drops down to travel underneath the Great Eastern Mainline railway bridge, various overhead structures are a prominent feature.

13.4.3 Views looking from the slip roads towards the Junction 28 roundabout, positioned below the M25 and above the A12, are of a planted wooded area. General views away from the roundabout are of planted vegetation and trees, with intermittent views of agricultural land. The M25 anticlockwise entry slip road has a partial view of a small residential property and scrap yard to the west. A partial view of the adjacent petrol station is visible from the eastern portion of the roundabout. A partial view of a dwelling house can be seen from the south-eastern portion of the roundabout.

13.4.4 Views from A12, which runs below the Junction 28 roundabout south west to north east, are restricted by vegetation to the north and south of the carriageway. General views at the junction and the approach from the A12 are of planted vegetation and trees with intermittent views of agricultural land. When traveling beneath the junction, views are of planted vegetation, elevated earthworks and retaining walls. Travel along the west and east of the junction (Colchester Road and Brentwood bypass respectively) provides intermittent views of open land either side of the road, screened by planted vegetation, trees and woods.

13.4.5 The A1023 Brook Street east of the Junction 28 roundabout allows for intermittent views either side of the road, which include open land, commercial and residential properties. The road is screened by planted vegetation and trees.

Driver stress

13.4.6 M25 Junction 28 is a major national and inter urban regional transport artery which plays a critical role providing access between the M25 and the A12, particularly the A12 towards Essex. It is thus intrinsically linked to the performance of the surrounding highway network.

13.4.7 Driver stress levels are affected by high levels of demand combined with limited capacity on the gyratory section due to the capacity of the signalised intersections resulting in delays and accidents. The north east quadrant of the

M25 has high volumes of traffic and often experiences severe congestion, featuring in the top 10 percentile of all UK roads in terms of vehicle hour delay. This causes disruption and delays to the surrounding road network when emergency closures and lane closures of the motorway, gyratory and the Dartford Crossing are imposed.

13.4.8 Junction 28 experiences a high number of accidents and incidents, with a total of 48 recorded between 01/11/2008 and 30/04/2014. While the majority of these accidents were minor, in many cases these result in significant disruption to traffic and unreliable journey times, which can contribute towards elevated levels of driver stress.

Non-Motorised Users (NMU)

13.4.9 Results of NMU surveys (2014) show that NMUs use both the carriageway and traffic-free routes – footways and Shared Use Paths (SUPs) in the vicinity of Junction 28. However, overall usage is low.

13.4.10 Footways exist on the A12 and A1023. On the northern side of the A12, west of the M25 Junction 28 roundabout, a footway provides access to the vicinity of the roundabout and then to the southern side of the A12 via an uncontrolled crossing of the A12 entry slip and exit slip road. This connects with an SUP to the southern side of the A12/A1023.

13.4.11 Shared Use Paths exist on the A1023 immediately east of the M25 Junction 28 roundabout junction, through the southern side of the junction via one uncontrolled and one controlled crossing point. This SUP then continues along the southern side of the A12 west of the roundabout towards Harold Wood providing a connection to NCNR 136.

13.4.12 A cycle crossing at grade within the southern portion of the roundabout at Junction 28 provides a connection east to west between Brentwood and Harold Park, continuing along Brook Street and Colchester Road. Accident data for the period 01/11/2008 to 30/04/2014 shows that no collisions involved NMUs. However, a number of rear-shunt or side-swipe accidents were recorded in the immediate vicinity of, and on, the roundabout. This indicates that cyclists using the carriageway are likely to be at risk of collision if changes to lanes and directions result in driver confusion.

13.4.13 There are no PRoW within 500 m of Junction 28.

13.4.14 Although there are no bridleways within the study area, the British Horse Society website (www.bhs.org.uk) shows a riding centre - Colmar Farm Riding Centre Ltd, to the north east of Junction 28 on Weald Park Way - that could be expected to generate equestrian trips within the vicinity.

Effects on land and property

Agricultural land and holdings

13.4.15 The study area is rural, with an agricultural landscape dominated by unmanaged rough grassland. The agricultural area surrounding Junction 28 is identified as Grade 3 (see Chapter 9 Geology and Soils for further details). From aerial inspection, it appears that this land is largely comprised of arable fields. It is likely that a proportion of this land will be Best and Most Versatile (BMV) Agricultural Land. None of the study area is within Defra's Countryside

Stewardship Scheme (www.magic.gov.uk), which is the main grant aided agri-environment scheme for England.

13.4.16 Two agricultural holdings may be affected by the Scheme. East of the Weald Brook is Grove Farm, occupied by G & R Skips and Recycling. Land surrounding this industrial site is rough grassland and woodland, with no sign of managed grazing on recent and historical Google Earth imagery. West of West Brook is a similar area of unmanaged grassland accessed from the road leading to Maylands Golf and Country Club. No farm buildings lie in the path of the Scheme.

Residential and private property

13.4.17 The privately owned agricultural land which forms the Scheme site is surrounded by a mixture of other privately owned uses, including residential and commercial. The following properties are within 500 m of the Scheme:

- Grove Farm, north west of Junction 28 and accessed via the M25 anticlockwise slip road and the east bound slip road off the A12 entering to the roundabout, comprises a dwelling and farm buildings, including a small scrap and storage yard operated by G&R Skips and recycling, and associated businesses;
- Farm buildings south west of Junction 28;
- Putwell Bridge Caravan Park, south of the A12 Colchester Road to the west of Junction 28, which has permission for change of use to a burial ground (see Development land below);
- A dwelling, The Poplars, and farm buildings south east of Junction 28;
- Dwellings fronting Nags Head Lane to the south east of Junction 28, east of the M25;
- The South Weald Service station, comprising a Shell petrol station and Mizu Noodle Bar restaurant, east of Junction 28 at the junction of A1023 Brook Street and Roman Road;
- Two dwellings either end of the service station, one of which is adjacent to the Junction 28 roundabout; and
- Commercial properties along Brook Street including the Brentwood Garden Centre, Poolman swimming pool and Spirit Health Club.

Community land and facilities

13.4.18 No community land is located within 500 m of the Scheme. Maylands Golf Club is located adjacent to the scheme and also Henderson Sports and Social Club is nearby whilst the Poolman swimming pool and Spirit Health Club are within 500 m of the scheme to the south east (see above). All are private sport/leisure facilities.

Development land

13.4.19 Brentwood and Havering both safeguard land along the Great Eastern Mainline for Crossrail in their respective adopted Local Plans. There are no other allocated sites within 500 m of the Scheme.

13.4.20 There is one significant permitted planning application within 500 m of the Scheme, for the change of use of land south of the A12 Colchester Road and west of Harold Park to burial grounds (P1742.14). The application includes land currently occupied by the Putwell Bridge Caravan Park.

Community severance effects

13.4.21 Brentwood, the centre of which is approximately 2.1 miles east of Junction 28, is home to the following uses:

- Restaurants, public houses and a hotel (Holiday Inn Brentwood, Harvester, The Bull Public House, Marygreen Manor Hotel and Restaurant, The Nags Head Public House);
- Retail (Londis Convenience Store, Car Showrooms, Wickes);
- Employment (BT office, industrial area on Hubert Road to the south of A1023);
- Services (post office on Brook Street); and
- Leisure (Warley Country Park).

13.4.22 In addition to those identified in the land and property baseline, there is a cluster of community facilities and services which may be public or private located along Brook Street outside of the 500 m search radius.

13.4.23 The centre of Romford, approximately 4.6 miles to the west of Junction 28 along a SUP adjacent to the southern side of the A12, is considered to be within reasonable cycling distance (< 5 miles) of the Scheme. Romford hosts all of the local services and amenities expected within a town centre. The eastern part of the town, Harold Park, extends to approximately 800 m from Junction 28 along the A12 and includes shops and services at the junction with Willow Way and along Colchester Road and Harold Court Road.

13.4.24 Footpaths crossing the area of land to be used by the Scheme provide pedestrian links between Brook Street, Brentwood and Harold Park, Romford and other neighbouring areas.

13.5 Potential impacts

Motorised Travellers

View from the road

13.5.1 The Scheme is likely to hinder views from the Junction 28 roundabout, slip roads, M25, A12 and local roads due proposed bridges and embankments. Removal of vegetation may further impact views.

Driver stress

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 Junction's enhanced capacity to cater for traffic, reduced queueing, congestion and risk of conflicts and collisions.

Non-Motorised Users

13.5.2 Although paths will remain open during construction, the Scheme has the potential to affect the Junction 28 footpath and cycleway crossing and footpaths along Colchester Road, and hence the amenity experienced by users. During its operational phase, the scheme's design will seek to maintain access for cyclists and pedestrians.

Effects on land and property

Agricultural land and holdings

13.5.3 Agricultural land and holdings in the north west quadrant of Junction 28 are likely to be affected by the Scheme through land take and severance.

Residential and private property

13.5.4 Permanent land take will be required at Grove Farm, and the adjacent Maylands Golf Course may also be affected by the construction of the scheme. The former is likely to constitute a significant adverse effect.

Community land and facilities

13.5.5 Community land is not required to construct the Scheme.

Development land

13.5.6 The Scheme is not expected to require any land take from the permitted burial ground south of the A12.

Community severance effects

13.5.7 It is likely that there will be some temporary or permanent impact on community severance due to changes to paths, particularly affecting access to Grove Farm and services and facilities in the surrounding villages.

13.6 Proposed level and scope of assessment

13.6.1 The assessment uses published guidance provided in DMRB Volume 11 Section 3 to consider the impacts of the M25 Junction 28 Improvements on people and communities. It combines the NMU and Community Effects components of Part 8, Part 9 for effects on Vehicle Travellers, and Part 6 for Land Use effects.

13.6.2 In line with Article 3(1) of the EIA Directive, the assessment carried out in accordance with DMRB Volume 11 Section 3 Part 8 sufficiently covers human health impacts as a result of the Scheme without need for a standalone HIA.

13.6.3 Highways England is currently drafting guidance on a new topic, 'People and Communities' to replace both 'Effects on All Travellers' and 'Community and Private Assets' topics. Should this guidance become available prior to the completion of the ES, it will be considered and implemented where the programme allows.

13.6.4 The assessment considers any impacts that the Scheme may have as follows:

- Effects on all travellers;
  - Motorised Travellers (MTs), using private and public vehicles;

  - View from the road, the extent to which travellers are exposed to the different types of scenery through which a route passes, including type and quality of scenery and any features of particular interest or prominence;
  - Driver stress, the adverse mental and physiological effects experienced by a driver traversing a road network, including frustration, fear of potential accidents and uncertainty of the route; and
  - Non-Motorised Users (NMUs), pedestrians and cyclists, arising from provision, reduction or disruption to paths, or changes to journey experience through traffic flow changes. As there are no bridleways located within the study area and NMU survey results suggest negligible equestrian use of paths in the area (no equestrians were recorded), equestrians are excluded from the assessment. Assessment of effects will focus on changes in journey lengths (distance travelled and time taken) and amenity, defined by the DMRB as the relative pleasantness of a journey. This concerns changes in the physical qualities of paths, degree and duration of exposure to traffic, noise, air quality and visual intrusion;
- Effects on land and property, including demolition and land take affecting:
  - Agricultural land and holdings – devoted to the rearing of livestock and production of crops to produce food and plants;
  - Residential and private property – including residential, commercial or industrial property, which does not accommodate public open space or any other community facility or asset;
  - Community land and facilities – any area of public open space or facilities such as schools, hospitals, libraries and recreation facilities used by the public; and
  - Development land – land designated within the development plan for particular development purposes, or for which planning permission has been granted.
- Community severance effects, defined by the DMRB as the separation of residents from facilities and services they use within their community including: doctors' surgeries, hospitals, aged persons' homes, schools, shops, post offices, churches, parks, play areas, sports centres and other leisure facilities. The effect on vulnerable groups, such as children and the aged, will be taken into consideration.

13.7 Proposed assessment methodology

Baseline and assessment data

13.7.1 Table 13.1 summarises the information sources to be used for the assessment. No site visit will be undertaken; rather, the findings will be largely based upon a desk-based study of the area, consultation with local stakeholders, and consultants' knowledge based on previous similar schemes. Where relevant, information will be used from other specialist topics to help assess the magnitude of impact on receptors.

Table 13.1: People and communities assessment information sources

Receptor	Information source
MTs: View from the road	• Landscape and visual effects assessment.
MTs: Driver stress	• Transport Assessment traffic data.
NMUs	• Desk-based study of paths in the study area; and • NMU surveys undertaken in 2014.
Land and property	• Desk-based study of land (including Agricultural Land Classification maps), properties and facilities in the study area; • Geology and soils assessment; and • Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents.
Community severance	• Desk-based study of land, properties and facilities in the study area; • Findings from this assessment concerning land and property and NMUs; and • Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents.

Sensitivity value of receptors

13.7.2 The sensitivity value of receptors is generally related to the availability of these within the study area and the impact on the existing baseline. Each receptor is assigned a sensitivity value according to professional judgement and the criteria included within the DMRB Volume 11, Section 3 (Table 13.2).

Table 13.2: Sensitivity of receptors assessment criteria

Sensitivity value	Criteria
Negligible	Very infrequent use of resource, multiple equivalent or better alternatives are freely and easily available.
Low	Low or infrequent use of a resource, suitable alternative are readily available.
Medium	Moderate or occasional use of a resource, limited equivalent alternative resources used by the receptor are reasonably available.
High	Frequent or continuous use of a resource, no suitable equivalent alternative resources used by the receptor are reasonably available.

13.7.3 In the case of some receptors, additional guidance will be used to analyse baseline conditions and hence determine sensitivity according to the DMRB recommended criteria. This applies to view from the road, driver stress, and agricultural land and holdings.

View from the road

13.7.4 Existing views from the road are assessed according to travellers' ability to see the surrounding landscape on the following four point scale recommended by the DMRB:

- No view – road is in a deep cutting or contained by earth bunds, environmental barriers or adjacent structures;
- Restricted view – frequent cuttings or structures blocking the view;
- Intermittent view – road generally at ground level but with shallow cuttings or barriers at intervals; and
- Open view – view extending over many miles, or only restricted by existing landscape features.

Driver stress

13.7.5 As no reliable relationship has been established between physical factors and driver stress, the assessment estimates levels of stress based on peak hourly flow and average journey speed, in accordance with DMRB guidance (Table 13.3).

Table 13.3: Driver stress assessment criteria

Average motorway peak hourly flow per lane, flow units/hour	Average motorway journey speed, km/h		
	Under 75	75-95	Over 95
Under 1200	High	Moderate	Low
1200-1600	High	Moderate	Moderate
Over 1600	High	High	High

Agricultural land and holdings

13.7.6 The sensitivity of agricultural land and holdings is determined as follows:

- High: farm types in which the operation of the enterprise is dependent on the spatial relationship of land to key infrastructure, and where there is a requirement for frequent and regular access between the two, or dependent on the existence on the infrastructure itself, e.g. dairying; irrigated arable cropping and field scale horticulture; intensive livestock or horticultural production;
- Medium: farm types in which there is a degree of flexibility in the normal course of operations, e.g. combinable arable crops; grazing livestock farms (other than dairying); and
- Low: farm types and land uses undertaken on a non-commercial basis.

Magnitude of impact

13.7.7 Magnitude of impact considers the change to the study area's baseline conditions as a result of the Scheme, and the permanence and reversibility of the impact. Magnitude of impact will be determined by professional judgement and knowledge of the Scheme, and awarded a value of high, medium, low or negligible (Table 13.4). Impacts are either positive or negative.

13.7.8 For effects on motorised travellers, this will use the specific criteria outlined above (Table 13.3) in relation to existing and expected conditions during the scheme's construction and operation. If construction phase traffic flow data is not available, the assessment will assign a level of driver stress by applying

professional judgement based on information regarding the presence of construction plant, route diversions and other potential construction impacts.

13.7.9 The magnitude of impact on all land and property is related to the amount and permanence of land take required, severance, and the use of land for access, water supply and drainage, and the resultant impacts on residents, viability of businesses, or the community.

Table 13.4: Magnitude of impact assessment criteria

Magnitude of impact	Criteria
Negligible	Minimal damage/disruption to a receptor asset. Impacts may be temporary or permanent.
Low	The impacts are predicted to result in slight or moderate damage/disruption to a receptor. Impacts may be temporary or permanent.
Medium	The impacts are predicted to result in moderate or large damage/disruption to a receptor. Impacts are likely to be permanent.
High	The impacts are predicted to result in very large damage/disruption to the receptor. Impacts are likely to be permanent.

13.7.10 The magnitude of impact on NMUs will be assessed according to the DMRB guidance in Table 13.5. This, considered in tandem with the impact on community land or facilities, will inform the assessment of community severance impact.

Table 13.5: Magnitude of impact assessment criteria - NMUs

Magnitude of impact	Criteria
Low	In general the current journey pattern is likely to be maintained, but there will probably be some hindrance to movement, for example: • Pedestrian at-grade crossing of a new road carrying below 8,000 vehicles per day (AADT); or • A new bridge will need to be climbed or subway traversed; or • Journeys will be increased by up to 250 m.
Medium	Some residents, particularly children and elderly people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive, for example: • Two or more of the hindrances set out under 'Low' are applied to single trips; or • Pedestrian at-grade crossing of a new road carrying between 8,000 - 16,000 vehicles per day (AADT); or • Journeys will be increased by 250 m - 500 m.
High	People are likely to be deterred from making trips to an extent sufficient to induce reorganisation of their habits. Considerable hindrance will be caused to people trying to make their existing journeys for a prolonged period of time, due to, for example: • Pedestrian at-grade crossing of a new road carrying over 16,000 vehicles; • An increase in length of journeys of over 500 m; or

Magnitude of impact	Criteria
	• Three or more of the hindrances set out under 'Low' or two or more hindrances set out under 'Medium'.

Significance of effect

13.7.11 The relationship between the sensitivity of the receptor and the magnitude of impact of the Scheme determines the significance of the effect as illustrated in Table 13.6. Effects are either adverse or beneficial.

Table 13.6: Significance of effect assessment criteria

Sensitivity of receptor	Magnitude of impact			
	High	Medium	Low	Negligible
High	Large or very large	Moderate or large	Slight or moderate	Slight
Medium	Moderate or large	Moderate	Slight	Neutral or slight
Low	Slight or moderate	Slight	Neutral or slight	Neutral or slight
Negligible	Slight	Neutral or slight	Neutral or slight	Neutral

13.8 Vulnerability to major accident and disasters

13.8.1 This section considers the expected effects of the development on people and communities deriving from the vulnerability of the development to risks of major accidents and/or disasters which are relevant to the project concerned.

13.8.2 Disasters, accidents and incidents are not clearly quantified or defined by EIA regulations. It is currently a matter for professional judgement as to whether a potential event may be classified as major and therefore whether there is a need for assessment within EIA. Guidance suggests that risk assessment pursuant to EU legislation such as Directive 2012/18/EU or Council Directive 2009/71/Euratom may be appropriate. These directives concern safety of nuclear installations and the prevention of major accidents which involve dangerous substances (such as those that have previously occurred at Seveso, Bhopal, Schweizerhalle, Enschede, Toulouse and Buncefield), and the limitation of their consequences for human health and the environment. Guidance also suggests that further assessment of this topic within EIA could only be justified if the level of risk at the Scoping stage concludes that an event could be major and that there was a reasonable doubt over the likelihood of the event (e.g. greater that 1% probability of occurrence), although it might be concluded that no one threshold, criteria or guidance will address all types of potential accidents or disaster.

13.8.3 The probability of a major accident, incident or disaster occurring as a result of the Scheme has been assessed. The proposed development would not include any potentially dangerous operation, such as the use of nuclear or dangerous chemical materials or processes. Some chemicals may be present on site during

construction, though risks associated with such materials would be adequately managed using ordinary construction site management practices.

13.8.4 There is a risk that the Scheme may increase the likelihood of road traffic accidents during construction. This risk will be mitigated using appropriate traffic management measures. It is assumed that correct design will ensure that the proposed junction revision will not result in any increase in the likelihood of accidents during operation. Traffic incidents are a typical consideration of the operation of any highway. This accident risk is not considered to be of the magnitude targeted by the EIA Regulations. Chemicals and hazardous materials may be transported by road (subject to appropriate licences). The probability of a major accident involving the transportation of such materials occurring as a result of the Scheme is considered sufficiently low to not warrant further assessment.

13.8.5 Some types of civil infrastructure may be considered vulnerable to malicious incident. The Scheme comprises an upgrade to existing infrastructure, and is not considered likely to increase the risk or vulnerability of the infrastructure to attack. The probability of any attack on this element of infrastructure occurring is considered to be of sufficiently low probability to not warrant further assessment.

13.8.6 No significant adverse effects relating to people and communities deriving from the vulnerability of the development to risks of major accidents and/or disasters are expected and therefore this topic has been scoped out from future assessment.

13.9 Proposed consultation

13.9.1 In accordance with DMRB Volume 11 Section 3 guidance, consultation will be undertaken with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners (including agricultural tenants) and residents likely to be affected by the Scheme. 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.

13.10 Potential mitigation and monitoring measures

13.10.1 The Scheme design includes mitigation measures such as the enhancement of NMU accessibility.

13.10.2 Monitoring and mitigation will otherwise be implemented where adverse effects are identified.

13.10.3 During the construction phase, phasing of the construction works can minimise any disruption to paths and community severance. Where paths are disrupted, the community should be notified by way of clear signage in advance of the construction works, and informed of alternate routes. Access to severed properties should be maintained for the duration of the construction period. In order to reduce the impact on driver stress, motorised travellers should also be informed of the works by clear signage. Consultation with the Local Authority can assist in determining other suitable mitigation measures.

13.10.4 For operational phase, mitigation will likely involve consultation with landowners and other stakeholders to discuss the Scheme and agree on suitable

compensation measures for instances of land take or where business viability is significantly affected.

13.11 Assumptions and limitations

13.11.1 The assessment will be based on professional judgement and will provide a broad, high level indication of effects based on simple assessment and professional judgement. A more detailed assessment of effects will be possible with further details concerning the construction and design of the scheme.

13.12 Conclusion

13.12.1 The likely effects of the Scheme on people and communities have been identified as follows:

- MTs will be adversely affected in terms of view from the road and driver stress during the Scheme's construction. The adverse effect on view from the road is likely to be permanent, though of limited significance, whereas driver stress is expected to benefit from Junction 28's enhanced traffic capacity following completion of the scheme;
- Pedestrian and cyclist NMUs are likely to experience some disruption caused by construction, but are expected to benefit from improved amenity and journey length during the operation of the scheme;
- Grove Farm and agricultural land and holdings to the north west of Junction 28 are likely to be significantly adversely affected by the Scheme's requirement for permanent land take and its severance effect. Maylands Golf Course may also be affected by the construction of the Scheme;
- Neither community nor development land are anticipated to be affected by the Scheme through land take or severance; and
- Overall changes to community severance are anticipated due to changes to paths. Whilst temporary effects during the scheme's construction will be adverse, the impact of the Scheme's design may be a reduction in severance during operation.

13.12.2 Table 13.7 outlines the receptors to be scoped in/out from further assessment, based on the above identification of potential effects.

13.12.3 The outcome of the Scheme in relation to people and communities is also likely to be affected by significant effects on other environmental topics, as well as the effects of any concurrent development in the vicinity not identified in the baseline. This will be assessed in the cumulative effects chapter.

Table 13.7: People and communities' receptors scoped in and out of further assessment

Receptor	Scoped in (✓) / out (✗)	Comments/Justification
MT: View from the road	✓	A landscape and visual effects assessment will be undertaken to assess the magnitude of the impact on drivers view from the road.
MT: Driver stress	✓	Transport Assessment traffic data will be used to assess the magnitude of impacts on driver stress.
NMU	✓	A desk-based study of paths in the study area and NMU surveys undertaken in 2014 will be used to assess the magnitude of the impacts on NMUs.
Agricultural land and holdings	✓	A desk-based study of land (including Agricultural Land Classification maps), properties and facilities in the area, the geology and soils assessment and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on agricultural land and holdings.
Residential and private property	✓	A desk-based study of land (including Agricultural Land Classification maps), properties and facilities in the area, the geology and soils assessment and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on agricultural land and holdings.
Community land and facilities	✗	Community land is not required to construct the Scheme, therefore an assessment will not be made on the potential effects on community land and facilities.
Development land	✗	The Scheme is not expected to require any land take from the permitted burial ground south of the A12, therefore, an assessment will not be made on the potential effects on development land.
Community severance	✓	A desk-based study of land, properties and facilities in the area, findings from this assessment concerning land and property and NMUs and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on community severance.
Vulnerability to major accidents and disasters	✗	No significant adverse effects relating to people and communities deriving from the vulnerability of the Scheme to risks of major accidents and/or disasters are expected and therefore this topic has been scoped out from future assessment.

14. Climate change

14.1 Introduction

14.1.1 This chapter describes the climate change scoping assessment for the Scheme. The assessment was undertaken to ascertain the likely potential effects on climate change, and the vulnerability of the Scheme to climate change, due to the Scheme 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) (herein referred to as the 'EIA Regulations 2017'), which states that the assessment should consider both:

- the potential impact of the Scheme on climate change, in particular the magnitude of greenhouse gas (GHG) emissions (herein referred to as 'emissions') emitted during both construction and operation; and
- the vulnerability of the Scheme to climate change, in particular the impacts of extreme weather scenarios (as caused by climate change) on the Scheme during operation and its adaptation for these impacts.

14.2 Study area

Effects of the Scheme on climate

14.2.1 The study area is defined in terms of the lifecycle stages of Section 7 of PAS 2080:2016. In summary, the study area will cover:

- use of materials for construction (including temporary works and permanent structures) (A1-3);
- transportation of construction materials to site (A4);
- construction plant use (A5);
- construction use of mains water (A5);
- construction waste transportation (A5);
- construction waste off-site processing (A-5);
- replacement cycles (B2-5);
- operational energy (B6); and
- in-use traffic (B8).

14.2.2 Further details of the lifecycle stages that will be included within the assessment are set out in Table 14.1.

Table 14.1: Effect of the Scheme on Climate study area

Lifecycle Scope	Study Area
Temporary and permanent construction materials (A1-3):	The study area will cover the use of construction materials for temporary works and permanent structures within the Scheme boundary, and the supply chain emissions associated with these, as captured in the relevant materials emissions factor values.

Lifecycle Scope	Study Area
	Consumable materials, and materials contained within construction plant and equipment will not be included as it is standard practice to exclude them. Consumables are excluded as they are small, and plant is excluded on the basis that it will be used on other schemes, and the emissions associated with them cannot be attributed to any one scheme.
Materials Transportation (A4):	The study area will cover transportation of the temporary and permanent construction materials and the total distances travelled from the primary site of manufacturing, not the direct supply depot, including international freight transportation, where relevant. The primary site of manufacturing is used because transportation from a local supply depot does not represent the realistic transportation carbon emissions, so can lead to under reporting. The emissions scope will consider both the direct vehicle/ freight emission, but also the fuel supply chain emissions, as captured in the emissions factor values covering fuel supply (well-to-tank) and use.
Construction Plant (A5):	The study area for quantification of emissions for construction plant considers the same plant quantities, sizes and operating hours as that to be used for the noise assessment (Chapter 6) for construction of the Scheme only. The emissions scope will consider only the direct plant emission, where only plant specification data is available. If direct fuel consumption data is available, the emissions scope will consider direct plant emissions, but also the fuel supply chain emissions, as captured in the fuel emissions factor values covering fuel supply (well-to-tank) and use.
Construction Water Use (A5):	This study area covers mains water use only within the construction site boundary, including site compounds. The emissions scope will consider emissions from all activities for supply of water, as captured in the water supply emissions factor values.
Construction Waste Transportation (A5):	The study area will cover transportation of bulk construction waste and the distances travelled from the construction site to the initial waste treatment/ disposal site. The emissions scope will consider both the direct vehicle emission, but also the fuel supply chain emissions, as captured in the vehicle emissions factor values covering fuel supply (well-to-tank) and use.
Construction Waste Off-Site Processing (A5):	The study area will cover primary processing of bulk construction waste, as available and quantified and in the waste assessment (Chapter 12). The emissions scope will consider emissions from all activities for waste processing, as captured in the waste management emissions factor values.
Replacement (B2-5):	The study area for replacement includes the inspection works and planned replacement cycles of bulk items, e.g. road surface, over the planned operational life-time of the project, within the original construction site boundary. The emissions scope will consider materials use, transportation, and construction works, as defined by A1 – 5 above.
Operational Energy (B6):	The study area for operational energy will include the electricity and direct fossil fuel consumption for operation of the infrastructure within the site boundary, over the planned operational life-time of the project. The emissions scope will cover direct emissions from consumption of fossil fuels, and supply chain emissions from primary electricity generation, fuel and electricity supply chain (well-to-tank), and transmission and distribution losses, as captured in the emissions factor values for electricity and fuels.

Lifecycle Scope	Study Area
In-use Traffic (B9):	The study area for traffic use of the infrastructure is identical to that for the air quality assessment for operational traffic use (Chapter 5). The full definition for the study area is specified in the Air Quality Chapter (Chapter 5), on the basis it is the source for the data used to quantify emissions for this lifecycle stage.

14.2.3 Preliminary studies and consultations (A0), direct operational GHG emissions (B1), operational water use (B7), other processes (B8), and end of life (C1-4) will be excluded from the study areas on the basis that either:

- the emissions are likely to be minimal/ negligible, or
- the lifecycle stage is not applicable to the Scheme.

14.2.4 The study area (as set out above) will be dependent upon the availability of design and construction information. If such data is not available, part or all of the affected lifecycles will be excluded from the assessment.

Vulnerability of the Scheme to climate change

14.2.5 The Scheme is described in Chapter 2 of this document. Figure 14.1 shows the location of the Scheme alongside the Met Office UK Climate Projections 25 km gridded data (grid ID: 1629), which is the source of climate change information used in this chapter. Figure 14.2 shows the location of the Scheme within the broader context of the Thames river basin as the site may be at risk of localised fluvial flooding.

Figure 14.1: Location of 25km grid box (ID: 1629)

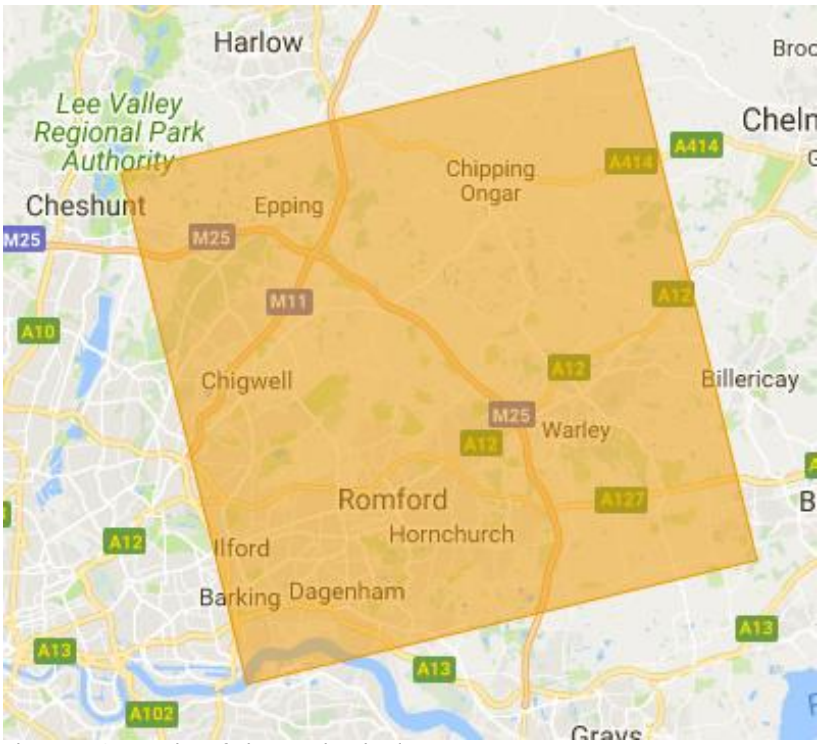


Figure 14.2: Location of Thames river basin

14.3 Planning and policy context

14.3.1 A summary of the legislation, regulatory and policy framework for both the effects of the Scheme and the vulnerability of the Scheme to climate change is provided in Table 14.2 below.

Table 14.2: Relevant Legislation, regulation and policies

Legislation/ Regulation	Summary of Requirements
National Planning Policy Framework (NPPF) 2012	Chapter 10 Meeting the challenge of climate change, flooding and coastal change considers the role of development in mitigating and increasing resilience to climate change. Where development is being brought forward in a vulnerable area, the NPPF stipulates that suitable adaption measures such as green infrastructure can be used to make the development acceptable in planning terms.
National Networks National Policy Statement (NN NPS)	In line with the objectives and provisions of the Climate Change Act (2008), the NPPF states that local authorities should adopt proactive strategies to mitigate and adapt to climate change. Paragraph 2.7 notes that network improvements can be used to improve resilience and adapt to climate change and extreme weather everts as well as reducing congestion. Paragraph 5.15 reiterates the EIA directive for climate to be considered within the Environmental Statement. Paragraph 4.39 states that “new development should be planned to avoid increased vulnerability to the range of impacts arising from climate change”. Paragraph 4.42 requires the applicant to take into account the potential impacts of climate change using latest UK climate Projections available at that time.

Legislation/ Regulation	Summary of Requirements
	The NPS states that, "the annual CO_2 impacts from delivering a programme of investment on the Strategic Road Network of the scale envisaged in Investing in Britain's Future amount to well below 0.1% of average annual carbon emissions allowed in the fourth carbon budget". However, the NPS requires that an assessment of emissions is carried out and mitigation measures are implemented. The NPS assessment also has to include evidence of the emissions impacts of a Scheme and comparison of them against Government budgets.
Town and Country Planning (Environmental Impact Assessment) Regulations 2017	The requirement to consider a project's vulnerability to climate change has resulted from the 2014 amendment to the EIA Directive (2014/52). The Directive has been fully transposed into UK law in the Town and Country Planning (Environmental Impact Assessment) Regulations and came into force in the UK on the 16th May 2017. The Directive requires: "*A description of the likely significant effects of the project on climate (for example the nature and magnitude of greenhouse gas emissions) and the vulnerability of the project to climate change.*"
Road Investment Strategy (RIS) and Strategic Business Plan 2015	The Government's Road Investment Strategy will see £15.2 billion invested in over 100 road schemes between 2015 and 2021 (DfT, 2014b). Of this total, some £300 million has been allocated to address issues including flooding, carbon emissions, landscape and biodiversity.
Highways Agency Climate Change Adaptation Strategy and Framework (2009)	The Highways Agency Climate Change Adaptation Strategy and Framework has led to modifications in existing standards on the national network. Local roads are maintained by upper tier and unitary local authorities in Great Britain. For local roads, the UK Roads Liaison Group Code of Practice for Well Maintained Highways sets out a regularly updated set of recommendations for dealing with climate change by local authorities.
Highways Agency Carbon Routemap: opportunities for a national low carbon transportation system (2014)	The Highways Agency Routemap covers the direct and indirect greenhouse gas emissions associated with the Agency's organisational activity, the highway asset base and associated supply chain, and those arising from the use of the network by customers.
Climate Change Act 2008	The Climate Change Act (2008) strengthened the institutional framework in respect of planning policy and managing the impact of climate change. The Government has established legally binding carbon reduction targets through the Climate Change Act 2008 to drive the reduction requirements required by the Kyoto Protocol. The overall objective is to reduce emissions by at least 80% of the 1990 base level year by 2050 (UK Government, 2008). Additionally, as set out in Table 14-3 below, total emissions limits (carbon budgets) and interim targets have been specified to drive intermediate emissions reductions, and to enable progress tracking.
The Carbon Plan (Department of Energy and Climate Change (DECC), 2011	The Carbon Plan sets out how the UK will achieve the necessary decarbonisation. The Plan advises that emissions from domestic transport and industry (which produces the materials and products for transport infrastructure) make up nearly half of the UK's total emissions.

Legislation/ Regulation	Summary of Requirements
Construction 2025 (July 2013) HM Government	Construction 2025 sets out how efficiency improvements for construction and operation of new buildings and infrastructure will be achieved, including a target to reduce emissions by 50%.
Infrastructure Carbon Review (2013) HM Treasury	The Infrastructure Carbon Review sets out carbon reduction action required by infrastructure organisations that have formally endorsed the review; this includes Highways England. The Review shows that the infrastructure industry controls 16% of the UK's total carbon emissions, covering construction (A1-5), and operation and maintenance of assets (B1-8). It also highlights that a further 37% of carbon emissions are related to the use of infrastructure assets (B9), over which the industry can have some influence.

Table 14.3: UK carbon reduction targets

Carbon Budget	Carbon Budget Level	Reduction Below 1990 Levels
3rd carbon budget (2018 to 2022)	2,544 $MtCO_2e$	37% by 2020
4th carbon budget (2023 to 2027)	1,950 $MtCO_2e$	51% by 2025
5th carbon budget (2028 to 2032)	1,725 $MtCO_2e$	57% by 2030

Table Source: UK Government Carbon Reduction Targets 2008

14.3.2 Further relevant information and guidance includes:

- Highways England (2016) Major Projects' Instructions: Environmental Impact Assessment: Implementing the Requirements of 2011/92/EU as amended by 2014/52/EU (EIA Directive);
- UK Climate Projections 2009 (UKCP09) (Murphy et al., 2009);
- UK Climate Change Risk Assessment (2017) (ASC, 2016a);
- National Adaptation Programme (HM Government, 2013); and
- European Commission Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment (European Commission, 2013).

14.3.3 Climate resilience and climate change adaptation is fast becoming an established issue in EIA policy, practice and organisational and planning policies. This is in response to legislative and regulatory drivers, but also in response to the nature of the risks and associated costs presented to projects and programmes. The consideration of climate resilience issues for the Scheme is therefore not only important to demonstrate compliance with these legislative and regulatory requirements, but to also demonstrate and respond to the Scheme's long-term resilience for planning effective and efficient operation.

14.4 Baseline conditions

Effects of the Scheme on climate

14.4.1 The baseline conditions for effects on climate are defined by the national background emissions and emissions estimations for other highways schemes. Both baselines are outlined in the following sections.

National Emissions Baseline

14.4.2 It is acknowledged that total global emissions from all sources amount to approximately 50 billion tonnes of CO_2e. However, it is not considered representative to compare any UK scheme against this, as any scheme will always be negligible. Instead, it is considered most appropriate to use the national baseline for comparison as it is magnitude and is more relevant, and UK specific. The total background UK emissions for 2015 (the last reported year) is 495.7 million tonnes of CO_2e. The breakdown of this by sector, by final user is shown in Table 14.4.

Table 14.4: National Emissions

Sector (by final user)	GHG Emissions (Million tonnes of CO_2)	% of total
Business	147	29.66%
Transport	134.9	27.21%
Public	14.6	2.95%
Residential	112.1	22.61%
Agriculture	51.1	10.31%
Industrial processes	13.3	2.68%
Land use, land use change and forestry	-7.4	-1.49%
Waste management	18.2	3.67%
Exports	12.1	2.44%
Grand Total	495.7	n/a

Table Source: www.UK.gov 2017 Final UK greenhouse gas emissions national statistics

Scheme Emissions Baseline

14.4.3 Emissions baselines from other highways schemes, as set out in Table 14.5, overleaf, provides appropriate data to act as both baselines and a proxy for the M25 Junction 28. These have been obtained from the M4 Corridor around Newport, Environmental Statement (Welsh Government, 2016) as the best available source of such baseline data.

Table 14.5: Scheme Emissions Benchmarks

	Project / Length & width Component							
	M4CaN	A14	A465	HA project A	HA project B	HA project C	HA project D	HA Project E
Carbon Footprint Lifecycle Stages	23km New relief road	37km improvement scheme	7.8km embankment section	26.6km widening of A road	6.5km single to 2 lane dual carriageway	4km upgrade of existing junction	0.7km Refurbished existing viaduct	22.1km Upgrade from dual to 3 lanes
CapCO_2								
Material	436,600	740,100	44,300	74,500	77,300	36,100	5,800	213,700
Labour + Plant	42,800	243,800	5,800	38,500	27,500	8,200	4,000	20,900
Earthworks	43,200		2,500					
Construction tCO_2e / km	21,800	26,600	6,700	4,300	16,100	11,100	13,900	10,600
OpCO2								
Operation + Maintenance/ annum	1,600	2,400	2,600	n/a	n/a	n/a	n/a	n/a
UseCO2								
Use / annum	2,268,700	4,386,400	882,000	n/a	n/a	n/a	n/a	n/a

Table Source: Welsh Government, M4 Corridor around Newport, Environmental Statement: Volume 3, Appendix 2.4 Carbon Report, March 2016, Table 6: Comparison of the M4CaN carbon with other road infrastructure projects – expressed in tCO_2e

Vulnerability of the Scheme to climate change

14.4.4 This section describes the baseline conditions, including a description of current local climate, past extreme weather events and projected changes in climate. In the detailed assessment phase, a comprehensive data and literature review will be produced that takes account of the latest science and evidence to capture recent and projected changes in climate and evidence of recent impacts related to extreme weather events.

14.4.5 Table 14.6 provides a summary of the local climate, whilst Table 14.7 provides a summary of weather extreme records for South-East and Central Southern England.

Table 14.6: Writtle climate (1981 to 2010)

	Average Maximum Temperature (°C)	Average Minimum Temperature (°C)	Days of air frost (days)	Sunshine (hours)	Seasonal Rainfall (mm)	Days of rainfall >= 1 mm (days)	Monthly mean wind speed at 10m (knots)
Winter	8	1	32	182	145	30	n/a
Spring	14	4	19	189	79	18	n/a
Summer	22	11	12	278	82	18	n/a
Autumn	15	7	6	362	90	18	n/a
Annual	15	6	1	395	99	17	n/a

Table Source: https://www.metoffice.gov.uk/public/weather/climate. Winter is defined as December to February, Spring is March to May, Summer is June to August and Winter is September to November.

Table 14.7: Weather extreme records: South-East and Central Southern England

Variable	Value	Date	Location
Highest daily maximum temperature (°C)	38.5	10 August 2003 Faversham	10 August 2003 Faversham
Lowest daily maximum temperature (°C)	-19.5	14 January 1982	Lacock (Wiltshire)
Highest 155-minute total rainfall (UK)	169mm	14 August 1975	Hampstead (Greater London)

Table Source: https://www.metoffice.gov.uk/public/weather/climate-extremes/#?tab=climateExtremes

14.4.6 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%.

14.4.7 In the detailed assessment phase, UKCP09 gridded data relevant to the study area will be presented.

14.5 Potential impacts

Effects of the Scheme on climate

14.5.1 As stated in Section 14.3, effects on climate is a wide-ranging and complex topic as it covers the whole project life-cycle and emissions from sources that could be on an international scale. In comparison, the receptor and impact of effects on climate are very specific, as follows:

- there is only one receptor, the atmosphere, which is entirely non-site specific; and
- there is only one impact, global warming, which occurs with the same level of effect per unit of emissions and is also entirely non-site specific.

14.5.2 These characteristics place the focus of the potential impacts on the sources and the quantity of emissions that they generate, because it is the magnitude of emissions from each source, and in total, that define the overall impact. Given this, the impacts are taken as the quantities of emissions occurring from each life-cycle or sub-activity thereof, as listed in Table 14.1. Further, the level of impact will be considered by comparison of the Scheme against, the different lifecycle stages, the national baseline and other highways schemes.

14.5.3 Overall positive impacts of the Scheme will potentially arise from reductions in emissions resulting from improved energy efficiency, and reduced vehicle idling/ congestion/ journey times. The reduced operational energy (B6) and traffic (B9) emissions once operational, relative to the baseline emissions will be calculated based on the data available in the ES.

Vulnerability of the Scheme to climate change

Potential impacts on receptors

14.5.4 Table 14.8 summaries the potential impacts of climate change and extreme weather events on the road infrastructure receptors of the Scheme that are 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.

Table 14.8: Typical climate impacts on road infrastructure

Aspect	Impact: Precipitation (high and increasing)	Impact: Precipitation (low and decreasing)	Impact: Temperature (high and increasing)	Impact: Wind
Roads	• Flooding • Loss of strength of layer materials • Damage to structure and surfaces • Erosion of unpaved shoulders • Traffic disruption and congestion	• Damage to thin surfaces and asphalt • More rapid binder deterioration	• Ageing of bituminous binders • Softening, deformation and damage to bitumen in asphalt • Expansion and buckling of concrete roads and structures • Reduced visibility and operational disruption (fires)	• Accumulation of debris • Wind-loading of structures
Bridges and culverts	• Increased river scour		• Expansion and buckling of concrete roads and structures	• Wind-loading of structures
Earthworks	• Increased slope instability • Soil saturation • Erosion of surface • Undercutting • Excessive vegetation growth	• Earthworks failure due to desiccation • Damage to vegetation and more difficult to establish erosion protection measure		• Erosion
Subgrade soils	• Soil softening, erosion collapse and settlement • Deformation of rigid structures	• Shrinkage and cracking		

Aspect	Impact: Precipitation (high and increasing)	Impact: Precipitation (low and decreasing)	Impact: Temperature (high and increasing)	Impact: Wind
Drainage	• Blockages • Water accumulation • Erosion and scour of structures and surfaces • Softening of subsurface materials	• Erosion, silting and sedimentation	• Expansion, cracking and erosion • Loss of vegetation	
Construction	• Difficult working conditions • Excessive moisture in materials • Reduced working periods and increased delays • Water damage	• More dust • Evaporation of construction water	• Enhanced reactions when cement Stabilising and drying of concrete • Difficult working conditions • Damage and disruption (fires)	• Difficult working conditions • More dust • Evaporation of construction water
Operation and maintenance	• Additional damage and maintenance requirement • Reduced opportunities maintenance • Operational disruption			

Climate vulnerability assessment

14.5.5 Table 14.9 assesses the sensitivity of the road infrastructure and the regional (London) geographic exposure to extreme weather and climate change to determine the level of climate vulnerability based on the scale as set out in the matrix in Table 14.12:

- **High**: High climate sensitivity/exposure;
- **Moderate**: Moderate climate sensitivity/exposure; and,
- **Low**: No significant climate sensitivity/exposure.

Table 14.9: Climate vulnerability assessment: Road infrastructure, London

Climate variable/hazard	Regional exposure	Sector sensitivity	Climate vulnerability
Average (air) temperature change (annual, seasonal, monthly)	High	Low	Low
Extreme (air) temperature (frequency and magnitude)	High	Moderate	Moderate
Average precipitation (annual, seasonal, monthly)	High	Low	Low

Climate variable/hazard	Regional exposure	Sector sensitivity	Climate vulnerability
Extreme rainfall (frequency and magnitude)	High	High	High
Average wind speed change (annual, seasonal, monthly)	Moderate	Low	Low
Gales and extreme winds (frequency and magnitude)	Moderate	High	Moderate
Humidity	Moderate	Low	Low
Solar radiation	Moderate	High	Moderate
Sea level rise (plus local land movements), storm surge/tide	Low	High	Low
Water availability/drought	High	Low	Low
Flood (coastal and fluvial)	High	High	High
Subsidence and ground stability	Moderate	High	Moderate
Fog	Moderate	Moderate	Moderate
Storms (tracks and intensity), including storm surge	Low	High	Low
Snow, ice and hail	Moderate	High	Moderate
Storms and lightning	Moderate	Moderate	Moderate

14.6 Proposed level and scope of assessment

Effects of the Scheme on climate

14.6.1 Using DMRB terminology, a ‘simple’ assessment of the Scheme’s effects on climate will be undertaken using a desk based assessment to quantify the magnitude of emissions and determine the significance of effect. The level of detail will be determined by the data available to inform the assessment.

14.6.2 Revision to the guidance on determining significance is currently underway and will be addressed and updated in the ES.

14.6.3 The scope of assessment for effects on climate comprises the study area as defined in Section 14.4.

Vulnerability of the Scheme to climate change

14.6.4 Potential significant effects are anticipated for the Scheme (particularly relating to extreme rainfall and flooding). This section outlines the temporal and spatial boundaries of the scoping assessment, including the use of relevant climate change projections to identify future changes in climate.

14.6.5 Table 14.10 contains a summary of the climate change projections from UKCP09 that will be used in the assessment. An evolving climate baseline will be developed to understand the current climate and how this is projected to change over time, together with the associated impact on road infrastructure in the region. This is split between the current (1981-2010) and future climate periods.

Table 14.10: UKCP09 Climate change scenarios to be used in the assessment of exposure

Effects	Emissions scenario
2010 – 2039 (2020s)	High (IPCC SRES: A1FI) only*
2030 – 2059 (2040s)	High (IPCC SRES: A1FI), Medium (IPCC SRES: A1B), Low (IPCC SRES: B1)
2070 – 2099 (2080s)	High (IPCC SRES: A1FI), Medium (IPCC SRES: A1B), Low (IPCC SRES: B1)

*Regardless of any mitigating actions taken now, we are locked into a High emissions path for the next 2-3 decades.

14.6.6 The assessment will be spatially bound by the UK probabilistic projections 25 km grid box (ID: 1668), which fully encapsulates the study area (see Figure 14.2 Location of Thames river basin). Analysis of climate variables will be reported at this spatial scale. Where appropriate, the assessment will be focussed at the Scheme level with reference made to the area (the local area as determined by the design plans) and the region (London and the Thames river basin, where appropriate). The Stanford-le-Hope weather station has been selected as the most appropriate comprehensive source of weather and climate information which is representative of the area.

14.7 Proposed assessment methodology

Effects on climate

14.7.1 The GHG emissions will be quantified according to PAS 2080.

14.7.2 The assessment methodology will use design and construction data available within the timeframes of the assessment. All information will be taken at face-value. If data is not available within the timeframes of the assessment the scope of the assessment will be reduced.

14.7.3 It is proposed that emissions estimates and emissions calculations will be undertaken in Atkins Carbon Knowledgebase (CKB) and succinctly presented in tabular format in the ES. The CKB will be structured in accordance with the study area as defined in Section 14.2.

14.7.4 The CKB is an in-house, web-based carbon calculation and analysis software tool for the building and construction industry that can be used to calculate and assess footprints using an extensive database of emissions data. Using the tool's 'Project Tree' functionality each item, activity, or process for the lifecycle stages will be defined as a line item, in tiers according to the various project areas and lifecycle stages. The associated project data is then entered using pre-defined calculation formulas (defined specifically to enable direct use of project data) and the associated carbon conversions factors, both of which are provided in a library in the tool. The tool then automatically generates the GHG emissions inventory according to the project data entered and the associated carbon conversions factors used.

14.7.5 The CKB has a proven track record on infrastructure schemes, including NSIPs (e.g. Thames Tideway Tunnel), and was considered to be the most effective means to undertake the assessment.

14.7.6 Once the emissions from the Scheme have been estimated from the baseline traffic data these will be compared against the baseline 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 (Chapter 4). Very large to moderate effects are considered to have the potential to be significant, while slight and neutral effects are not considered significant.

Vulnerability of the Scheme to climate change

14.7.7 The methodology for integrating the consideration of climate change into the EIA process aligns with the following UK and international guidance:

- Highways England (2016) Major Projects' Instructions: Environmental Impact Assessment: Implementing the Requirements of 2011/92/EU as amended by 2014/52/EU (EIA Directive); and
- European Commission (2013) Guidance on Integrating Climate Change and Biodiversity into Environmental Impact Assessment.

Scoping phase

Step one: identify receptors and analysis of legal requirements

14.7.8 The relevant road infrastructure were identified in Section 14.5.4 that could be affected by climate change with consideration for:

- The impact of extreme weather and changes in climate on the Scheme over its lifetime;
- The impact of the Scheme on the climate resilience of wider (social, environmental and economic) systems over time (reflecting on the climate change issues associated with other relevant assessment areas of the EIA); and
- The legislation requirements and policy context was also considered.

Step two: climate vulnerability assessment

14.7.9 A climate vulnerably assessment will be undertaken to clearly identify the primary receptors that are vulnerable and the nature of this vulnerability over the life of the project. These vulnerabilities will then inform the detailed assessment phase.

14.7.10 The vulnerability of a project to extreme weather and climate change depends on:

- The typical sensitivity of the type of the project to climate variables and hazards; and
- The geographic exposure of the project to climate variables and hazards.

14.7.11 The climate vulnerability assessment will be informed by a qualitative sensitivity analysis and an assessment of exposure from an evolving baseline. The sensitivity analysis will focus on identifying the typical climate sensitivities for receptors to relevant climate variables and climate-related hazards, such as those outlined in Table 14.11. The level of exposure of the primary receptors is then determined based on an expert understanding and review of observed

climate, scenarios for projected future climate and a literature review of climate hazards associated with the prescribed changes.

Table 14.11: Typical climate variables and related hazards

Climate variable	Climate-related hazard
Average (air) temperature change (annual, seasonal, monthly)	Sea level rise (plus local land movements), storm surge/tide
Extreme (air) temperature (frequency and magnitude)	Water availability/drought
Average precipitation (annual, seasonal, monthly)	Flood (coastal and fluvial)
Extreme rainfall (frequency and magnitude)	Subsidence and ground stability
Average wind speed change (annual, seasonal, monthly)	Fog
Gales and extreme winds (frequency and magnitude)	Storms (tracks and intensity), including storm surge
Humidity	Snow, ice and hail
Solar radiation	Storms and lightning

14.7.12 A categorisation will then be assigned to each climate variable/hazards in relation to each receptor based on the following scale:

- **High:** High climate sensitivity/exposure;
- **Moderate**: Moderate climate sensitivity/exposure; and
- **Low:** No significant climate sensitivity/exposure.

14.7.13 This represents a qualitative assessment informed by expert opinion, supporting literature and stakeholder engagement. The vulnerability of primary receptors to relevant climate variables and hazards will then be determined using the vulnerability matrix below (see Table 14.12). High and selected Moderate vulnerabilities will then be taken forward to the detailed assessment stage (as part of the ES).

Table 14.12: Vulnerability rating matrix

Sensitivity	Exposure		
	Low	Medium	High
Low	Low	Low	Low
Medium	Low	Moderate	Moderate
High	Low	Moderate	High

Detailed assessment phase

14.7.14 Steps three and four will be undertaken as part of the ES.

Step three: baseline conditions

14.7.15 In support of the climate risk assessment an evolving climate baseline will produce a profile of key climate variables and hazards and how they are

expected to change over the life of the project. The evolving baseline will be based on local/regional Met Office observed extreme weather and climate data, UKCP09 climate projections (with consideration for the associated uncertainty) and other relevant sources of climate risks data and information. Note, this methodology will adopt UKCP18 climate projections once they are made available next year.

Step four: impact assessment

14.7.16 A detailed impact assessment will be undertaken, as required, for selected Moderate and High climate vulnerabilities identified. The foundation for this assessment will be a qualitative assessment based on expert judgment, engagement with project stakeholders and a review of relevant literature. This process will however be supplemented with quantitative data and information where available.

14.7.17 The assessment will focus on identifying and appraising the specific impact of relevant climate variables and hazards on primary project receptors over the life of the project. Taking account of the contribution of incorporated measures to climate resilience, this assessment will outline the level of climate resilience of each receptor to significant climate variable/hazards based on the following rankings:

- **High** - A strong degree of climate resilience, remedial action or adaptation may be required but is not a priority;
- **Moderate** - A moderate degree of climate resilience, remedial action or adaptation is suggested; and
- **Low** - A low level of climate resilience, remedial action or adaptation is required as a priority.

Step five: avoidance, minimisation, adaptation and compensation measures

14.7.18 Recommendations for supplementary climate change adaptation measures for all Low and selected Moderate level of climate resilience will be identified. The identification of possible measures will focus on:

Adaptation actions:

- Design;
- Operational and maintenance;
- Planning; and
- Financial.

Adaptive capacity building:

- Information;
- Supportive social structures; and
- Supportive governance.

14.8 Vulnerability to major accident and disasters

Effects of the Scheme on climate

14.8.1 Major accidents and disasters which could potentially cause emissions include: events which could affect traffic in the area such as major road traffic accidents, terrorist attacks or plane crashes; and other events such as fires or chemical explosions which cause release of emissions. The potential for change in significance on emissions will be discussed as part of the assessment in the ES. However, it should be noted that any effect would be temporary and considered unlikely to significantly affect total emissions.

Vulnerability of the Scheme to climate change

14.8.2 The risk of major accidents and disasters is greater during cold extremes, precipitation events and warmer temperatures. This is due reduced visibility, more difficult braking and an influence on the mode, frequency, and types of trips that individuals take. Increasing temperatures and changes in precipitation patterns has the potential to exacerbate road safety issues further.

14.8.3 Moreover, extreme events (such as heavy precipitation, drought and/or storms) may further exacerbate risks during major accidents and/or disasters.

14.9 Proposed Consultation

Effects of the Scheme on climate

14.9.1 It proposed that the surrounding county and borough councils will be consulted on the proposed assessment methodology post submission of the Scoping Report (Essex County Council and the Greater London Authority).

Vulnerability of the Scheme to climate change

14.9.2 In identifying receptors with High or Medium vulnerabilities to climate change and extreme weather, we will seek technical advice from relevant Highways England staff (i.e. local route managers or similar), local authority and the EA flood officer to inform the vulnerability assessment and to seek their advice as to the development of appropriate mitigation measures.

14.10 Potential mitigation measures

Effects of the Scheme on climate

14.10.1 Strategically, GHG emissions are mitigated by applying the internationally recognised carbon reduction hierarchy, 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.

14.10.2 This can be applied at an overall Scheme level and/ or at structures/ equipment level. Examples of the interpretation of these measures by lifecycle stage is provided in Table 14.13.

14.10.3 It should be acknowledged that the incorporation of such measures may be post the submission of the ES, as they are likely to be associated with design detail and/ or the appointed construction and operational contractor(s).

Table 14.13: GHG Emissions Mitigation Measures

Lifecycle Scope	Mitigation Measures
Temporary and permanent construction materials (A1-3):	Reduction of materials consumption will be carried out as specified for Materials and Waste. In additional, consideration will be given to alternative low carbon materials. All such consideration will ensure a whole life carbon assessment is undertaken to avoid designing with low carbon materials that have low life span.
Materials Transportation (A4):	Materials transportation distances will be avoided by minimising the quantity of materials required, as per A1-3. Additionally, where possible designs will be specified to minimise the necessity to source materials from long distances.
Construction Plant (A5):	Construction plant emissions will be minimised by designing for efficient construction processes as part of design development. During construction plant emissions will be managed via the Construction Environmental Management Plan, which should specify plant operator efficiency requirements.
Construction Water Use (A5):	Construction mains water consumption will be minimised by designing for efficient construction processes as part of design development. During construction mains water consumption will be managed via the Construction Environmental Management Plan, which should specify reduction and reuse measures, and rain water harvesting.
Construction Waste Transportation (A5):	Reduction of waste will be carried out as specified for Materials and Waste.
Construction Waste Off-Site Processing (A5):	Reduction of waste will be carried out as specified for Materials and Waste.
Replacement (B2-5):	Replacement cycles will be mitigated through design by designing for long-life and ease of deconstruction and recycling.
Operational Energy (B6):	Operational energy use will be minimised by designing for use of low energy lighting, and specification on controls that minimise on-time.
In-use Traffic (B9):	Mitigation of in-use traffic emissions will be as specified in the Air Quality section.

Vulnerability of the Scheme to climate change

14.10.4 Table 14.14 summarises some potential mitigation measures for reducing vulnerability road infrastructure receptors to climate impacts. During the detailed assessment phase we will engage with the project teams, including engineers, to identify the provision of appropriate mitigation measures for High (and selected Medium) impacts.

Table 14.14: Selected impact mitigation measures for roads

Aspect	Proposed measure(s)
Roads and supporting infrastructure	• Higher degree of compaction; • Appropriate structural designs, surfaces and construction; • Use different (harder) binders in asphalt; • Changes to concrete mixes and reinforcing; • Raise riding surface and appropriate drainage; • Accounting for climate risks in maintenance regimes; • Use of heat resistant surfacing materials; • Replacement of bridge expansion joints; and • Provide shade for roads, footpaths and cycleways.
Earthworks	• Higher degree of compaction; • Appropriate drainage; • Appropriate structural design; • Maintenance; • Slope stabilisation measures; • Green infrastructure (deep-rooted, drought resistant vegetation); • Isolation of susceptible soils; and • Construct at in-service moisture conditions.
Drainage	• Appropriate structural design and construction; • Strengthen embankments and cuttings; • Modify extreme rainfall return periods in design; • Maintenance; • Increase culvert and bridge openings; • Concrete and reinforcement; and • Green/blue infrastructure.
Construction	• More night-time construction to avoid undue heat stress for construction workers; • Construct in dry season; • Greater use of unslaked lime; • Modified and innovative construction techniques; • Water efficiency measures; and • Dust management plan.
Operation and maintenance	• Adequate resources and capacity in place; • Local community maintenance programmes; • More regular maintenance and preventative action; • Underpinning the efficiency and effectiveness of incorporated climate change adaptation measures; • Emergency planning for climate impacts; • Early warning systems and evacuation routes; • Monitoring and evaluation of asset resilience to inform climate change adaptation decision-making; • The incorporation of adaptation measures to existing assets during planned maintenance and repairs; and • Water efficiency measures.

14.11 Assumptions and limitations

Effects of the Scheme on climate

14.11.1 The key limitation to the proposed assessment methodology is the availability of data within the timeframes of the assessment.

14.11.2 It is assumed:

- For the purposes of consultation, a detailed emissions assessment is not required; and
- Where project specific data is not available, suitable proxy data can be applied, where sufficient engineering and construction expertise can be obtained to generate the such data.

Vulnerability of the Scheme to climate change

14.11.3 The assessment will provide a broad, high-level indication of potential impacts of climate change on the Scheme based on simple, qualitative assessment and professional judgement.

14.11.4 This assessment is based on an observational climate data set and the accompany UKCP09 projections. Modelled data for the future are not predictions of climate but simulations of future climate under a range of hypothetical emissions scenarios.

14.11.5 The assessment will be undertaken using data from UKCP09. Updated climate change projections are due to be published in 2018 (UKCP18). The UKCP18 project will update the UKCP09 projections over UK land areas and update UKCP09 projections of sea-level rise, giving greater regional detail, and provide more information on potential extremes and impacts of climate change. As the exact date for the release of UKCP18 is not known, the assessment of the impacts of climate change on the Scheme will proceed using climate data from UKCP09, until such time as the updated projections are made available. A study by the Met Office shows that UKCP09 continues to provide a valid assessment of the UK climate and can still be used for adaptation planning.

14.11.6 Any further research, analysis or decision-making should take account of the accuracies and uncertainties associated with climate projections. It is also important to note that the analysis is based on selected observational data, the results of climate model ensembles and a selected range of existing climate change research and literature available at the time of assessment. Any future decision-making based on this analysis should consider the range of literature, evidence and research available and any changes to this.

14.11.7 The determination of resilience has been undertaken under the assumption that robust design standards will be adhered to where detailed information is unavailable.

14.12 Conclusions

Effects of the Scheme on climate

14.12.1 Based on the inconclusive determination of the impact of the emissions, and the requirement of the NPS for an emission assessment to be carried out, an

assessment is deemed to be required, as set out in Table 14.15 and subject to availability of necessary design and construction information.

Table 14.15: GHG emissions scoped in and out of further assessment

Lifecycle Scope	Scoped in (✓) / out (✗)	Comment/Justification
Temporary and permanent construction materials (A1-3):	✓	Currently no calculated data.
Materials Transportation (A4):	✓	Currently no calculated data.
Construction Plant (A5):	✓	Currently no calculated data.
Construction Water Use (A5):	✓	Currently no calculated data.
Construction Waste Transportation (A5):	✓	Currently no calculated data.
Construction Waste Off-Site Processing (A5):	✓	Currently no calculated data.
Replacement (B2-5):	✓	Currently no calculated data.
Operational Energy (B6):	✓	Currently no calculated data.

Vulnerability of the Scheme to climate change

14.12.2 Table 14.16 outlines the findings from the climate vulnerability assessment. 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.

Table 14.16: Findings of the scoping phase: climate vulnerability

Effects	Scoped in (✓) / out (✗)		Comment/Justification
	Construction	Operation	
Average (air) temperature change (annual, seasonal, monthly)	✗	✗	Low climate vulnerability
Extreme (air) temperature (frequency and magnitude)	✓	✓	Moderate climate vulnerability
Average precipitation (annual, seasonal, monthly)	✗	✗	Low climate vulnerability
Extreme rainfall (frequency and magnitude)	✓	✓	High climate vulnerability
Average wind speed change (annual, seasonal, monthly)	✗	✗	Low climate vulnerability
Gales and extreme winds (frequency and magnitude)	✓	✓	Moderate climate vulnerability
Humidity	✗	✗	Low climate vulnerability
Solar radiation	✓	✓	Moderate climate vulnerability
Sea level rise (plus local land movements), storm surge/tide	✗	✗	Low climate vulnerability
Water availability/drought	✗	✗	Low climate vulnerability
Flood (coastal and fluvial)	✓	✓	High climate vulnerability
Subsidence and ground stability	✓	✓	Moderate climate vulnerability
Fog	✓	✓	Moderate climate vulnerability
Storms (tracks and intensity), including storm surge	✗	✗	Low climate vulnerability
Snow, ice and hail	✓	✓	Moderate climate vulnerability
Storms and lightning	✓	✓	Moderate climate vulnerability

15. Assessment of Cumulative Effects

15.1 Introduction

15.1.1 The cumulative effects chapter of the ES will bring together the principal findings of each of the above topic areas, identifying and assessing the combined effects of the Scheme. The anticipated cumulative effects of the Scheme will be considered with other existing or future significant development projects within the study area.

15.1.2 The requirement for cumulative effects assessment (CEA) is set out in Article 4(3) and Article 5(1) of the Environmental Impact Assessment (EIA) Directive. The requirements of the Directive are implemented through the EIA Regulations. The assessment of cumulative effects will use the guidance provided in DMRB Volume 11 Section 2 Part 5 Assessment and Management of Environmental Effects as well as the advice contained in PINS advice notes.

15.1.3 Cumulative effects "result from multiple actions on receptors and resources and over time and are generally additive or interactive (synergistic) in nature. Cumulative impacts can also be considered as impacts resulting from incremental changes caused by other past, present or reasonably foreseeable actions together with the project" (Guidelines for the Assessment of Indirect and Cumulative Impacts as well as Impact Interaction, European Commission, May 1999). Cumulative effects are broadly effects that result from the accumulation of a number of individual effects that may also have synergistic aspects.

15.2 Baseline

15.2.1 In order to carry out the assessment it is necessary to define the location and timing of nearby potential developments. In effect, the 'study area' will encompass all schemes which are 'committed' i.e. with valid planning consent including (but not necessarily limited to):

15.2.2 These should include but will not necessarily be 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 project.

15.2.3 The proposed thresholds and spatial area are as follows:

- Nationally Significant Infrastructure Projects – 10 km from the red line boundary;
- Regionally Significant Projects (e.g. a relevant major development) – 3 km from the red line boundary;

- Major development - within and 1.5 km from the red line boundary; and
- Minor development - within the red line boundary.

15.2.4 These thresholds are considered, based upon professional judgement and taking into account the nature and location of the Scheme, appropriate to the Scheme's likely zone of influence. This approach is congruent with guidance provided within PINS Advice Note 17.

15.2.5 Although the assessment will primarily include developments that are likely to occur and have some form of planning/land use approval, speculative developments will also be mentioned, specifically when their approval is fairly certain and if they are likely to have significant impacts.

Interaction with other projects

15.2.6 The traffic model will take account of the operational effects of major developments in the area and the wider surrounding region.

Trunk Road projects

15.2.7 The following proposed highway interventions are also proposed within the study area:

- A12 J19 Chelmsford to J25/A120 interchange widening scheme- anticipated start date in March 2020. Work is currently being undertaken on the preferred route with a second public consultation intended in Autumn 2017.
- Lower Thames Crossing- the preferred route was announced in April 2017. The new crossing is anticipated to increase capacity by an additional 70% by connecting Essex and Kent.

Development projects

15.2.8 The following development proposals have been found following a desk-based study of the PINS website, relevant local planning authority Local Plans and Proposals maps and planning application searches. This is a provisional list for inclusion in the assessment.

Table 15.1: Provisional list of development projects for inclusion in CEA assessment

Proposal	Council area/ Region	Documentation
Crossrail Approx. 400 m from site	Brentwood and Havering	Brentwood Replacement Local Plan 2005 Brentwood Draft Local Plan 2016 Havering Core Strategy and Development Control Policies DPD 2008
Gypsy and Traveller Site at The Caravan Park, Putwell Bridge Approx. 500 m from site	Havering	LB Havering (Proposals Map Changes July 2017)
Small, Medium, Large Wind Development Sites Approx. 500 m from site	Havering	LB Havering (Proposals Map Changes July 2017)

Proposal	Council area/ Region	Documentation
Cycleway Proposals Approx. 500 m from site	Brentwood	Brentwood Borough Council (adopted)
Change of use of land to burial grounds including removal of existing agricultural buildings and erection of two pavilion buildings for associated usage, hard and soft landscaping, new access to A12 and internal roads and paths, parking, and workshop area for storage of associated equipment, tools and materials. *Approx. 500 m from site*	Havering	Planning application – permitted P1742.14.
001A & 001B Land north of Highwood Close including St Georges Court, Brentwood 52 dwellings Approx. 2,800 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
010 Sow and Grow Nursery, Ongar Road, Pilgrims Hatch 37 dwellings Approx. 3,300 m from site boudary	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
013B Warley Training Centre, Essex Way, Warley 50 dwellings Approx. 2,300 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
022 Land at Honeypot Lane Brentwood The proposal is for 250 residential units Approx 1,850 m from site	Brentwood	Request for Screening Opinion - Environmental Impact Assessment Brentwood Draft Local Plan Site Allocation Maps 2016
039 Westbury Road Car Park, Westbury Road, Brentwood 22 dwellings Approx. 2,100 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
040 Chatham Way/ Crown Street Car Park, Brentwood 26 dwellings Approx. 2,600 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
041 Land at Hunter House, Western Road, Brentwood 22 dwellings Approx. 2,400 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016

Proposal	Council area/ Region	Documentation
081 Council Depot, The Drive, Warley 68 dwellings Approx. 2,700 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
099 Victoria Court, Victoria Road, Brentwood 40 dwellings Approx. 2,600 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
100 Baytree Centre, Brentwood 200 dwellings Approx. 2,800 m from site	Brentwood	Brentwood Draft Local Plan Site Allocation Maps 2016
032 Housing development Proposal for 150 residential units Approx. 650 m from site	Brentwood	Brentwood Draft Local Plan 2016 (expected adoption date 2017) Supporting Document: Site Allocation Maps 2016

15.2.9 This list will be updated as part of the assessment. The provisional 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.

15.3 Potential significant effects and mitigation

15.3.1 The DMRB identifies two types of cumulative impact in environmental assessment:

- Cumulative effects from a single scheme (acknowledging the outcomes of each of the environmental topics assessed for the M25 Junction 28 interchange and
- Cumulative effects from different schemes (assessed in combination with the Scheme in question).

15.3.2 The main source of data for the cumulative effects assessment will be the outcomes and information obtained from the individual environmental topic assessments. The assessment of cumulative effects arising from the Scheme in combination with other schemes will primarily constitute a desk-top study of planning documents broadly covering the location of schemes (if any are identified) considered relevant to the assessment.

15.3.3 Cumulative effects associated with noise, air quality and traffic are likely to increase due to Brentwood Borough Council and London Borough of Havering planned housing schemes. The growing housing requirements are likely to result in more cars using the local transport network and therefore an associated increased pressure on local transport infrastructure.

15.4 Proposed scope and methodology for further assessment

15.4.1 The focus of the desk-top study will be the collection of information relating to the background of relevant projects, their expected timelines and likely environmental impacts.

15.4.2 The ES will include an assessment of the potential for cumulative impacts. This assessment will include consideration of the following three dimensions to cumulative effects:

- Multiple effects on a single receptor (e.g. noise, air quality and visual effects on a single property); and
- Multiple effects on a resource distributed throughout the corridor (e.g. multiple losses of ponds).

15.4.3 The potential for cumulation of impacts arising from the M25 Junction 28 Interchange and the above projects will also be considered as part of the assessment within each topic section of the ES.

15.4.4 The Zone of Influence / Study Area proposed for each of the environmental topic areas is identified in Table 15.2 below. These are subject to change and will be confirmed in the ES.

Table 15.2: Zone of Influence / Study Area

Environmental topic	Zone of influence
Air quality	*Within 200 m of the site boundary.*
Noise and vibration	*600 m from the carriageway edge of any proposed new routes or existing routes to be bypassed or improved, and 600 m from any other affected routes within 1 km of the proposed new routes or altered existing routes.*
Biodiversity	• 2 km for statutory designated sites of nature conservation importance: SACs, SPAs, Ramsar sites, SSSIs, and NNRs and LNR; • 2 km for non-statutory SNCIs; • 30 km for SACs where bats are one of the qualifying species; • 5 km for bat records; • 1 km for notable habitats and notable or legally protected species; and • 1 km for ancient woodlands.
Road Drainage and the Water Environment	*Within 1 km of the Scheme.*
Landscape	• Landscape effects within 1.5 km from the perimeter of the Scheme; and • Visual effects within 1.5 km from the edge of the Scheme.
Geology and Soils	*250 m from the extent of the red line boundary.*
Cultural heritage	*500 m around the alignment of the Scheme.*
Materials and Waste	• Material resources study area includes the demand for key construction materials nationally; and • Waste study area includes the waste arisings and waste infrastructure capacity within the county of Surrey.
People and Communities	• Physical assets study area includes permanent and temporary land take outside of the highway boundary that has potential to result in asset loss; • Amenity and local economy and employment opportunities study areas include any land required for construction or operation of the Scheme and a 500 m buffer area around this land;

Environmental topic	Zone of influence
	• Community severance, accessibility and connectivity study area includes all roads, PRoW, permissive paths, Common Land and Access Land within 1 km of the Scheme; and • Development land study area includes sites within 500 m of the Scheme.

15.4.5 The developments will be identified and year specific assumptions made for the assessments looking at the anticipated peak year of construction and first year of operation.

15.4.6 In line with DMRB Volume 11, Section 2, Part 5, liaison will also be undertaken with the relevant Local Planning Authorities London Borough of Havering and Brentwood Borough Council to determine and agree whether any other schemes in the vicinity of the Scheme should be taken into consideration and when they believe them likely to come forward.

15.4.7 Effects will be identified as short term or long term and temporary or permanent. The following categories in Table 15.3, which are presented in the DMRB, Volume 11, Section 2, Chapter 3 (DMRB Table 2.6) will be used as a framework for determining significance of cumulative effects:

Table 15.3: Determining significance of cumulative effects

Significance	Effect
Severe	Effects that the decision-maker must take into account as the receptor/resource is irretrievably compromised
Major	Effects that may become a key decision-making issue
Moderate	Effects that are unlikely to become issues on whether the project design should be selected, but where future work may be needed to improve on current performance
Minor	Effects that are locally significant
Not significant	Effects that are beyond the current forecasting ability or are within the ability to absorb such change

15.5 Potential mitigation measures

15.5.1 Under each of the topic areas, where significant cumulative effects are identified, beyond those identified as residual effects, additional mitigation measures will be proposed or recommended.

15.5.2 The mitigation measures across all topic areas will be presented in this chapter of the ES.

15.6 Assumptions and limitations

15.6.1 The list of development projects will be updated as part of the assessment.

15.6.2 This provisional 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.

15.6.3 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.

15.7 Conclusion

15.7.1 This chapter of the ES will bring together and present the findings of each of the topic chapters to identify and assess the combined effects of the Scheme and the cumulative effects of the Scheme in association with other development projects within the study area, including details of proposed mitigation.

15.7.2 The cumulative effects arising as a result of the interaction between the Scheme and the planned housing growth in the vicinity will be assessed. Noise, traffic and air quality are likely to be affected by the cumulative impacts of these developments. Details of the anticipated effects will be assessed once the relevant environmental topic assessments have been undertaken.

16. Draft Structure of the Environmental Statement

16.1.1 The draft structure of the ES is provided in Box 16.1 below. A Non-Technical Summary will also be produced.

Box 16.1 Draft Structure of the ES

List of Abbreviations and Acronyms

Non-technical summary

Acronyms and Abbreviations

Section 1 – Introduction

Section 2 - Project Description

Section 3 – Alternatives Considered

Section 4 – Key Legislation and Policy

Section 5 - EIA Process, Approach and Methodology

Section 6 – Consultation

Sections 7 to 16 - Air Quality; Noise and Vibration; Biodiversity; Road Drainage and the Water Environment; Landscape; Geology and Soils; Cultural Heritage; Materials and Waste; People and Communities; and Climate Change. All topic sections to be structured as follows:

- Section 7.1 Introduction
- Section 7.2 Regulatory/Policy Framework
- Section 7.3 Methodology
- Section 7.4 Study Area
- Section 7.5 Baseline Conditions
- Section 7.6 Sensitive Receptors
- Section 7.7 Impact Assessment and Mitigation and Enhancement Measures – Construction Phase
- Section 7.8 Impact Assessment and Mitigation and Enhancement Measures – Operational Phase
- Section 7.9 Residual effects
- Section 7.10 Cumulative effects (this will address cumulative effects with other schemes i.e. interactive effects)
- Section 7.11 Summary - this will include a table summarising the significance of effects both prior to and following the implementation of mitigation
- Section 7.12 References

Section 17– Cumulative Effects

Section 18 - Summary of Effects, Mitigation and Management Measures

Section 19 – Conclusion

Section 20 – References

Section 21 - Glossary

Appendices

17. Summary

17.1.1 This Scoping Report represents the first stage in the EIA process and sets out the proposed methodology for the assessment of the environmental impacts which have potential to arise due to construction and operation of the Scheme. This Scoping Report 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 an ES.

17.1.2 A summary of the potential effects for each environmental topic scoped into the ES for further assessment and scoped out are presented in Table 17.1.

Table 17.1: Summary of the environmental topics effects scoped in and out of the EIA

Effects	Scoped in / out	Comment / Justification
Air Quality		
Construction Dust	✓	Receptors within 200 m of potential dust raising activities.
Construction Traffic	✓	Numbers of additional construction vehicles not yet known so cannot scope out.
Operational Traffic	✓	The Option Selection stage assessment showed that local air quality at receptors within 200 m of the Scheme could be affected by changes in traffic. The Option Selection stage also showed that the Scheme had the potential to increase regional emissions.
Noise and Vibration		
Construction	✓	Information regarding construction methodologies, plant itineraries, activity schedules, activity locations, and construction traffic etc is expected to become available in the EIA process and this information will be appraised accordingly.
Operational Traffic	✓	Simple noise modelling undertaken previously identified the requirement for the Scheme to proceed to a “detailed” DMRB assessment to confirm the level of impact for the Scheme. The detailed noise modelling will incorporate new traffic data obtained from a strategic traffic model and any new mitigation measures incorporated into the design. A further assessment of the impact significance is also required based on the results, particularly at locations where the baseline noise levels already exceed the significant adverse effect level.
Biodiversity		
Internationally designated statutory sites (SAC, SPA, Ramsar)	×	The Scheme will not affect internationally designated sites, as there are no internationally designated sites within 2 km of the Scheme, and no internationally designated sites where bats are one of the qualifying features within 30 km of the Scheme. The Scheme is also not crossing, adjacent to, or upstream/downstream of a watercourse designated as an internationally designated site.
Nationally designated statutory sites (SSSI, NNR)	×	The Scheme will not affect nationally designated sites as there are no nationally designated sites within 2 km of the Scheme.
Locally designated statutory sites (LNR)	×	The Scheme will not affect LNRs as there are no LNRs subject to direct land take or immediately adjacent to the Scheme.

Effects	Scoped in / out	Comment / Justification
Non-statutory designated sites (LWS, SMI, SBI)	✓	Ingrebourne River SMI is subject to direct impacts including land take due to the Scheme.
Ancient woodland	✓	The Scheme will not result in any losses of ancient woodland as there is no ancient woodland subject to direct land take. However, there is ancient woodland immediately adjacent to the Scheme.
Notable habitats	✓	Broadleaved woodland, the Ingrebourne River, and ponds may be subject to impacts from the Scheme, which are HPI.
Notable terrestrial invertebrates	✓	Suitable habitat for notable terrestrial invertebrates may be affected by the Scheme.
Aquatic invertebrates	✓	The Scheme will impact on the Ingrebourne River which may be suitable for notable aquatic invertebrate assemblages or white clawed crayfish which is legally protected.
Great crested-newt	✓	The Scheme may affect ponds and potential suitable terrestrial habitat for great crested newts, a notable species, which is also legally protected.
Reptiles	✓	The Scheme affects potential suitable habitat for reptiles, notable species which are legally protected.
Breeding birds	✓	The Scheme affects potential habitat for notable birds. Nesting birds are also legally protected.
Bats	✓	The Scheme may impact on one or more features suitable for roosting bats, and affect bat foraging habitat and/or disrupt commuting routes. Bats are notable species that are legally protected.
Hazel dormouse	✓	The Scheme affects potential dormouse habitat, a notable species that is legally protected.
Water vole	✓	The Scheme will impact on the Ingrebourne River which may be suitable for water voles, a notable species that is legally protected.
Otter	✓	The Scheme will impact on the Ingrebourne River which may be suitable for otter, a notable species that is legally protected.
Badger	✓	There is potential for disturbance or damage to setts or harm to badgers, which are legally protected, during construction.
Invasive plants	✓	There is potential to cause certain invasive plants species under Schedule 9 of the Wildlife and Countryside Act 1981 to spread (which is an offence) during construction if present.
Road Drainage and the Water Environment		

Effects	Scoped in / out	Comment / Justification
Surface Water	✓	To consider the potential effects from construction activities (largely sedimentation and spillage risk) and operational changes to receiving water shape and quality (changes to profile at watercourse crossings and discharge outfalls). Includes assessment against WFD criteria.
Groundwater	✓	To assess potential effects during construction and operation on groundwater levels and quality (from cuttings and infiltration from the drainage system) and whether this would impact other water users local to the Scheme. Includes assessment against WFD criteria.
Flood Risk	✓	To assess the potential effects during construction and operation from flood risk, both to the Scheme itself and wider land uses. Flood risk can manifest in many forms, including for example, storage of material in floodplains, intercepting groundwater or permeant alterations of a watercourse and its floodplain from the structure itself. Includes a formal FRA.
Landscape (Landscape resources)		
Areas of vegetation including; semi mature and mature planting local to the highway corridors and Junction areas, off site woodland belts, and blocks and hedgerow and individual trees	✓	The Scheme is likely to result in loss of vegetation along the existing road corridors, and in addition sections of Alder Wood are likely to be lost.
Local landscape character features i.e. landform, landscape pattern	✓	These landscape features are likely to be affected by the Scheme as cuttings and earth mounds will be introduced, mainly along the loop lane for traffic travelling from the M25 to A12.
Alder Wood, The Grove – semi natural woodlands	✓	Landscape effects on Alder Wood require further assessment as the Scheme cuts through sections of these woodlands.
Landscape character areas, F13 Great Warley Wooded Farmland Landscape Character Area and F15 Weald Wooded Farmlands	✓	Effects on landscape character require further assessment. The effects on landscape character would take into consideration key attributes of landscape character areas and above listed effects on loss of vegetation, effects on landscape character.
Landscape character at regional and national level	✓	Effects on landscape character require further assessment.
Warley, St Faith's and Weald Country Park (located within (1000 m)	×	There will be no direct or indirect landscape effects on these Country Parks as the Scheme is too distant (both Warley and St Faith's are greater than 1000 m distance) and any potential links with the Parks are broken by the presence of the railway line, intervening vegetation, and built development.

Effects	Scoped in / out	Comment / Justification
Weald Park (Grade II) Registered Park and Garden (located within 1000 m)	×	There will be no direct or indirect effects primarily as there is a dense woodland that forms a buffer between the Scheme and Weald Park. Therefore, the attributes and qualities of this designation will not be affected.
Effects on Ancient & Semi-Natural Woodlands in landscape effects Lower Vicarage Wood, Vicarage Wood Duck Wood, Fir Wood	✓	Landscape effects on Lower Vicarage Wood require further assessment as the Scheme boundary is adjacent to the woodland.
Landscape (Visual receptors)		
Users of the A12 dual carriageway to the west of Junction 28 (located within 500 m)	✓	It is expected that views of road users along the A12 are likely to change considerably during construction and operation.
Maylands Golf Course to the north west of Junction 28 (located within 500 m)	✓	The golf course is located in close proximity to the Scheme and as such, views of golf players will be affected in both construction and operational phases.
Residential receptors at Maylands Cottages and Harold Park to the west of Junction 28 (located within 500 m)	✓	The views from these receptors are likely to change as views from the edges of residential areas to the west are likely to include partial views of construction activities and introduced elements of highway infrastructure.
Users of Grove Farm immediately north west of Junction 28 (located within 50 m)	✓	Grove Farm will be surrounded by loop road and other new proposed elements of the Scheme.
Open access land including Tyler's Common to the south of Tyler's Hall Farm and open access land near Harold Court (located up to 1500 m)	✓	Tyler's Common is a large area of open access land and although it is located at considerable distance from the Scheme, the effects on views from the Common are carried forward for further assessment.
Residential receptors located along Dark Lane (located within 1500 m)	✓	There are some isolated houses located along elevated sections of Dark Lane that may have views of construction activities and operation of the Scheme.

Effects	Scoped in / out	Comment / Justification
Users of bridleway that follows Nags Head Lane and along the section of the bridleway section that follows the crest of the cutting along the existing M25, close to Dark Lane (located within 1500 m)	✓	Views of construction operations or the operation of the Scheme are likely to be available from sections of bridleway.
Putwell Bridge Farm and Oak Farm (located within 500 m)	✓	These residential receptors are located close to the Scheme, and are likely to sustain a change in view.
Employees within business parks (group receptor) adjacent to Brook Street near Junction 28 (located within 1500 m)	✓	These receptors are located close to the Scheme and are likely to have partial views of construction activities or newly introduced elements of the Scheme.
Residential receptors located on Brook Street near Junction 28, just to the west of Vicarage Close (located within 1500 m)	✓	These receptors are located close to the Scheme and may have views of construction activities or newly introduced elements of the Scheme.
Residential receptors in Brentwood (located within 1500 m)	×	Scoped out as the Scheme is located at a distance which is unlikely to significantly affect views from these receptors.
Employees at Telecommunications Head Office and nearby residential properties in Brentwood (located within 2000 m)	×	The views from these receptors are distant and the Scheme will not be visible from most locations however should the views be available these would be partial and would not give rise to significant effects.
Boyles Court, Grade II Listed building (located within 2000 m)	×	Situated to the south east of the M25 Junction 28 is surrounded by a dense woodland that would block views towards the Scheme, therefore there will be no change to the baseline view.
Residential receptors to the north east including Lake House, Colmar Farm, Colmar, Park Farm and Halfway House (located within 1500 m)	×	The views from these properties are blocked by intervening blocks of existing woodland Vicarage Wood, Lower Vicarage Wood and The Oaks.

Effects	Scoped in / out	Comment / Justification
Residential receptors located on Nag's Head Lane linking Brook Street area with Tyler's Common to the south of Junction 28 (located within 1000 m)	×	The views from these receptors are blocked by garden vegetation, belt of trees and vegetation along the existing railway line.
Residential receptors to the north east of the M25 in South Weald situated along Wigley Bush Lane (located within 1000 m)	×	The views blocked completely by Vicarage Wood and Lower Vicarage Wood as well as by wide belt of vegetation along the A12.
Geology and Soils		
Geology as a valuable resource	×	No mineral resources, geological SSSIs or LGS have been identified within the study area.
Soils and agricultural land	✓	Soils around Junction 28 are designated as Grade 3, it is possible that there are small pockets of BMV quality land in the area therefore further assessment is required.
Land contamination including human health, groundwater and surface water	✓	Potential impacts to human health, groundwater and surface water have been identified. Further assessment will be carried out including, but not limited to, production of a CSM and a ground investigation will be completed to ensure these are appropriately understood and mitigated.
Construction and operational phase pollution effects	✓	The development has the potential to introduce new sources of contamination associated with the accidental loss/spillage of fuels and oils.
Physical effects	✓	Physical effects including ground instability and topography will be assessed.
Re-use of soils and waste soils	×	Addressed in the waste section.
Cultural Heritage		
Designated heritage asset	✓	Assessment of the potential effects on designated assets due to physical changes or changes to setting.
Non-designated heritage assets	✓	Assessment of the potential effects on non-designated assets due to physical changes or changes to setting.
Potential for undiscovered archaeology	✓	Assessment of the potential for effects on previously undiscovered archaeological remains due to the Scheme. Emphasis should be placed on the potential of geoarchaeological and/or prehistoric remains at Weald Brook.

Effects	Scoped in / out	Comment / Justification
Historic landscape	×	Significant effects on the historic landscape character of the wider area are not anticipated due to the localised changes to an existing road corridor and junction.
Materials and Waste		
Change in demand for key construction materials during the CD&E phases.	✓	Assessment required to identify and evaluate the impacts of the Scheme against the national demand for key construction materials during the CD&E phases.
Change in demand for key construction materials associated planned/unplanned maintenance with during the operational phase.	×	Minimal impact is envisaged during the operational phase of the Scheme due to minimal material resource use (associated with planned/unplanned maintenance). Data related to operational material resource use by highway schemes is not readily available and as such will not be assessed.
Change in baseline waste arisings during the CD&E phases.	✓	Assessment required to identify and evaluate the impacts of waste arisings from the Scheme against the waste arisings baseline during the CD&E phases. The baseline for CD&E waste will be on a regional level and the baseline for hazardous CD&E waste will be on a national level.
Change in baseline regional waste arisings during the operational phase.	×	Minimal impact is envisaged during the operational stage of the Scheme due to minimal waste generation (through littering and planned/unplanned maintenance). Most of these wastes would likely be non-hazardous municipal type wastes during normal operation, and non-hazardous/inert and hazardous wastes from planned/unplanned maintenance. Data related to waste generated by highway Schemes is not readily available and as such will not be assessed.
Change in capacity of waste infrastructure during the CD&E phase.	✓	Assessment required to identify and evaluate the impacts of waste arisings from the Scheme against the regional waste infrastructure baseline during the CD&E phases. The baseline for CD&E waste will be on a regional level and the baseline for hazardous CD&E waste will be on a national level.
Change in capacity of regional waste infrastructure during the operational phase.	×	Operational waste arisings from the Scheme will not be assessed as it is envisaged that this will be minimal and no data related to waste generated by highway schemes is readily available. Therefore, an assessment will not be made of the potential effect of the operational waste arisings on operational waste infrastructure.
People and Communities		
MT: View from the road	✓	A landscape and visual effects assessment will be undertaken to assess the magnitude of the impact on drivers view from the road.
MT: Driver stress	✓	Transport Assessment traffic data will be used to assess the magnitude of impacts on driver stress.

Effects	Scoped in / out	Comment / Justification
NMU	✓	A desk-based study of paths in the study area and NMU surveys undertaken in 2014 will be used to assess the magnitude of the impacts on NMUs.
Agricultural land and holdings	✓	A desk-based study of land (including Agricultural Land Classification maps), properties and facilities in the area, the geology and soils assessment and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on agricultural land and holdings.
Residential and private property	✓	A desk-based study of land (including Agricultural Land Classification maps), properties and facilities in the area, the geology and soils assessment and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on agricultural land and holdings.
Community land and facilities	×	Community land is not required to construct the Scheme, therefore an assessment will not be made on the potential effects on community land and facilities.
Development land	×	The Scheme is not expected to require any land take from the permitted burial ground south of the A12, therefore, an assessment will not be made on the potential effects on development land.
Community severance	✓	A desk-based study of land, properties and facilities in the area, findings from this assessment concerning land and property and NMUs and Consultation with Local Authorities (London Borough of Havering and Brentwood Borough Council), business owners and residents will be used to assess the magnitude of the impacts on community severance.
Vulnerability to major accidents and disasters	×	No significant adverse effects relating to people and communities deriving from the vulnerability of the development to risks of major accidents and/or disasters are expected and therefore this topic has been scoped out from future assessment.
Climate Change (Effects on climate)		
Temporary and permanent construction materials (A1-3):	✓	Currently no calculated data.
Materials Transportation (A4):	✓	Currently no calculated data.
Construction Plant (A5):	✓	Currently no calculated data.
Construction Water Use (A5):	✓	Currently no calculated data.
Construction Waste Transportation (A5):	✓	Currently no calculated data.

Effects	Scoped in / out	Comment / Justification
Construction Waste Off-Site Processing (A5):	✓	Currently no calculated data.
Replacement (B2-5):	✓	Currently no calculated data.
Operational Energy (B6):	✓	Currently no calculated data.
In-use Traffic (B9):	✓	Known significant proportion of emissions
Climate Change (Vulnerability of the Scheme on climate)		
Average (air) temperature change (annual, seasonal, monthly)	×	Low climate vulnerability
Extreme (air) temperature (frequency and magnitude)	✓	Moderate climate vulnerability
Average precipitation (annual, seasonal, monthly)	×	Low climate vulnerability
Extreme rainfall (frequency and magnitude)	✓	High climate vulnerability
Average wind speed change (annual, seasonal, monthly)	×	Low climate vulnerability
Gales and extreme winds (frequency and magnitude)	✓	Moderate climate vulnerability
Humidity	×	Low climate vulnerability
Solar radiation	✓	Moderate climate vulnerability
Sea level rise (plus local land movements), storm surge/tide	×	Low climate vulnerability
Water availability/drought	×	Low climate vulnerability
Flood (coastal and fluvial)	✓	High climate vulnerability
Subsidence and ground stability	✓	Moderate climate vulnerability
Fog	✓	Moderate climate vulnerability

Effects	Scoped in / out	Comment / Justification
Storms (tracks and intensity), including storm surge	×	Low climate vulnerability
Snow, ice and hail	✓	Moderate climate vulnerability
Storms and lightning	✓	Moderate climate vulnerability

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18.12 Acronyms, Abbreviation and Descriptions

Acronyms, Abbreviations and Glossary Acronym/Abbreviation	Description
°C	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
CO_2	Carbon Dioxide
COSHH	Control of Substances Hazardous to Health
CRTN	Calculation of Road Traffic Noise
CSM	Conceptual Site Model
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

Acronyms, Abbreviations and Glossary Acronym/Abbreviation	Description
DfT	Department for Transport
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
EHER	Essex Historic Environment Record
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

Acronyms, Abbreviations and Glossary Acronym/Abbreviation	Description
HPI	Habitats of Principal Importance
HRA	Habitats Regulation Assessment
IAN	Interim Advice Note
JNCC	Joint Nature Conservation Committee
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
MPI	Major Project Instruction
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
NO_2	Nitrogen Dioxide
NOx	Nitrogen Oxide
NOEL	No Observed Effect Level
NPPF	National Planning Policy Framework

Acronyms, Abbreviations and Glossary Acronym/Abbreviation	Description
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
PCL	potential contaminant linkages
PCM	Pollution Climate Mapping
PCSM	Preliminary Conceptual Site Model
PEIR	Preliminary Environmental Information Report
PINS	Planning Inspectorate
PM_{10}	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

Acronyms, Abbreviations and Glossary Acronym/Abbreviation	Description
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
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

18.13 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.
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.

Term	Description
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 M25 J10 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.
Department for Transport	Government department responsible for the transport network in England, and for aspects of the transport network in the devolved administrations.

Term	Description
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.

Term	Description
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 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.

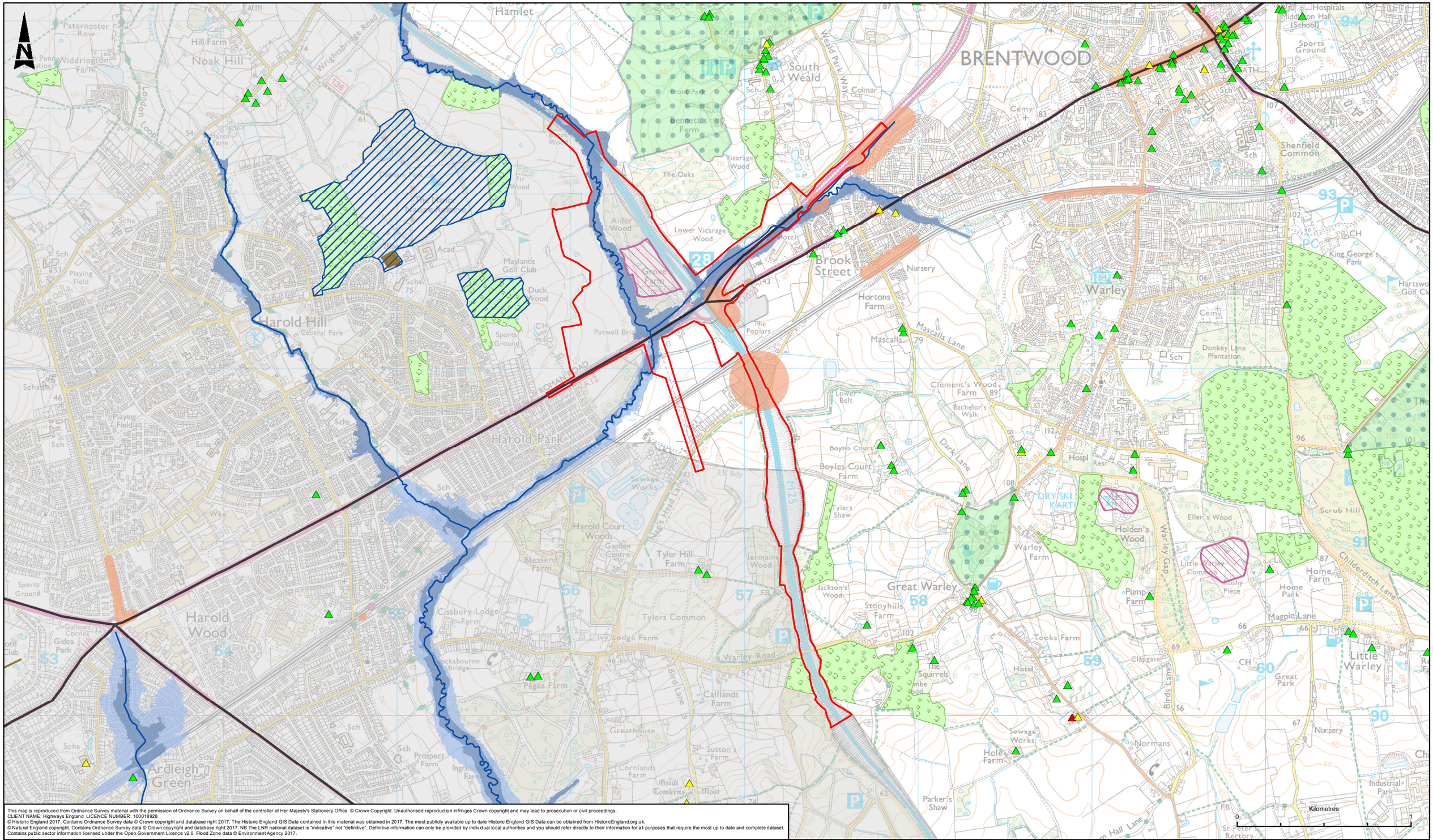
Term	Description
National Nature Reserve	Reserves established to protect some of the most important habitats, species and geology in the United Kingdom, and to provide 'outdoor laboratories' for research. There are currently 224 NNRs in England with a total area of over 94,400 hectares - approximately 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 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 PM_{10} and NO_x.
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

Term	Description
	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.
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 M25 J28 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 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,

Term	Description
	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.
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.

Appendices

Appendix A. Environmental Constraints and Scheme Drawing



LEGEND

- Scheme Red Line Boundary
- Registered Parks and Gardens
- Scheduled Monuments
- Local Nature Reserves (LNR)
- Ancient Woodland
- Important Areas for Noise
- Historic Landfill Sites
- Air Quality Management Areas
- Flood Zone 3
- Flood Zone 2
- River Network
- PCM Links
- Listed Buildings Grade I
- Listed Buildings Grade II*
- Listed Buildings Grade II

Rev	Date	Description	By	Chk'd	App'd
P01	08/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION**
Suitability: **S2**

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Client: highways england

Project Title: ROAD INVESTMENT STRATEGY
M25 Junction 28

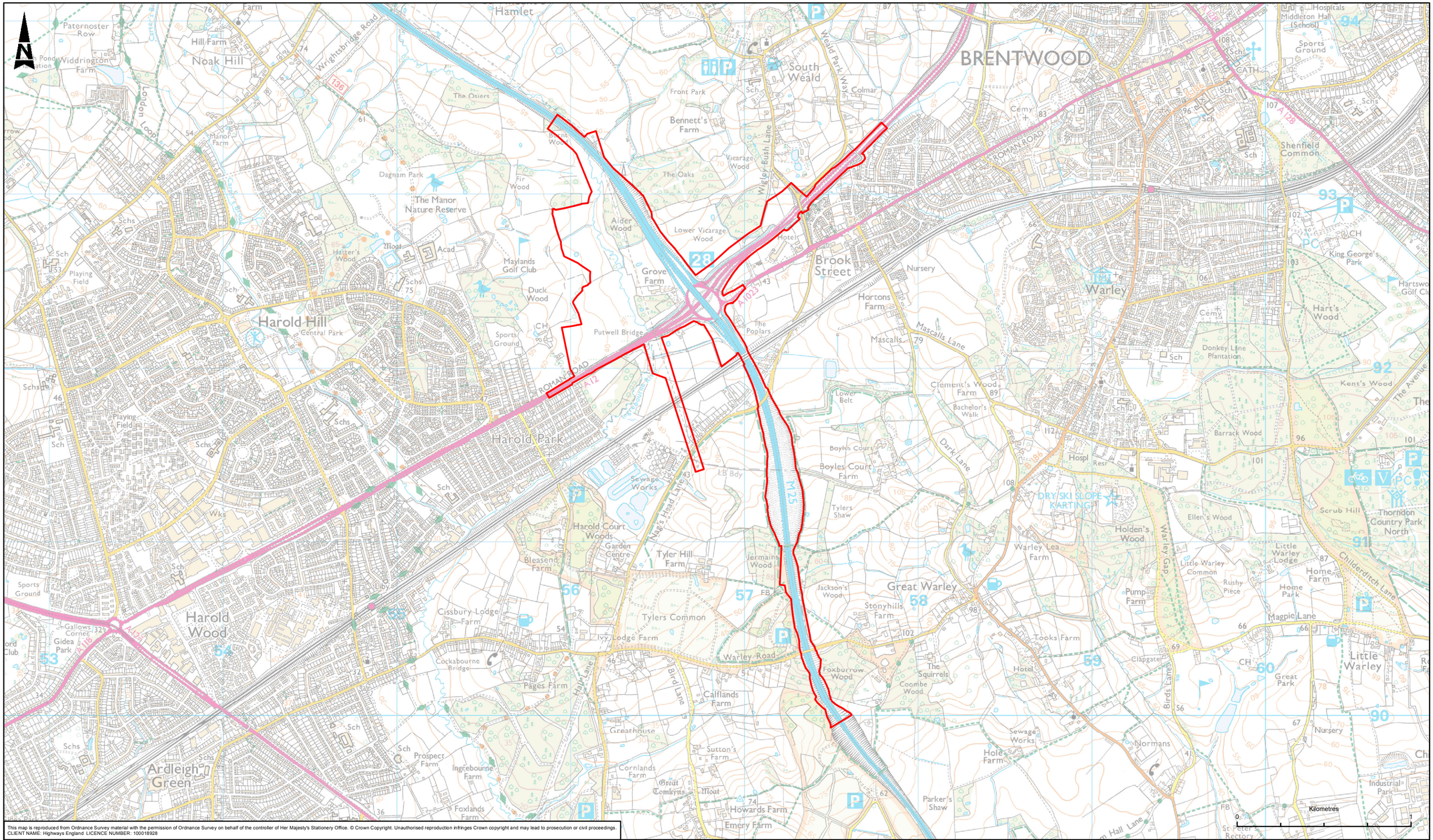
Drawing Title: FIGURE A-1
ENVIRONMENTAL CONSTRAINTS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:20,000	SD	AR	DOK	PG

Original Size	Date	Date	Date	Date
A3	08/11/17	08/11/17	08/11/17	08/11/17

Drawing Number (Project | Originator | Volume | Location | Type | Role | Number): HE551519 - ATK - EGN - XX - GS - GI - 000001

Revison: P01



LEGEND

Scheme Red Line Boundary

Rev	Date	Description	By	Chk'd	App'd
P01	08/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION**

Suitability: **S2**

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Client: highways england

Project Title: ROAD INVESTMENT STRATEGY
M25 Junction 28

Drawing Title: FIGURE A-2
SITE LOCATION
PRELIMINARY DCO BOUNDARY

Scale	Designed / Drawn	Checked	Approved	Authorised
1:20,000	SD	AR	DOK	PG

Original Size	Date	Date	Date	Date
A3	08/11/17	08/11/17	08/11/17	08/11/17

Drawing Number: Project | Originator | Volume
HE551519 - ATK - EAC - XX - GS - GI - 000001
Location | Type | Role | Number

Revison: P01

DO NOT SCALE

Millimetres 0 10 100

M25

A12

CI

CII

CIII

PROPOSED BRIDGE OVER THE REALIGNED SLIP

PROPOSED REALIGNMENT OF EXISTING SLIP

PROPOSED WIDENING OF EXISTING M25

MAYLANDS GOLF COURSE

BRENTWOOD

PROPOSED REALIGNMENT OF EXISTING WATERCOURSE

PROPOSED VIADUCT OVER LOOP ROAD, WATERCOURSE AND BPA PIPELINE

PROPOSED REALIGNMENT OF EXISTING SLIP

PROPOSED REALIGNMENT OF EXISTING A12

PROPOSED REALIGNMENT OF EXISTING SLIP

M25 J28

ROMFORD

Scale 1:5000

100m 0m 100m 200m 300m

KEY

- PROPOSED RIP SCHEME
- PROPOSED BRIDGE
- PROPOSED RETAINING WALLS
- PROPOSED EARTHWORKS
- NATIONAL GRID - OVERHEAD POWER LINE
- NATIONAL GRID - HIGH PRESSURE GAS MAIN
- EXISTING RAILWAY
- BPA PIPELINE WITH 3m EXCLUSION ZONE
- PROPOSED BREAKOUT OR PUNCTURE OF EXISTING LANE
- PROPOSED REDLINE BOUNDARY
- CX SITE SPECIFIC HAZARD - REFER TO SHE BOX

SHEET LAYOUT

SAFETY, HEALTH AND ENVIRONMENTAL INFORMATION

In addition to the hazards/risks normally associated with the types of work detailed on this drawing, note the following significant residual risks (Reference shall also be made to the design hazard log).

Construction

WORKS IN CLOSE PROXIMITY OF BPA LINE
WORKS IN CLOSE PROXIMITY OF O/H CABLES
WORKS IN CLOSE PROXIMITY OF NHP MAIN

Maintenance / Cleaning

CONVOLUTED WINTER MAINTENANCE ROUTE

Use

NONE IDENTIFIED AT THIS STAGE

Decommissioning / Demolition

NONE IDENTIFIED AT THIS STAGE

Description	Status	Revision	Drawn	Checked	Reviewed	Authorised	Issue Date
DRAWING CREATED	A1	P01.1	AE	SC	PM	PG	03/11/17

Drawing Suitability: Signed off - Publication

Status: A1

Project Title: M25 Junction 28 Improvement

Drawing Title: FIGURE A-3 AREA OF DEVELOPMENT OPTION 5F

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Drawing Number: Project HE551519 - Originator ATK - Volume HGN - Location XX - Type DR - Role LM - Number 000001

Original Size: A1 | Scale: 1:5000 | Project Ref. No: 5158157 | Sheet: 1 of 1 | Rev: P1

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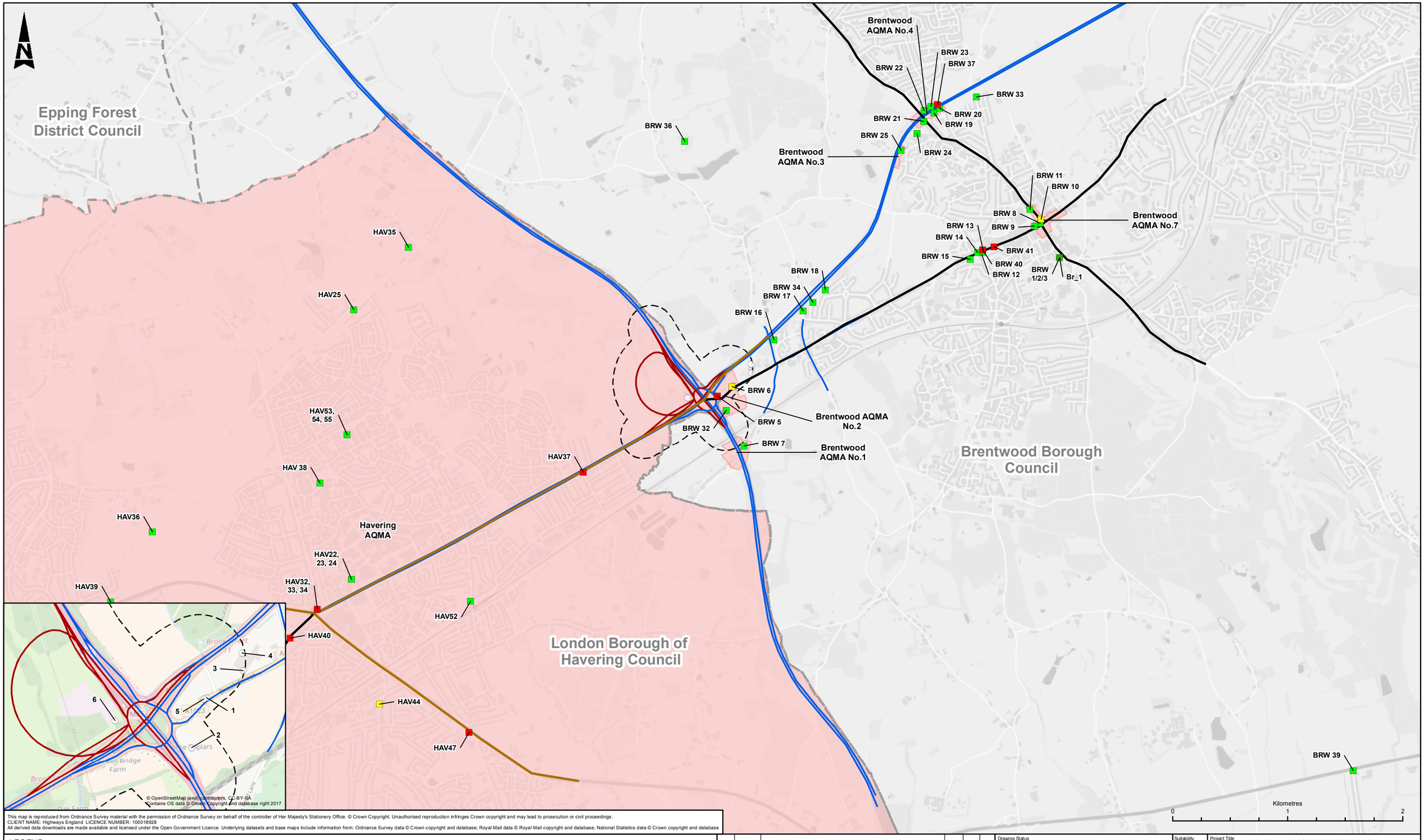
Appendix B. Air Quality



LEGEND

- Local Authority Boundary
- Air Quality Management Area

DEFRA PCM Roadside NO_2 Concentrations (2015)

- < 40 µg/m³
- > 40 µg/m³

- Sensitive Human Health Receptors

Modelled Road Network

- Affected Road Network
- Unaffected Road Network
- 200m study area around Affected Road Network

Diffusion Tube Monitoring Sites (2015)

Annual Mean NO_2 Concentration

- No data
- < 36 µg/m³
- 36 to 40 µg/m³
- > 40 µg/m³

Continuous Monitoring Sites (2015)

Annual Mean NO_2 Concentration

- No data
- < 36 µg/m³
- 36 to 40 µg/m³
- > 40 µg/m³

Rev	Date	Description	By	Chk'd	App'd
P01	25/10/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: FOR INFORMATION
Suitability: S2

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Client: highways england

Project Title: ROAD INVESTMENT STRATEGY M25 Junction 28

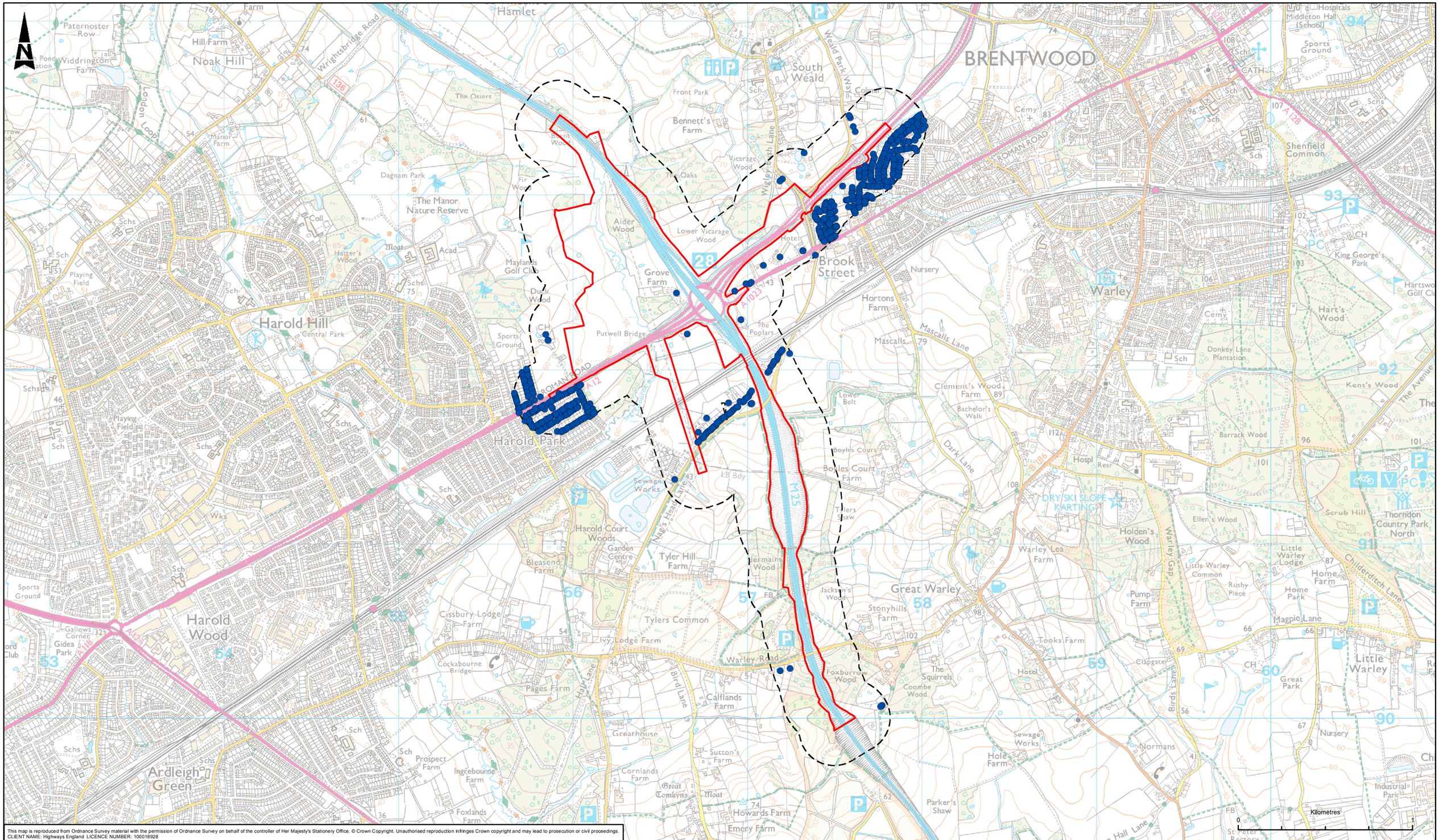
Drawing Title: FIGURE B-1 AIR QUALITY CONSTRAINTS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:30,000	SD	AR	DOK	PG

Original Size	Date	Date	Date	Date
A3	25/10/17	25/10/17	25/10/17	25/10/17

Drawing Number: HE551519 - ATK - EAQ - XX - GS - GI - 000001
(Project | Originator | Volume | Location | Type | Role | Number)

Revison: P01



LEGEND

- Scheme Red Line Boundary
- Area Potentially Affected by Construction Dust
- Receptors Sensitive to Construction Dust

Rev	Date	Description	By	Chk'd	App'd
P01	08/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION**

Suitability: **S2**

Project Title: ROAD INVESTMENT STRATEGY
M25 Junction 28

Drawing Title: FIGURE B-2
STUDY AREA FOR CONSTRUCTION DUST ASSESSMENT

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Client: highways england

Scale	Designed / Drawn	Checked	Approved	Authorised
1:20,000	SD	AR	DOK	PG
Original Size	**Date**	**Date**	**Date**	**Date**
A3	08/11/17	08/11/17	08/11/17	08/11/17

Drawing Number: Project | Originator | Volume
HE551519 - ATK - EAQ - XX - GS - GI - 000002
Location | Type | Role | Number

Revison: P01

B.1 Local Planning Policy

Brentwood Borough Council

B.1.1 Brentwood Borough Council is currently preparing a new Local Plan which, once adopted, will supersede saved policies in the current Replacement Local Plan (2005). Of relevance to air quality policy CP1 General Development Criteria states "Any development will need to satisfy all of the following: …vii) The proposal would not have an unacceptable detrimental impact on health, the environment *or amenity due to the release of pollutants to…air (including noise, fumes, vibration, smells, smoke, ash, dust and grit).et.al".* In addition, policy **PC6 Transport Pollution** states: "*All new transport proposals and improvements to existing transport infrastructure and services will be assessed against their impact on air quality…and will need to be designed so as to minimised any negative impacts and, where necessary, incorporate reasonable and appropriate mitigation measures."*

B.1.2 In the draft Local Plan, which is expected to be adopted in 2017, **Policy 10.11: Air Quality** states: "The Council will promote measures to improve air quality, particularly within designated Air Quality Management Areas, and will expect development proposals to reduce sources of air pollution. Where the Council considers that air quality objectives are likely to be prejudiced or proposals fall within an Air Quality Management Area, applicants will be required to submit a detailed air quality assessment which sets out the impact the proposed development would have upon air quality.".

London Borough of Havering Council

B.1.3 London Borough of Havering's Local Development Framework (LDF) was adopted in 2008 and is currently being updated. The Core Strategy, as part of the LDF, sets out the council's approach to planning up to 2020. **Core Policy 15 - Environmental Management** states: *"To reduce their environmental impact and to address the causes and adapt to and mitigate the effects of climate change in their location, construction and use new development should: ….ensure that it does not singularly or cumulatively breach air quality targets"* In addition, **DC52 – Air Quality** states: *"Planning permission will only be granted where new development, both singularly and cumulatively, does not cause significant harm to air quality, and does not cause a breach of the targets set in Havering's Air Quality Management Area Action Plan. A formal assessment will be required where it is suspected that a development is likely to cause a breach of emission levels for prescribed pollutants. Where the assessment confirms a breach, planning permission will only be granted if suitable mitigation measures are put in place through conditions or legal agreement"*.

B.1.4 In the draft Local Plan covering 2016 to 2031, which is currently undergoing public consultation due to end 29th September 2017. There are a number of policies listed in the draft Local Plan for consultation which address air quality. The most relevant being **Policy 33 – Air Quality**, which highlights the council's commitment to improving air quality and subsequently the health of residents. The policy will be applied by supporting development which is at least air quality neutral; optimises use of green infrastructure, supports active travel to reduce emissions, meets carbon dioxide reduction targets in the London Plan, and minimises emissions from construction.

Pollutants

Nitrogen Dioxide

B.1.5 NO_2 is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and NO_2 are collectively termed NO_x. Almost a third of the UK NO_x emissions are from road transport. The majority of NO_x emitted from vehicles is in the form of NO, which oxidises rapidly in the presence of ozone (O_3) to form NO_2. In high concentrations, NO_2 can affect the respiratory system, *exacerbating asthma, bronchial symptoms*, reduced lung function and can also enhance the response to allergens in sensitive individuals, whereas NO does not have any observable effect on human health at the range of concentrations found in ambient air. There is an increasing awareness of an association between chronic exposure to NO_2 and premature mortality (COMEAP, 2015). Elevated concentrations of oxides of nitrogen can have an adverse effect on vegetation, including leaf or needle damage and reduced growth. Deposition of pollutants derived from oxides of nitrogen emission contribute to acidification and/or eutrophication of sensitive habitats.

Particulate Matter

B.1.6 The principal sources of 'primary' polluting particles are combustion processes, which include traffic and industry. Diesel engines produce the majority of particulate emissions from the vehicle fleets. Approximately a fifth of primary PM_{10} emissions in the UK are derived from road transport. 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

B.1.7 Carbon dioxide (CO_2) is a greenhouse gas and is used as an indicator of the wider scale, non-local effects of transport schemes. CO_2 does not affect human health or ecology at ambient levels and so is not significant as a local pollutant but is important for its national and international role in climate change.

B.2 Air Quality Management Areas – Further Information

B.2.1 AQMAs 3 to 7 in Brentwood Borough Council were all declared for exceedances of the annual mean AQS objective for NO_2. AQMAs 3 and 4 are both located adjacent to the A12 to the east of the current study area, located 2.5 km and 3 km east of M25 Junction 28 respectively. AQMA 7, Wilson's Corner, is located in Brentwood town centre, situated just over 3 km north east of M25 Junction 28. AQMAs 5 and 6 are located over 9 km north east of M25 Junction 28.

B.2.2 It is noted that the 2015 Updating and Screening Assessment produced by Brentwood Borough Council recommended that AQMAs 1, 3, 5 and 6 are revoked due to the lack of exceedances of the AQS objectives within these AQMAs in recent years. Furthermore, Brentwood Borough Council 's 2016 Annual Status Report noted that there were no exceedances of air quality objectives at monitoring sites with relevant exposure in 2015, indicating that there are grounds for revoking these four AQMAs.

B.2.3 AQMAs within the study area summarised in Table B.1

Table B.1: Description of AQMAs Declared by London Borough of Havering and Brentwood Borough Council

Local Authority	Name	Air Quality Criteria Exceeded	Description
London Borough of Havering	Havering AQMA	NO_2 annual mean PM_{10} 24 hour mean	An area encompassing the entire Borough of Havering.
Brentwood Borough Council	AQMA No.1	NO_2 annual mean	Comprises parts of Nags Head Lane, Brentwood and the M25.
Brentwood Borough Council	AQMA No.2	NO_2 annual mean	Comprises parts of Brook Street, Brentwood and the A12.
Brentwood Borough Council	AQMA No.3	NO_2 annual mean	Comprises parts of Greenshaw and Porters Close, Brentwood and the A12.
Brentwood Borough Council	AQMA No.4	NO_2 annual mean	Comprises parts of Warescot Road, Hurstwood Avenue and Ongar Road, Brentwood and the A12.
Brentwood Borough Council	AQMA No.7	NO_2 annual mean	Comprises parts of Ongar Road, Ingrave Road, High Street and Shenfield Road, Brentwood in proximity to Wilsons Corner (the junction of the A128 and A1203).

Air Quality Monitoring

Connect Plus Services NO_2 Diffusion Tube Data

B.2.4 The annual mean NO_2 concentrations for the Connect Plus Services monitoring sites within the air quality study area are shown below in Table B.2.

Table B.2 Connect Plus annual mean diffusion tube monitoring results ($\mu g/m^3$)[21, 22]

Site ID	Site Type	Grid Ref	Sept 2013 - Sept 2014	Sept 2014 - Sept 2015	Sept 2015 – 2016
CP7	Roadside	557425,192726	40.2	40.8	46.9

Highways England NO_2 Diffusion Tube Data

B.2.5 Highways England has undertaken a NO_2 diffusion tube survey within the air quality study area over a period of six months, between February and August 2016. The data for the six month period in 2016 has been annualised using a factor of 1.13 as derived from analysis of data at two background continuous monitoring sites within 50 miles of the Scheme. The annualised mean results

were then adjusted using a factor of 0.88 derived from Defra's bias adjustment spreadsheet for diffusion tubes prepared by Staffordshire Scientifics Group using 20% triethanolamine (TEA) in water.

Table B.3: Highways England NO_2 Diffusion Tube monitoring data (µg/m^3)

Site ID	Site Type	X, Y	Unadjusted 2016 average (Feb – Aug)	Adjusted 2016 average
HE01	Roadside	557030, 192496	65.2	64.7
HE02	Roadside	557531, 192749	43.5	43.2
HE03	Roadside	557043, 191854	31.4	31.1
HE04	Roadside	557162, 191987	31.7	31.5
HE05	Roadside	556788, 191618	29.9	29.7
HE06	Roadside	557956, 192219	26.8	26.6
HE07	Roadside	557001, 193790	30.4	30.1
HE08	Roadside	555057, 194239	21.0	20.9
HE09	Roadside	553977, 194554	23.0	22.8
HE10	Roadside	554061, 193978	31.1	30.9
HE11	Roadside	554371, 193091	22.8	22.6
HE12	Roadside	554868, 192605	23.5	23.3
HE13	Roadside	556000, 191900	41.8	41.5
HE14	Roadside	555631, 191678	40.6	40.3
HE15	Roadside	555801, 191784	43.1	42.8
HE16	Roadside	557925, 192992	32.1	31.9
HE17	Roadside	557313, 190348	40.1	39.9
HE18	Roadside	557724, 190420	27.0	26.8
HE19	Roadside	557744, 190009	27.9	27.7

Site ID	Site Type	X, Y	Unadjusted 2016 average (Feb – Aug)	Adjusted 2016 average
HE20	Roadside	555392, 192385	23.5	23.4
HE21	Roadside	557693, 193181	33.4	33.1
HE22	Roadside	556933, 192382	50.9	50.6
HE23	Roadside	557416, 192880	34.4	34.2
HE24	Roadside	557177, 193141	25.6	25.4
HE25	Background	553917, 191852	25.2	25.0

B.3 Local Authority Air Quality Monitoring

Nitrogen Dioxide

B.3.1 None of the local authorities operate a continuous monitoring station within the air quality study area. Annual mean concentrations of NO_2 at the closest CMS sites to the air quality study area, Brentwood Council Office, Rainham and Romford are presented in Table B.4 for 2011 to 2016. Concentrations are below the annual mean AQS objective of 40 µg/m^3 at both Rainham and Brentford Council Office CMS, however exceedances have been recorded at Romford CMS in 2014 and 2016.

Table B.4: Annual mean NO_2 concentrations (µg/m^3) from CMS near to the Scheme

Site ID	Local Authority	Site Type	X, Y	2011	2012	2013	2014	2015	2016
HV1 Rainham	London Borough of Havering	Roadside	553250, 182750	31.0	-	30.2	35.3	32.0	34.0
HV3 Romford	London Borough of Havering	Roadside	551108, 188257	32.0	36.2	34.0	57.5*	35	44.0
BRW1 Council Office	Brentwood Borough Council	Urban Back ground	559860, 193617	26.3	26.9	25.0	22.5	25.5	24.0

= data not available / monitoring not undertaken; *= data capture below 75%.
Exceedances of annual mean NO_2 UK AQS objective are highlighted in bold.

Table Source: Data have been sourced from local authority reports and London Air Quality Network (London Borough of Havering, 2015, 2016; London Air Quality Network, 2017; Brentwood Borough Council, 2014

B.3.2 The two CMS sites located in Havering also measure PM_{10}. Concentrations of PM_{10} were below both the annual mean and daily mean AQS objectives at these sites, see Table B.5 and Table B.6.

Table B.5: Annual mean PM_{10} concentrations ($\mu g/m^3$) at CMS near to the Scheme

Site ID	Local Authority	Site Type	X,Y	2011	2012	2013	2014	2015	2016	2011
London Borough of Havering_1	HV1 Rainham	Roadside	553250, 182750	-	-	-	-	19	18	19
London Borough of Havering_2	HV3 Romford	Roadside	551108, 188257	7	23	23	24	25	24	-

Table B.6: Number of exceedances of 24-hour mean PM_{10} objective and CMS near to the Scheme

Site ID	Local Authority	Site Type	X,Y	2011	2012	2013	2014	2015	2016	2011
London Borough of Havering_1	HV1 Rainham	553250, 182750	Roadside	-	-	-	-	3	-	6
London Borough of Havering_2	HV3 Romford	551108, 188257	Roadside	0	17	11	6	11	0	-

Passive Monitoring

Table B.7: Annual mean NO_2 diffusion tube monitoring results ($\mu g/m^3$)

Local Authority ID	Site Type	X, Y	2010	2011	2012	2013	2014	2015
Brentwood Borough Council								
BRW 1/2/3	Urban background	559861,193617	31.6	31.5	31.0	29.3	22.7	28.9
BRW 5	Urban background	556887,192412	53.5	52.3	55.8	45.9	40.0	42.7
BRW 6	Roadside	557014,192493	46.1	48.2	44.0	37.7	33.1	38.1
BRW 7	Roadside	557118,191978	33.1	31.7	35.8	27.5	24.5	26.0
BRW 8	Urban background	559691,193912	42.9	44.7	43.9	44.2	35.6	35.6
BRW 9	Roadside	559643,193889	42.8	37.2	42.8	40.5	32.1	32.7
BRW 10	Roadside	559699,193948	54.9	60.7	38.1	45.8	36.2	36.6
BRW 11	Roadside	559604,194035	42.8	40.2	23.9	34.2	28.0	32.8
BRW 12	Roadside	559187,193658	36.5	31.8	32.8	32.3	26.9	27.4
BRW 13	Roadside	559195,193681	40.0	39.9	39.7	35.4	29.2	-
BRW 14	Roadside	559148,193660	45.0	40.4	39.2	44.0	33.4	35.0
BRW 15	Roadside	559085,193601	33.7	28.0	27.1	26.4	20.7	21.9

Local Authority ID	Site Type	X, Y	2010	2011	2012	2013	2014	2015
BRW 16	Urban background	557379,192900	34.3	35.5	34.3	32.5	26.7	27.2
BRW 17	Roadside	557632,193151	35.1	33.4	33.3	29.7	24.5	26.5
BRW 18	Urban background	557826,193333	31.1	29.7	29.0	26.7	23.2	23.5
BRW 19	Roadside	558769,194873	35.8	24.6	35.0	33.1	26.7	26.1
BRW 20	Kerbside	558818,194913	43.7	41.5	37.1	43.5	28.0	31.5
BRW 21	Roadside	558681,194799	32.1	31.5	28.4	29.6	23.9	23.6
BRW 22	Roadside	558683,194894	37.7	39.9	43.0	38.3	33.0	31.6
BRW 23	Roadside	558742,194928	42.4	41.9	49.0	43.2	35.9	34.5
BRW 24	Roadside	558624,194695	34.1	32.0	32.6	30.8	25.2	25.5
BRW 25	Urban background	558482,194547	35.3	36.6	34.3	32.7	27.2	26.5
BRW 26	Roadside	562278,196649	37.6	35.5	34.2	35.4	28.3	29.6
BRW 28	Urban background	564446,199509	31.9	32.5	28.6	29.0	22.6	24.2
BRW 29	Roadside	564617,199849	32.7	33.0	35.2	30.4	23.6	27.1
BRW 30	Roadside	564654,199898	37.4	35.7	34.7	34.5	26.8	29.0
BRW 31	Roadside	565186,200071	36.0	32.4	29.6	32.4	24.1	26.5
BRW 32	Urban background	556964,192288	40.9	37.4	38.8	34.9	30.0	32.6
BRW 33	Urban background	559139,195012	33.2	32.5	31.1	28.1	22.1	23.5
BRW 34	Roadside	557719,193226	36.3	33.7	29.2	30.2	25.1	26.4
BRW 36	Urban background	556603,194628	18.6	20.4	29.0	18.7	15.8	15.8
BRW 37	Roadside	558800,194947	89.0	98.6	91.8	93.5	76.8	71.6
BRW 38	Roadside	563659,198314	25.8	25.2	27.0	24.9	21.7	19.6
BRW 39	Roadside	562412,189153	36.4	32.6	31.6	34.6	26.9	29.5
BRW 40	Roadside	559191,193681	-	-	-	-	38.8	41.0
BRW 41	Roadside	559292,193710	-	-	-	-	43.4	45.8
London Borough of Havering								
HAV2, 5, 6	Urban Centre	332395,433175	70.0	64.5	56.6	55.8	54.0	51.7
HAV1, 7, 8	Urban Centre	551108,188257	44.8	46.4	46.5	44.0	40.6	39.0
HAV3	Urban Background	551726,183462	31.8	32.6	30.5	28.6	32.9	28.3

Local Authority ID	Site Type	X, Y	2010	2011	2012	2013	2014	2015
HAV4	Urban Background	553724,187560	23.8	24.9	22.1	19.5	24.5	20.1
HAV9, 10, 11	Urban Centre	551629,188296	-	-	-	-	33.3	30.7
HAV12	Roadside	552096,189619	-	-	-	-	36.8	37.4
HAV13, 14, 15	Roadside	550607,189685	-	-	-	-	39.1	39.4
HAV 16, 17, 18	Roadside	551414,187802	-	-	-	-	34.2	34.7
HAV19, 20, 21	Kerbside	550607,189685	-	-	-	-	45.6	44.8
HAV22, 23, 24	Urban Background	553707,190817	-	-	-	-	25.8	26.6
HAV25	Urban Background	553727,193161	-	-	-	-	23.3	22.9
HAV26	Urban Background	549532,189777	-	-	-	-	21.1	22.7
HAV27, 28, 29	Kerbside	550942,187420	-	-	-	-	47.8	47.6
HAV30	Urban Background	549318,189384	-	-	-	-	21.8	24.8
HAV31	Industrial	550197,187908	-	-	-	-	26.1	27.1
HAV32, 33, 34	Kerbside	553410,190558	-	-	-	-	51.6	55.0
HAV35	Urban Background	554204,193704	-	-	-	-	23.4	24.2
HAV36	Rural	551979,191230	-	-	-	-	15.7	21.1
HAV37	Kerbside	555723,191750	-	-	-	-	49.8	48.2
HAV 38	Roadside	553434,191656	-	-	-	-	22.2	21.5
HAV39	Roadside	551616,190622	-	-	-	-	31.1	33.3
HAV40	Roadside	553174,190306	-	-	-	-	48.1	49.5
HAV41	Roadside	552517,189826	-	-	-	-	43.0	45.0
HAV42	Kerbside	550623,188890	-	-	-	-	32.3	31.4
HAV43	Roadside	556072,186539	-	-	-	-	35.0	38.2
HAV44	Kerbside	553952,189731	-	-	-	-	37.7	37.1
HAV45	Kerbside	552327,187422	-	-	-	-	37.2	35.7
HAV46	Kerbside	5552425,182334	-	-	-	-	32.9	31.3
HAV47	Roadside	554730,189487	-	-	-	-	48.5	42.0
HAV48	Urban Background	550602,189990	-	-	-	-	27.3	28.4

Local Authority ID	Site Type	X, Y	2010	2011	2012	2013	2014	2015
HAV49	Roadside	550722,183294	-	-	-	-	29.1	26.8
HAV50	Kerbside	551526,182672	-	-	-	-	38.3	41.1
HAV51	Urban Background	551180,189432	-	-	-	-	26.5	24.3
HAV52	Roadside	554741,190626	-	-	-	-	37.5	34.3
HAV53, 54, 55	Urban Background	553671,192074	-	-	-	-	25.3	22.9
HAV56	Kerbside	552047,182357	-	-	-	-	49.9	40.4
HAV57	Urban Centre	551420,188526	-	-	-	-	63.1	59.0
HAV58, 59, 60	Urban Centre	551397,188509	-	-	-	-	84.7	75.2

Appendix C. Noise and Vibration

Figure C.1: Daytime Noise Levels from Strategic Noise Map (LAeq 16hr)

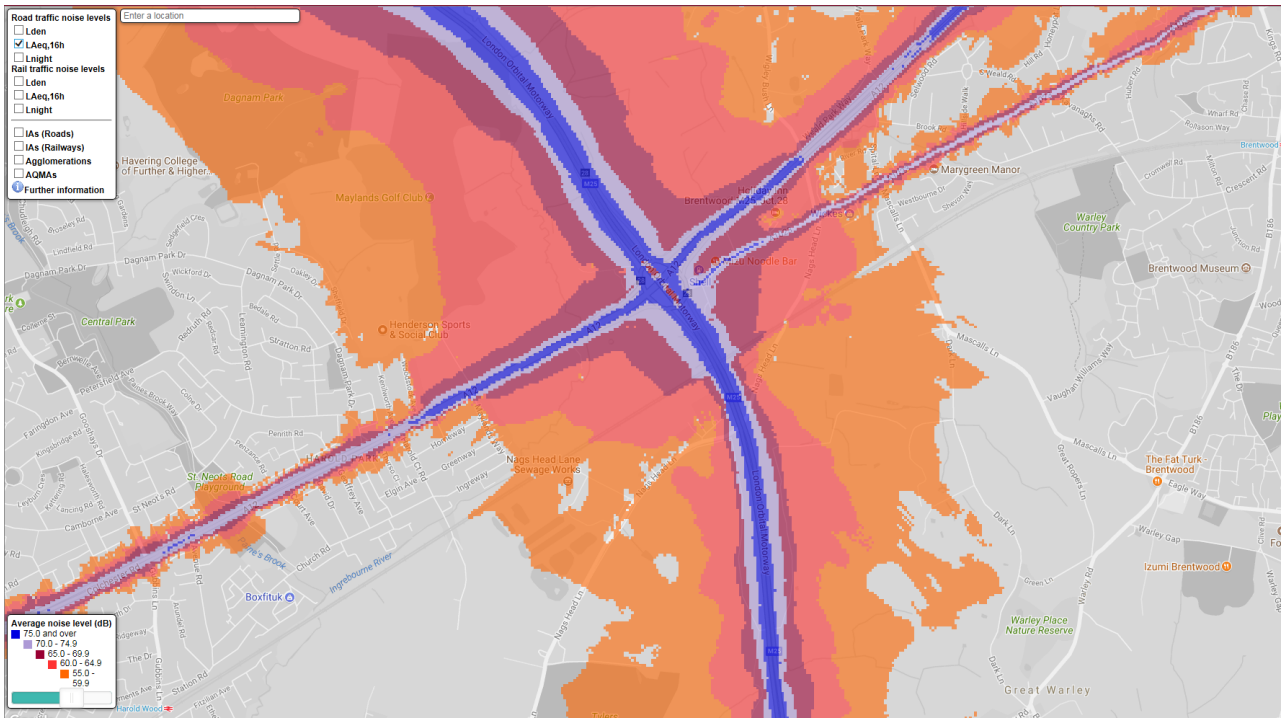
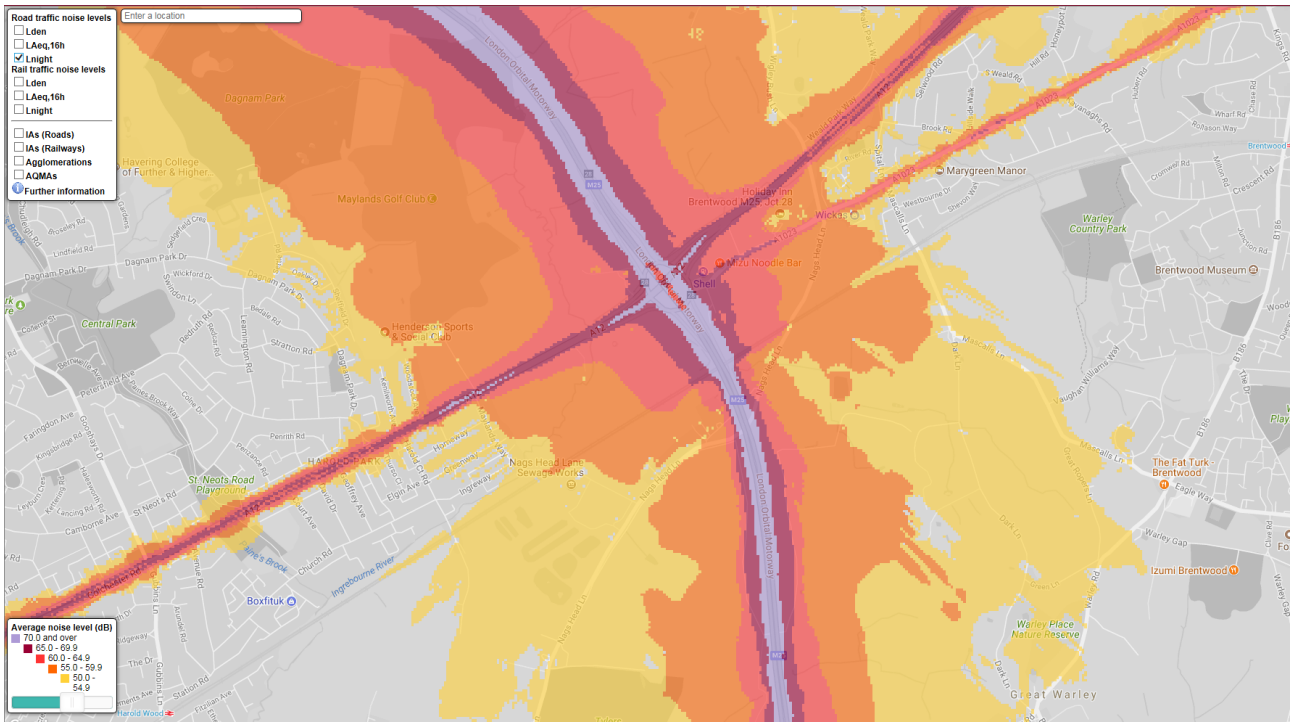


Figure C.2: Night Time Noise Levels from Strategic Noise Map (Lnight) no edits



Appendix D. Biodiversity

Table D.1: Relevant Biodiversity Legislation

Species	Legislation	Offences	Licensing procedures and guidance
Bats European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately[1] capture, injure or kill a bat; deliberate disturbance[2] of bats; or damage or destroy a breeding site or resting place used by a bat. [The protection of bat roosts is considered to apply regardless of whether bats are present.]	A Natural England (NE) licence in respect of development is required. Guidance documents: NE Standing Advice for protected species 2013 European Protected Species: Mitigation Licensing- How to get a licence (NE 2013) Bat Mitigation Guidelines (English Nature 2004) Bat Workers Manual (JNCC 2004)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb[3] a bat in such a place.	Licence from NE is required for surveys (scientific purposes) that would involve disturbance of bats or entering a known or suspected roost site.
Badger	Protection of Badgers Act 1992 (as amended)	Wilfully kill, injure or take a badger; or intentionally or recklessly damage, destroy or obstruct access to a badger sett or disturb a badger in its sett. [It is not illegal to carry out disturbance activities in the vicinity of setts that are not occupied.]	Where required, licences for development activities involving disturbance or sett interference or closure are issued by Natural England (NE). Licences for activities involving watercourse maintenance, drainage works or flood defences are issued under a separate process. Licences are normally not granted from December to June inclusive because cubs may be present within setts. Guidance documents: NE Standing Advice for protected species 2013 Badgers & Development (NE 2007)
Otter European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately[1] capture, injure or kill an otter; deliberate disturbance[2] of otters; or damage or destroy a breeding site or resting place used by an otter.	Licences issued for development by Natural England. Guidance documents: NE Standing Advice for protected species 2013 European Protected Species: Mitigation Licensing- How to get a licence (NE 2013)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb[3] an otter in such a place.	No licence is required for survey in England. However, a licence would be required if the survey methodology involved disturbance.

Species	Legislation	Offences	Licensing procedures and guidance
Hazel dormouse European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately[1] capture, injure or kill a hazel dormouse; deliberate disturbance[2] of a hazel dormouse; or damage or destroy a breeding site or resting place used by a hazel dormouse.	A Natural England licence in respect of development is required. Guidance documents: NE Standing Advice for protected species 2013 European Protected Species: Mitigation Licensing- How to get a licence (NE 2013) Dormouse Conservation Handbook (English Nature 2006)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb[3] a hazel dormouse in such a place.	Licence issued for survey and conservation by Natural England.
Water vole	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally kill, injure or take water voles; intentionally or recklessly damage, destroy or obstruct access to any structure or place used for shelter or protection or disturb a water vole in such a place.	Conservarion licences issued for trapping and translocation operations by Natural England. Certain displacement operations can be carried out under a class licence. Guidance documents: The Water Vole Conservation Handbook (R. Strachan & T. Moorhouse, Wildlife Conservation Research Unit, 3nd Edition 2011) Water voles and development licensing policy - NE Technical Information Note TIN042 2008 NE Standing Advice for protected species 2013 The Water Vole Mitigation Handbook (M. Dean, R. Strachan, D. Gow & R. Andrews 2016)
Birds	Wildlife and Countryside Act 1981 (as amended) S.1	Intentionally kill, injure or take any wild bird; intentionally take, damage or destroy the nest of any wild bird while that nest is in use or being built; intentionally take or destroy the nest or eggs of any wild bird. Intentionally or recklessly disturb a Schedule 1 species while it is building a nest or is in, on or near a nest containing eggs or young; intentionally or recklessly disturb dependent young of such a species	No licences are available to disturb any birds in regard to development. Licences are available in certain circumstances to damage or destroy nests, but these only apply to the list of licensable activities in the Act and do not cover development. General licences are available in respect of ‘pest species’ but only for certain very specific purposes e.g. public health, public safety, air safety. Guidance documents: NE Standing Advice for protected species 2013

Species	Legislation	Offences	Licensing procedures and guidance
		[e.g. most birds of prey, kingfisher, barn owl, black redstart, little ringed plover].	
Great crested newt European protected species	Conservation of Habitats and Species Regulations 2010 (as amended) Reg 41	Deliberately[1] capture, injure or kill a great crested newt; deliberate disturbance[2] of a great crested newt; deliberately take or destroy its eggs; or damage or destroy a breeding site or resting place used by a great crested newt.	Licences issued for development by Natural England. Guidance documents: NE Standing Advice for protected species 2013 European Protected Species: Mitigation Licensing- How to get a licence (NE 2013) Great Crested Newt Mitigation Guidelines (English Nature 2001)
	Wildlife and Countryside Act 1981 (as amended) S.9	Intentionally or recklessly obstruct access to any structure or place used for shelter or protection or disturb[3] a great crested newt in such a place.	Licences issued for science (survey), education and conservation by Natural England.
Adder Common lizard Grass snake Slow worm	Wildlife and Countryside Act 1981 S.9(1) and S.9(5)	Intentionally kill or injure any common reptile species.	No licence is required. However, an assessment for the potential of a site to support reptiles should be undertaken prior to any development works which have potential to affect these animals. Guidance documents: NE Standing Advice for protected species 2013
White-clawed crayfish	Wildlife and Countryside Act 1981 S.9(1) only	Intentionally take from the wild.	Licences issued by Natural England for survey (to take crayfish by hand, by hand net or by crayfish trap). Use of crayfish traps for survey requires Environment Agency consent. Using crayfish traps to remove crayfish for maintenance or development activities in a watercourse requires a conservation licence from Natural England and a permit from the Environment Agency. No licences in respect of development are available. Guidance documents: NE Standing Advice for protected species 2013
Rabbits, foxes and other wild mammals	Wild Mammals (Protection) Act 1996	Intentionally inflict unnecessary suffering to any wild mammal.	Natural England provides guidance in relation to rabbits, foxes (which are also protected under the Wildlife and Countryside Act 1981 from live baits and decoys) and other wild mammals, on their website. Lawful and humane pest control of these species is permitted.

Species	Legislation	Offences	Licensing procedures and guidance
Plants Invasive species e.g. Japanese knotweed, hybrid knotweed, giant knotweed, giant hogweed, rhododendron, Himalayan balsam	Wildlife and Countryside Act 1981 S.14	It is illegal to plant or otherwise cause these species to grow in the wild.	Any contaminated soil or plant material is classified as controlled waste and should be disposed of in a suitably licensed landfill site, accompanied by appropriate Waste Transfer documentation, and must comply with section 34 of the Environmental Protection Act 1990. Guidance documents: The Knotweed Code of Practice (Environment Agency, 2013 version 3) Managing Invasive Non-native Plants (Environment Agency 2010) Guidance on Section 14 of the Wildlife and Countryside Act, 1981 (Defra 2010)

[1]Deliberate capture or killing is taken to include "accepting the possibility" of such capture or killing
[2]Deliberate disturbance of animals includes in particular any disturbance which is likely a) to impair their ability (i) to survive, to breed or reproduce, or to rear or nurture their young, or (ii) in the case of animals of hibernating or migratory species, to hibernate or migrate; or b) to affect significantly the local distribution or abundance of the species to which they belong.
[3]Lower levels of disturbance not covered by the Conservation of Habitats and Species Regulations 2010 remain an offence under the Wildlife and Countryside Act 1981 although a defence is available where such actions are the incidental result of a lawful activity that could not reasonably be avoided.

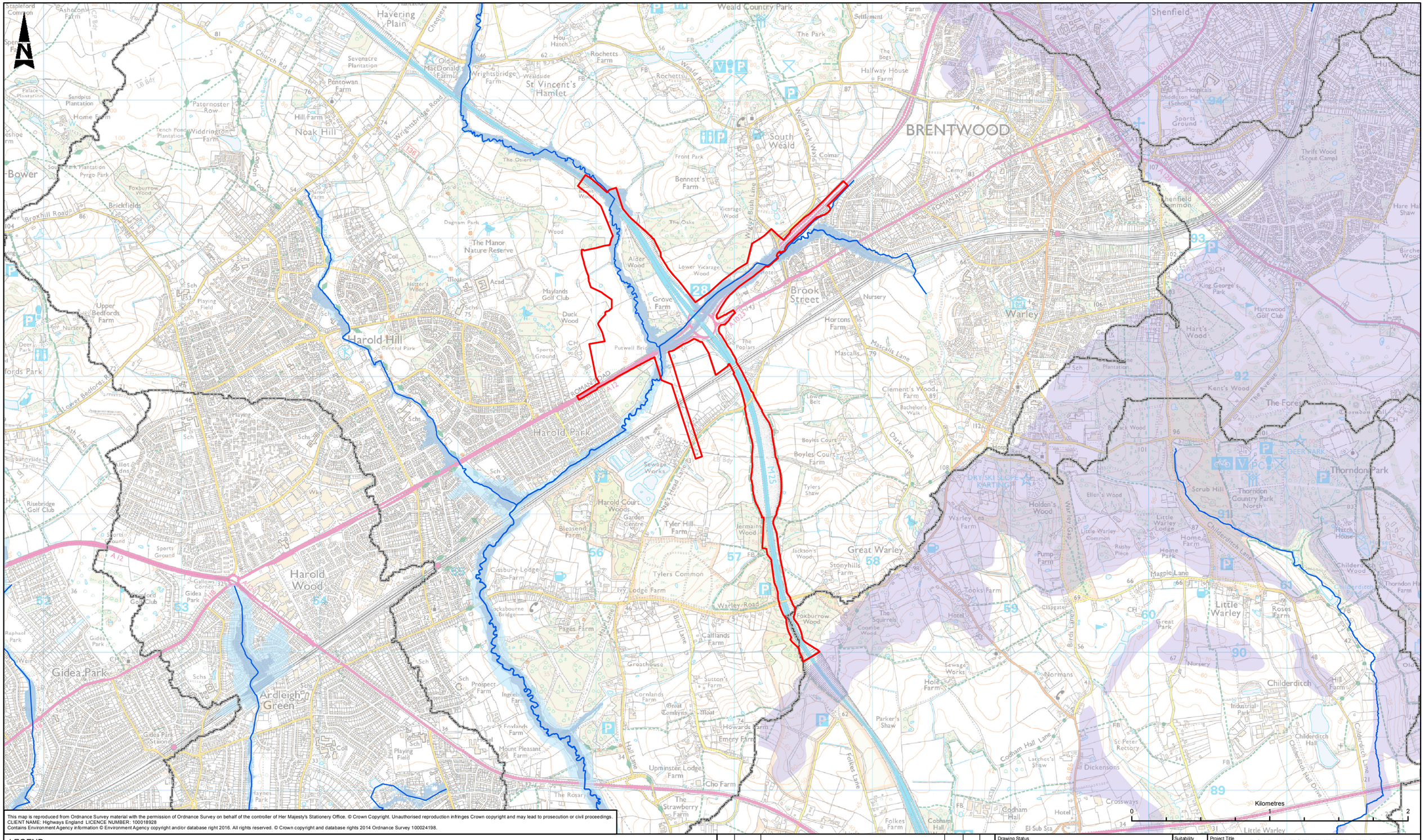
Table D.2: Relevant Site Designation Legislation

Site designation	Legislation	Offences	Licensing procedures and guidance
Local Nature Reserve (LNR)	National Parks and Access to the Countryside Act 1949 S.21	LNRs are given protection through policies in the Local Development Plan.	LNRs are generally owned and managed by local authorities. Development proposals that would potentially affect a LNR would need to provide a detailed justification for the work, an assessment of likely impacts, together with proposals for mitigation and restoration of habitats lost or damaged. Guidance documents: The National Planning Policy Framework (Department for Communities and Local Government, March 2012), with particular reference to Policy 11, and the joint Circular.
Local Sites (eg Local Wildlife Sites, Sites of Importance for Nature Conservation)	There is no statutory designation for local sites.	Local sites are given protection through policies in the Local Development Plan.	Development proposals that would potentially affect a local site would need to provide a detailed justification for the work, an assessment of likely impacts, together with proposals for mitigation and restoration of habitats lost or damaged. Guidance documents: The National Planning Policy Framework (Department for Communities and Local Government, March 2012), with particular reference to Policy 11, and the joint Circular.

Table D.3: Relevant Habitat and Species Legislation

Habitats and species	Legislation	Guidance
Species and Habitats of Principal Importance for the Conservation of Biodiversity	Natural Environment & Rural Communities Act 2006 S.40	S.40 of the NERC Act 2006 sets out the duty for public authorities to conserve biodiversity in England. Habitats and species of principal importance for the conservation of biodiversity are identified by the Secretary of State for England, in consultation with Natural England, are referred to in S.41 of the NERC Act for England. The list, known as the 'England Biodiversity List', of habitats and species can be found on the Natural England web site. The 'England Biodiversity List' is used as a guide for decision makers such as public bodies, including local and regional authorities, in implementing their duty under Section 40 of the NERC Act 2006 to have regard to the conservation of biodiversity in England when carrying out their normal functions. Ecological impact assessments should include an assessment of the likely impacts to these habitats and species.

Appendix E. Road Drainage and the Water Environment



LEGEND

- Scheme Red Line Boundary
- River Watercourses
- River Catchment Areas
- Flood Zone 3
- Flood Zone 2
- Ground Water Bodies

Rev	Date	Description	By	Chk'd	App'd
P01	08/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION**

Suitability: **S2**

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Client: highways england

Project Title: ROAD INVESTMENT STRATEGY
M25 Junction 28

Drawing Title: FIGURE E-1
SURFACE AND GROUND WATER BODIES

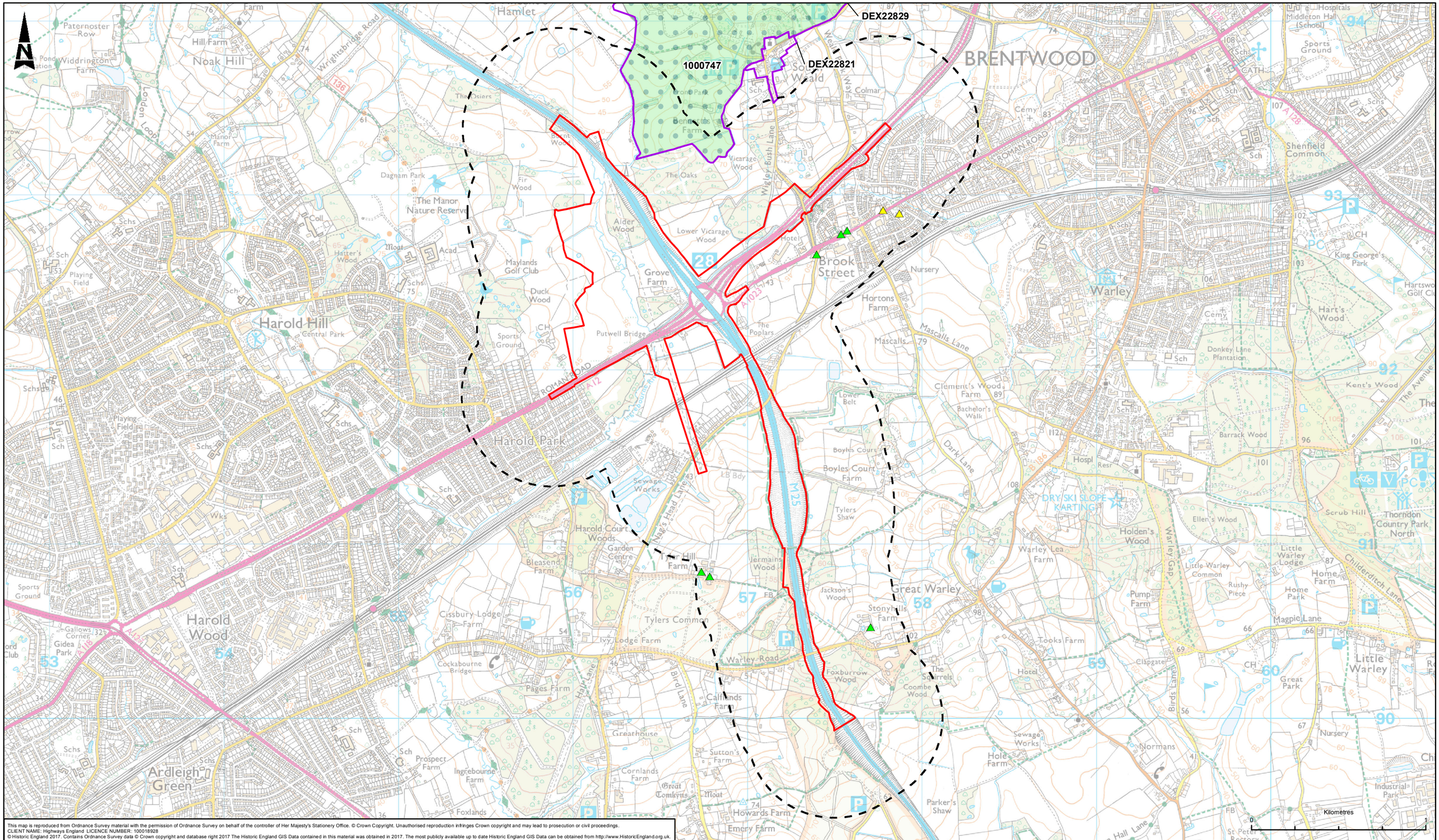
Scale	Designed / Drawn	Checked	Approved	Authorised
1:25,000	SD	AR	DOK	PG

Original Size	Date	Date	Date	Date
A3	08/11/17	08/11/17	08/11/17	08/11/17

Drawing Number: HE551519 - ATK - EWE - XX - GS - GI - 000001
(Project | Originator | Volume | Location | Type | Role | Number)

Revision: P01

Appendix F. Cultural Heritage



LEGEND

- Scheme Red Line Boundary
- 500m Study Area
- Conservation Areas
- Registered Parks and Gardens
- Listed Buildings Grade II*
- Listed Buildings Grade II

Rev	Date	Description	By	Chk'd	App'd
P01	10/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION**
Suitability: **S2**

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Drawing Title: FIGURE F-1
DESIGNATED HERITAGE ASSETS

Scale	Designed / Drawn	Checked	Approved	Authorised
1:20,000	SD	AR	DOK	PG
Original Size	**Date**	**Date**	**Date**	**Date**
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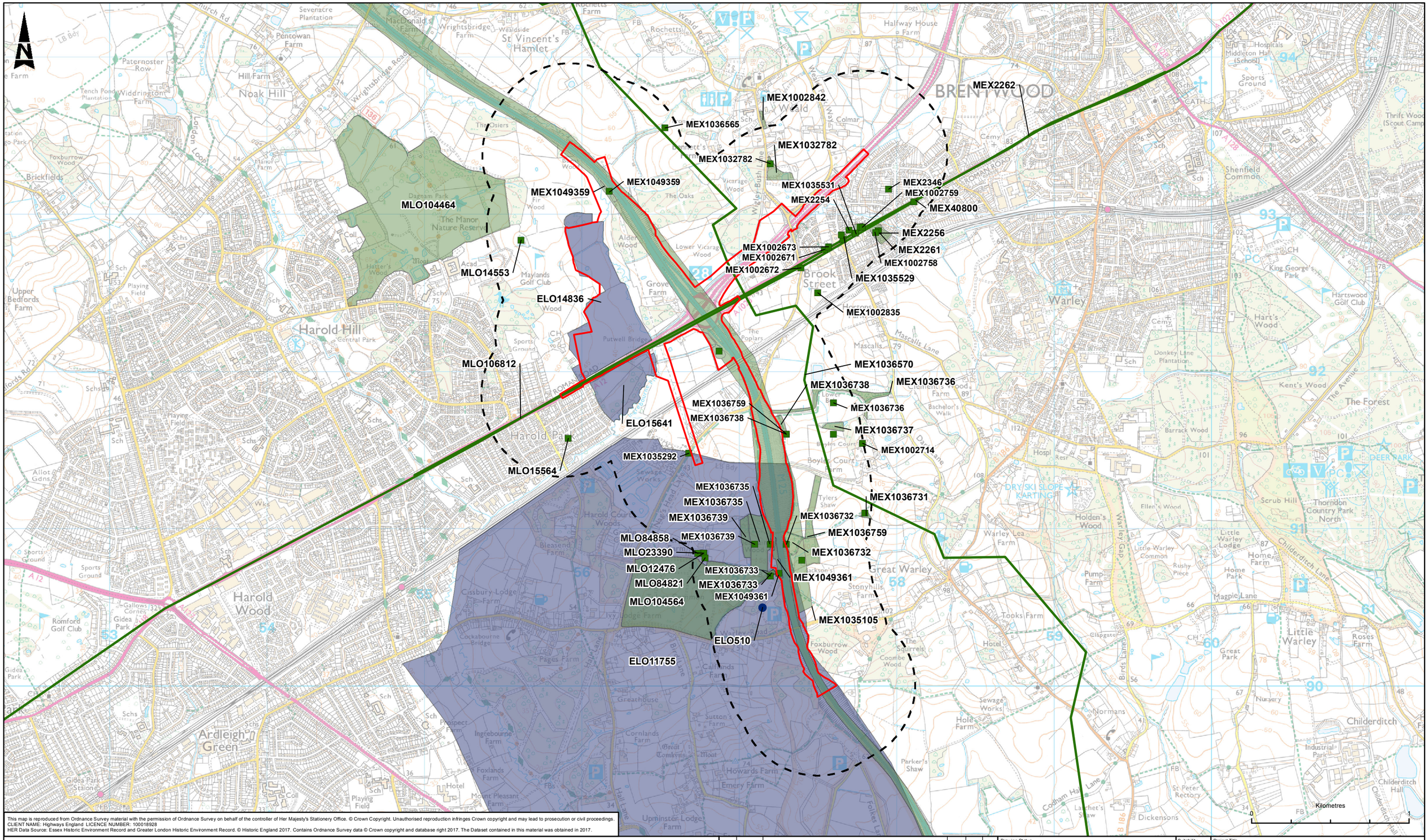
Drawing Number (Project | Originator | Volume | Location | Type | Role | Number): HE551519 - ATK - EHR - XX - GS - GI - 000001

Revison: P01



LEGEND

- Scheme Red Line Boundary
- 500m Study Area
- Historic Environment Record Monuments Polygons
- Historic Environment Record Events Polygons
- Historic Environment Record Monuments Lines
- Historic Environment Record Monuments Points
- Historic Environment Record Events Points

Rev	Date	Description	By	Chk'd	App'd
P01	10/11/17	FOR INFORMATION	SD	AR	DOK

Drawing Status: **FOR INFORMATION** | Suitability: **S2**

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Project Title: ROAD INVESTMENT STRATEGY
M25 Junction 28

Drawing Title: FIGURE F-2
NON-DESIGNATED HERITAGE ASSETS

Scale	Designed / Drawn	Checked	Approved	Authorised
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Drawing Number (Project | Originator | Volume | Location | Type | Role | Number): HE551519 - ATK - EHR - XX - GS - GI - 000001

Revision: P01

Table F.1 Gazetteer of Heritage Assets

Reference (EHER, GLHER or NHLE)	Type	Description	Designation	Location to Scheme	Time Period
1197190	Listed Building	Nag's Head Inn. Public house. 17th century origin, altered in 18th and 19th century.	Grade II	Approx. 450 m south of the Scheme	Post-medieval
1183938	Listed Building	Timber framed range of weather boarded outbuildings to Tylers Hall Farmhouse. Circa 18th century, small single-storey timber framed weather boarded building.	Grade II	Approx. 1.5 km south of the Scheme	Post-medieval
1197231	Listed Building	The Golden Fleece Inn. Now a public house. Circa 1400 origin. Altered in early 16th, 17th, 18th, 19th and 20th century. Timber framed and plastered, peg-tiled roof.	Grade II*	Approx. 450 m south of the Scheme	Medieval/Post-medieval
1279743	Listed Building	Moat House. Early 16th century timber framed with hipped peg-tiles roof. Altered in 17th, 19th and 20th century.	Grade II*	Approx. 500 m south of the Scheme	Medieval/Post-medieval
1297259	Listed Building	The Bull Inn. Public House, c 1600 origin. Altered in 20th century.	Grade II	Approx. 450 m south of the Scheme	Post-medieval
1079905	Listed Building	Tylers Hall Farmhouse. Early 18th century timber framed weather boarded farmhouse.	Grade II	Approx. 1.5 km south of the Scheme	Post-medieval
1205707	Listed Building	17,19 and 21 Brook Street. House, now three cottages. Early 16th century origin. Timber framed, rendered and colourwashed, peg-tiled roofs.	Grade II	Approx. 450 m south of the Scheme	Medieval/Post-medieval
1297215	Listed Building	Stony Hills Farm. Mid-17th century farmhouse. Timber framed and weather	Grade II	Approx. 450m east of the Scheme	Post-medieval

Reference (EHER, GLHER or NHLE)	Type	Description	Designation	Location to Scheme	Time Period
		boarded, peg tiled roof. T-plan.			
100747	Registered Park and Garden	Weald Park. A late 17th and early 18th century park and woodland sited on an earlier 12th century medieval deer park.	Grade II	Approx. 150 m east of the Scheme	Medieval/Post-medieval
DEX22821	Conservation Area	South Weald	N/A	Approx. 1.5 km east of the Scheme	N/A
DEX22829	Conservation Area	Weald Park	N/A	Approx. 150 m east of the Scheme	N/A
060983/00/00 MLO12476	Non-designated monument	Tylers Common Upminster. Early medieval to medieval settlement.	N/A	Approx. 1.5 km south of the Scheme.	Medieval
061300/00/00 MLO15564	Non-designated monument	Greenway Harold PK Romford. Two buildings shown on map of c. 1618 named as Dial House.	N/A	Approx. 200 m south of the Scheme.	Post-medieval
060984/00/00 MLO23390	Non-designated monument	Tylers Common Upminster. Site of Roman building.	N/A	Approx. 1.5 km south of the Scheme.	Roman
MLO104464	Non-designated monument	Dagnam Park Drive/Settle Road [Dagnam Park], Harold Hill, Havering, Public Park. The park preserves its 18th century boundaries together with some landscape features.	N/A	Approx. 200 m south-west of the Scheme.	Post-medieval
MLO104564	Non-designated monument	Nag's Head Lane/Waverly Road [Tylers Common], Havering, Common Land. Substantial area of commonland consisting of grassland and scrub with two ponds.	N/A	Approx. 1.5 km south of the Scheme.	Medieval
MLO106812 EHER MEX2262	Non-designated monument	Possible Roman Road running from London to Chelmsford.	N/A	Within scheme footprint (Colchester	Roman

Reference (EHER, GLHER or NHLE)	Type	Description	Designation	Location to Scheme	Time Period
				Road/Brook Street).	
MEX1032780	Non-designated monument	South Weald historic settlement.	N/A	Approx. 250-300 m north of Scheme.	Medieval/Post-medieval
MEX1032782	Non-designated monument	Vicarage, South Weald.	N/A	Approx. 250-300 m north of Scheme.	Medieval/Post-medieval
MEX1035292	Non-designated monument	Boundary post, Nag's Head Lane, Brentwood, opposite entrance to sewage works.	N/A	Approx 250-300 m south of Scheme.	Post-medieval
MEX1035529	Non-designated monument	Alan-Williams Turret (destroyed), Brook House, Brook Street.	N/A	Approx 250-300 m south of Scheme.	Post-medieval
MEX1035530	Non-designated monument	Spigot Mortar Emplacement (destroyed), Brook Street.	N/A	Approx 250-300 m south of Scheme.	Post-medieval
MEX1035531	Non-designated monument	Road Barrier (destroyed), "The Golden Fleece", Brook Street.	N/A	Approx 250-300 m south of Scheme.	Post-medieval
MEX1036565	Findspot	Findspot on the Epping-Horndon Gas Pipeline. Pottery.	N/A	Within Scheme footprint	Post-medieval
MEX1036570	Findspot	Fieldwalking along the Epping-Horndon Gas Pipeline. Pottery and flint finds.	N/A	Within Scheme footprint	Undated.
MEX1049359	Non-designated monument	Five ditches encountered during M25 road widening in 2012.	N/A	Within Scheme footprint.	Unknown
MEX2254	Non-designated monument	Near Shenfield Road. Site of hospital/	N/A	Approx. 250-300 m south of the Scheme.	Medieval
MEX2256	Non-designated monument	Moat House. Moat is fragmentary and dry.	N/A	Approx. 250-300 m south of the Scheme.	Medieval
MEX2261	Non-designated monument	Moat House. 16th-18th century house.	N/A	Approx. 250-300 m south of the Scheme.	Medieval/Post-medieval

Reference (EHER, GLHER or NHLE)	Type	Description	Designation	Location to Scheme	Time Period
MEX2346	Findspot	Brentwood Hillside Walk. Roman finger ring.	N/A	Approx. 250-300 m south of the Scheme.	Roman
MEX40795	Non-designated monument	Brentwood – The Golden Fleece. Wall plaster was removed from a large area of the interior and the timbers recorded.	N/A	Approx. 250-300 m south of the Scheme.	Medieval/Post-medieval
MEX40800	Non-designated monument	Brentwood – London Road. A brick chamber was observed.	N/A	Approx. 250-300 m south of the Scheme.	Post-medieval

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