

Road Investment Strategy
M25 Junction 25 Improvements
Environmental Study Report
October 2016

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Glossary

AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekly Traffic
ALC	Agricultural Land Classification
AOD	Above Ordnance Datum
AQMA	Air Quality Management Area
AQS	Air Quality Strategy
ARN	Affected Road Network
ASR	Appraisal Specification Report
BAP	Biodiversity Action Plan
BBC	Broxbourne Borough Council
BCR	Benefit Cost Ratio
BGS	British Geological Society
BNL	Basic Noise Level
BS	British Standard
CEMP	Construction Environmental Management Plan
CO ₂	Carbon Dioxide
CMS	Continuous Monitoring Stations
CRTN	Calculation of Road Traffic Noise
dB	Decibel
DCO	Development Consent Order
DEFRA	Department for Environment, Food and Rural Affairs
DfT	Department for Transport
DMRB	Design Manual for Roads and Bridges
DM	Do Minimum
DS	Do Something
EA	Environment Agency
EAR	Environmental Assessment Report
EAST	Early Assessment Sifting Tool
ELC	European Landscape Convention
ECI	Early Contractor Involvement
EFT	Emission Factor Toolkit
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
EQS	Environmental Quality Standards
FRA	Flood Risk Assessment

GLVIA	Guidelines for Landscape and Visual Impact Assessment
GEML	Great Eastern Mainline
HE	Historic England
HER	Historic Environment Records
HDV	Heavy Delivery Vehicle / Heavy Duty Vehicle
HGV	Heavy Goods Vehicle
IAN	Interim Advice Note
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IPC	Infrastructure Planning Commission
LAQMA.TG	Local Air Quality Management Technical Guidance
LBAP	Local Biodiversity Action Plan
LCA	Landscape Character Assessment
LEP	Local Enterprise Partnership
LDF	Local Development Framework
LPA	Local Planning Authority
LNR	Local Nature Reserve
LVIA	Landscape and Visual Impact Assessment
MAGIC	Multi-Agency Geographic Information for the Countryside
MMP	Materials Management Plan
Mph	Miles per hour
NCAP	National Character Area Profile
NE	Natural England
NPPF	National Planning Policy Framework
NMR	National Monuments Record
NMU	Non-Motorised User
NCRN	National Cycle Route Network
NN NPS	National Networks National Policy Statement
NNR	National Nature Reserve
NO ₂	Nitrogen Dioxide
NOEL	No Observed Effect Level
NPSE	Noise Policy Statement for England
NSIP	Nationally Significant Infrastructure Project
NVZ	Nitrate Vulnerable Zone
OAR	Options Appraisal Report
PCF	Project Control Framework
PCM	Pollution Climate Model
PINS	Planning Inspectorate

PM _{2.5}	Particulate Matter with a diameter of 2.5 micrometres or less
PM ₁₀	Particulate Matter with a diameter of 10 micrometres or less
PPGs	Pollution Prevention Guidelines
PPG	Planning Policy Guidance
PRoW	Public Right of Way
RBMP	River Basin Management Plan
RIGS	Regionally Important Geological / Geomorphological Site
RIP	Regional Investment Programme
RIS	Road Investment Strategy
SAC	Special Area of Conservation
SNCI	Site of Nature Conservation Importance
SOAEL	Significant Observed Adverse Effect Level
SPA	Special Protection Areas
SPZ	Source Protection Zone
SRN	Strategic Road Network
SSSI	Site of Special Scientific Interest
SUP	Shared Use Paths
SWMP	Site Waste Management Plan
TAME	Traffic Appraisal Modelling and Economics
TAG	Transport Appraisal Guidance
TPO	Tree Preservation Order
TRA	Traffic Reliability Area
UKBAP	UK Biodiversity Action Plan
WFD	Water Framework Directive
ZVI	Zone of Visual Influence

1 Introduction and context

1.1 Background

In December 2014 the Department for Transport (DfT) published the Road Investment Strategy (RIS) for 2015-2020. The work confirmed the case for the need for an improvement at M25 Junction 25 and considered the options available to take forward to the options identification stage. The scheme is defined as an “*upgrade of the junction between the M25 and the A10 at Cheshunt, providing greater capacity for traffic*”.

Possible design solutions for schemes named in the RIS were identified through the route strategies process run by Highways England. That process included the collation of evidence of network performance issues, and local stakeholders and interested parties were engaged to explore the problems, issues and the potential range of solutions.

In 2015, Atkins was commissioned by Highways England to compile existing and new information and to produce the necessary documentation for Project Control Framework (PCF) Stage 0 (Strategy, Shaping and Prioritisation). This work culminated in the recommendation of developing the preferred strategic-level option i.e. online improvements to the existing junction.

Atkins was subsequently commissioned to undertake PCF Stage 1: Option Identification which commenced in November 2015. Highways England provided an updated ‘Client Scheme Requirements’ (CSR) (document reference: Stage_0_CSR_M25_Jn25_-_Signed.pdf) dated 14 March 2016 which highlights the needs and objectives of the scheme.

PCF Stage 1: Option Identification entails the identification of options from the solutions developed in PCF Stage 0 to be taken to stakeholder consultation, the assessment of those options in terms of environmental impact, traffic forecasts and economic benefits and the refinement of the cost estimate for the options (including an allowance for risk).

The purpose of this document is to report the environmental assessment of the options in PCF Stage 1 and comprises an Environmental Study Report (ESR).

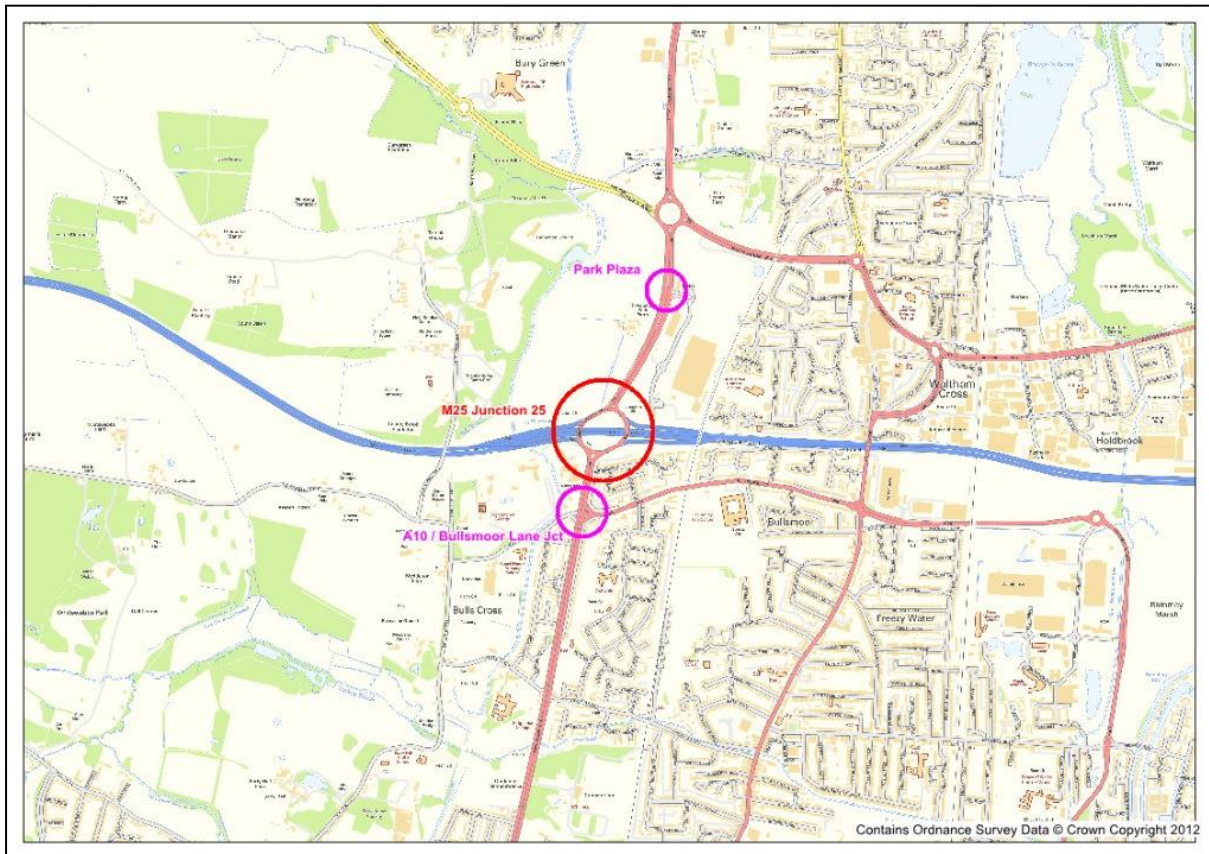
1.2 Geographical context

Junction 25 lies to the north of the M25 London Orbital on the border between Hertfordshire County to the north and the London Borough of Enfield to the south. Holmesdale Tunnel lies on the M25 to the east of Junction 25, which is at the intersection of the M25 and the A10 Great Cambridge Road in Waltham Cross.

Appendix A and Figure 1-1 show that a number of towns are located in the vicinity of the junction, including Waltham Cross and Cheshunt to the north, Waltham Abbey to the east and Enfield to the south. As well as being part of the London Orbital, M25 Junction 25 links Hertfordshire with north and central London, connecting the towns of Broxbourne, Hoddesdon, Hertford and Ware to London and providing regional access to these towns.

Approximately 300m to the south of M25 Junction 25 there is a 4-arm signalised junction at Bullsmoor Lane on the A10, serving the residential area of Bullsmoor. To the south, the A10 Great Cambridge Road links to Enfield, connects with the A406 north Circular Road and into Central London. Approximately 800m to the north of the M25 Junction 25 is a commercial development at Park Plaza, accessed by a signal controlled junction. To the north the A10 Great Cambridge Road eventually connects with the M11 near Cambridge.

Figure 1-1 Location of M25 Junction 25



1.3 Environmental overview

M25 Junction 25 lies within an area of urban fringe land to the north of London. There are a variety of surrounding land uses comprising open space, agricultural land (designated as grade 3 - good to moderate quality), roads and residential/light commercial/institutional properties. There are a number of Air Quality Management Areas (AQMAs) designated in the area. There are several Noise Important Areas (NIAs) within the study area and the wider area, with the main ones being Holmesdale Tunnel and two at Waltham Cross. These are centred on sections of the M25 and the A1010 leading to Waltham Cross Railway Station. A number of noise sensitive buildings lie within 600m. The environmental risks from improvements to Junction 25 are principally to do with the noise and air quality issues.

The area is not of high landscape value and already has a number of major roads that detract from the visual environment. There are large areas of residential properties to the south east of M25 Junction 25 that could be affected by visual impacts from the improvements. There is a registered park and garden approximately 750m to the south west. The area surrounding M25 Junction 25 is not of notable ecological value though there are internationally designated areas (Special Protection Area and Ramsar site) in the Lee Valley, approximately 1.2km to the east. Designated heritage assets are not likely to be significantly affected by any of the proposed scheme options and water quality and flooding issues are unlikely to be affected by any of the proposed scheme options. There is no particular risk associated with geology, soils and materials and community effects are likely to be limited whilst there will be benefits to pedestrians crossing the junction. The environmental constraints around the junction are shown in Appendix B.

1.4 Purpose of the environmental study report

This ESR has been prepared to provide a broad overview of the environmental constraints and relative environmental benefits associated with the various options proposed at PCF Stage 1. Significant environmental constraints that would preclude further consideration of

an option will be identified. The ESR will also identify the further assessment requirements at PCF Stage 2 to confirm a determination on significance as the scheme design progress through the PCF stages. It will also identify likely mitigation requirements and opportunities for enhancement.

The preferred option will be selected at the end of PCF Stage 2, and if the selected option requires a statutory Environmental Impact Assessment (EIA), it will be prepared during PCF Stage 3. If not, a Record of Determination (RoD) will be prepared and a Notice of Determination (NoD) to confirm that the scheme will not give rise to significant environmental effects and therefore does not require a statutory EIA

1.5 Scope and content

This ESR considers the three proposed options that have been identified to date. These are described in Section 3 and shown in Appendix C. The baseline information has primarily been obtained through desk studies from readily available information sources. Some site visits have also been undertaken to obtain further information.

Further monitoring and survey work will be required at a later stage in the design process, in order to close data gaps, and the requirements for this are set out in each topic section of the EAR. It is anticipated that the recommended further survey information will be incorporated into a refined version of the ESR at PCF Stage 2, once the number of options has been reduced and more detailed information is available on the option designs.

This ESR covers the following Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3 topics:

- Air Quality
- Cultural Heritage
- Landscape
- Ecology and Nature Conservation
- Geology and Soils
- Materials and Waste
- Noise and Vibration
- Road Drainage and the Water Environment
- People and Communities

As a Major Project for Highways England, this ESR (non-statutory) forms part of the PCF Stage1: Options Identification (Options Phase). This report follows on from and is underpinned by the Stage 1 Environmental Study Scoping Report v2.1 (August 2016)¹.

1.6 Structure of the environmental study report

The report is set out as follows:

- Section 2 of the report describes the background to the current situation at M25 Junction 25 including problems experienced which have influenced the scheme objectives
- Section 3 describes the proposed scheme options being considered
- Section 4 describes the alternatives considered and the process by which the scheme options were selected
- Section 5 describes the methodology for the environmental assessment process
- Sections 6 to 14 considers each of the environmental topics under the following subheadings:
 - Introduction
 - Assessment methodology, including value / sensitivity of receptor
 - Study area

¹ M25_J25_Environmental_Scoping_Report_v2.1.pdf

- Baseline conditions
- Regulatory and policy framework
- Potential significant effects
- Design, mitigation, enhancement measures and opportunities
- Summary and recommendations
- Limitations to assessment
- Section 15 outlines the cumulative effects of the scheme
- Section 16 gives initial details of the Construction Environmental Management Plan (CEMP)
- Section 17 provides a summary comparing the options considered in the environmental assessment

Figures and other information that support the environmental assessments are saved in named appendices and within the text of this report:

- Appendix A – Location Plan
- Appendix B – Environmental Constraints Plan
- Appendix C – Scheme Options
- Appendix D - Landscape
- Appendix E – Cultural Heritage
- Appendix F – Nature Conservation
- Appendix G – Air Quality
- Appendix H - Water
- Appendix I – Envirocheck Reports
- Appendix J – Geology and Soils
- Appendix K – People and Communities
- Appendix L – Noise and Vibration

2 Background to the project

2.1 Existing junction characteristics

2.1.1 Junction description

The M25 section between Junctions 23 and 27 has recently been upgraded and is now running as a "smart" motorway which comprises the hard shoulder being used as a permanent traffic lane with Emergency Refuge Areas (ERAs) at defined intervals.

M25 Junction 25 itself is a 4-arm signalised roundabout with a three lane approach on all arms, including the eastbound and westbound M25 slip roads and the north and southbound A10. The circulatory carriageway varies between two and three lanes wide.

Figure 2-1 M25 Junction 25



2.1.2 M25 Junction 25 strategic and local function

M25 Junction 25 performs a national, regional and local function; it is one of nine junctions on the northern quadrant of the M25 London Orbital and connects with other parts of the Strategic Road Network (SRN) via the A10 to the north and south, from which it connects to a number of local and regional towns as described above.

The M25 between Junction 24 and Junction 25 has been identified as being the 93rd busiest link on the SRN in terms of traffic volume with an Annual Average Daily Traffic (AADT) of 66,422 vehicles. In general, the north quadrant, particularly from Junction 21a to 27 has a high proportion of freight traffic travelling on the shorter route between the Midlands and north of England and the access points to the continent. Freight traffic accounts for an average of 26% of all traffic over this section.

The M25 Junction 25 performs an important function for local and regional businesses, particularly freight, travelling across country. Stakeholders have previously identified high demand for freight traffic travelling to and from the Thurrock area, including ports in Tilbury and London Gateway. Heathrow and Gatwick airports are also directly served by this route.

The operation of M25 Junction 25 is closely linked to the operation of two A10 junctions immediately to the north and south.

Given the regional function of the A10 through the study area, it also carries high volumes of through traffic. Whilst the M11 has taken over some of the regional function of the A10 as a connector from the M25 to Cambridge. Directions to Cambridge are signed at the M11 / M25

Junction 27 and not from M25 Junction 25. Cambridge is signed at other junctions on the A10 e.g. the A121 and A414.

2.1.3 Non-motorised user provisions

There is a shared cycle path/foot path connecting the northern and southern arms of the A10 at Junction 25. The path runs along the eastern side of the A10, north of M25 Junction 25, passes under the junction roundabout, joins the inside of the eastern side of the roundabout for 150m before passing under the junction again, connecting with the A10 to the south.

2.2 Current problems

The key challenges experienced by motorised travellers (MT), non-motorised users (NMU), local communities, businesses, residents, other stakeholders and the local environment are:

- **Route:** Accessibility to and from M25 Junction 25 inhibits its role as a major national and inter-urban regional transport artery. M25 Junction 25 is intrinsically linked to the performance of the surrounding highway network (e.g. TfL and Hertfordshire) in terms of ability to support existing and future accessibility and growth
- **Asset Condition:** M25 Junction 25 is the second highest signalised junction in all of the South East (Highways England Areas 3, 4 and 5) in terms of Highways Agency Information Line (HAIL) issues raised, with the majority of issues relating to the operation of the traffic signals. This is due to dated and inappropriate signal technology. It is noted that a separate signal improvement programme is planned by Highways England prior to the RIS scheme.
- **Capacity:** Issues such as long peak hour queues have been reported on M25 Junction 25 approaches and the circulatory carriageway. Furthermore, modelling indicates that the junction operates over capacity with long queues and delays in both the AM and PM peaks. This is due to a combination of high traffic flows, conflicting regional and local traffic movement requirements, a narrow west approach that results in the short middle flare not being used properly and traffic signal systems that are not coordinated with capacity issues at the A10 Bullsmoor Lane junction resulting in blocking back of traffic onto the M25.
- **Safety:** M25 Junction 25 is amongst the top 10 motorway junction collision hot spots.
- **Social:** Traffic capacity issues inhibit economic growth opportunities.
- **Social:** The shared cycle/pedestrian route beneath the M25 Junction 25 has lighting, flooding and security issues, inhibiting potential usage.
- **Environment:** AQMAs are designated in the vicinity of M25 Junction 25, (Teresa Gardens and Arlington Crescent) and are affected by traffic and congestion, including a high proportion of HGVs. Noise Important Areas have been identified at Waltham Cross and Holmesdale Tunnel where traffic has been identified as a major source of noise pollution.

2.3 Regulatory framework

2.3.1 National policy

In December 2014 the Government adopted a National Networks National Policy Statement (NN NPS), which sets out the Government's policies to deliver Nationally Significant Infrastructure Projects (NSIPs) on the national road and rail networks in England. The Secretary of State will use the NN NPS as the primary basis for making decisions on development consent applications for national networks NSIPs in England.

The NN NPS states that improvements on the highways network are vital to alleviate congestion, particularly in the South East. Paragraph 2.17 states that:

“It is estimated that around 16% of all travel time in 2010 was spent delayed in traffic, and that congestion has significant economic costs: in 2010 the direct costs of congestion on the Strategic Road Network in England were estimated at £1.9 billion per annum.”

The NN NPS indicates that options testing need not be considered by the examining authority or the decision-maker if projects have been subject to full options appraisal in achieving their status within Road or Rail Investment Strategies, or other appropriate policies or investment plans. For national road and rail schemes, proportionate consideration of alternatives will have been undertaken as part of the investment decision-making process.

2.4 Strategic objectives

The RIS identifies five overarching long-term challenges for the SRN, of which the following three are likely to be of key importance to the M25 Junction 25 Improvements:

- **Access around major cities** – addressing serious congestion at the periphery of the major cities which are anticipated to be the greatest drivers of growth (particularly London and designated Opportunity Areas such as the Upper Lee Valley) through lasting solutions which make the best use of all modes.
- **Connecting outlying areas** – providing better links to support growth within outlying regions, including Hertfordshire and growth areas such as the A10/M11 and A1(M) Growth Areas.
- **Building a smarter network** – unlocking the potential of smarter infrastructure and new technologies to enable the most to be made of the SRN.

2.5 Scheme objectives

During the scheme review at PCF Stage 0, the following scheme objectives were developed which will inform the current assessment:

- **Route Operation:** Reduce queueing (number of vehicles) on the junction and its approaches, with the M25 Junction 25 off-slips adjacent to Holmesdale Tunnel being the highest priority.
- **Asset Status:** reduce the number of HAILs (particularly related to signal operation and performance).
- **Capacity:** Reduce the average delay (time lost per vehicle per mile) through the junction and smooth the flow of traffic by improving journey time reliability through the junction.
- **Safety:** Reduce annual collision frequency and severity ratio on both the gyratory and on the M25 Junction 25 slips.
- **Social:** Improve existing cycling, walking and other vulnerable user group connections across the M25 in the vicinity of Junction 25 and support the projected population and economic growth in the area as identified in key policy documents.
- **Environment:** Reduce the impact of ground based traffic on air quality and noise pollution, specifically at local AQMAs (Teresa Gardens, Arlington Crescent and LB Enfield) and identified Important Areas for Noise (Waltham Cross and Holmesdale Tunnel).
- **Environment:** Improve biodiversity within the scheme if the opportunity exists.

2.6 Environmental impact assessment

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 will be transposed into UK legislation in 2017 and therefore will be relevant to this scheme if it is deemed that the EIA Regulations are applicable.

2.7 Highways England strategic performance / key performance indicators

Highways England has published its Delivery Plan, 2015 -2020 and Strategic Business Plan (SBP). It states that:

“Government has made a strong commitment to an ongoing improvement in environmental outcomes through the operation, maintenance and modernisation of the strategic road network. We are committed to ensuring that all activity on the network is delivered in a

manner that does not harm the environment; but instead delivers long term benefits to the natural and built environment, creating a sustainable future for all”

Section 6: *Improving the Environment*, sets out a number of environmental interventions to meet this commitment which are transposed into Performance Indicators (PIs) and Key Performance Indicators (KPIs) to measure how Highways England are delivering better environmental outcomes across the network over the next five years.

An extract from the Delivery Plan Annex B: key performance indicators and performance indicators is provided in Table 2-1 below. Where relevant, the proposed scheme will aim to contribute to meeting these PIs and KPIs.

There is an additional relevant KPI for People and Communities:

“The number of new and upgraded crossings is a KPI in the Highways England Delivery Plan (2015-2020)”.

The development of new indicators which demonstrate improved facilities for cyclists, walkers and other vulnerable users is identified as a requirement in the Delivery Plan. The Delivery Plan sets out Highways England’s commitments for improving integration and accessibility through the network including a commitment to work with local communities, to listen to local people to identify how to improve the physical or environmental quality of a place, or the economic or social well-being of a community.

Table 2-1 Highways England Delivery Plan Annex B

Topic	Performance Specification			Delivery Plan		
	Measure	KPI target	Highways England Output	Delivery Date	Section number	
Delivery better environmental outcomes	KPI	Noise: Number of Noise Important Areas mitigated	At least 1,160 Noise Important Areas over RP1	1,160 Noise Important Areas mitigated	By 31st March 2020	6.1.1
	KPI	Biodiversity: Delivery of Improved biodiversity, as set out in the Company’s Biodiversity Action Plan	Publish Biodiversity Action Plan by 30 June 2015 & report annually against the Plan to reduce net biodiversity loss on ongoing annual basis	Biodiversity Action Plan (BAP) to include method for demonstrating impact on biodiversity, and subsequent reporting progress against this plan	Publish BAP by 30 June 2015, report progress annually	6.1.4
	PI	Suite of PIs to provide additional information about environmental performance. These should, at a minimum, include: - Air Quality;	N/A	Undertake 10 Air Quality Pilot Studies to test the feasibility of ‘Air Quality Intervention Measures’	Complete all 10 studies by 31 March 2016	6.1.2
	PI	Suite of PIs to provide additional information about environmental performance. - Carbon dioxide, and other greenhouse gas emissions for the Company and its supply chain that occur as they carry out work on the SRN.	N/A	Monitor carbon dioxide equivalents in tonnes associated with the company’s activities, and separately activities associated with the supply chain	Report annually	6.1.3
	Requirement	Demonstrate what activities have been undertaken, and how effective they have been, to improve environmental outcomes	N/A	Produce a programme and monitor progress against it	Programme by 31 March 2016, then annually report progress	6.0
	Requirement	Develop metrics covering broader environmental performance. These should include: - a new or Improved biodiversity metric	N/A	Produce a programme, collect data to develop biodiversity baseline and monitor against it; by the end of RP1, develop and a biodiversity metric.	Programme by 31 March 2016, annual progress reports, new ‘env capital’ metric by 31 March 2020	6.1.4
	Requirement	Develop metrics covering broader environmental performance. These should include: - carbon dioxide, and other greenhouse gas emissions arising from the use of the network.	N/A	Produce a programme, collect data to develop baseline and monitor against it; by the end of RP1, develop a network carbon metric.	Programme by 31 March 2016, annual progress reports, new network carbon metric by 31 March 2020	6.1.3

2.8 Construction, operation and long term management

Specific construction, operational and long term management arrangements are not known at this stage of the project. The following assessments assume best practice based on industry guidance and professional experience.

3 Description of proposed options

3.1 Overview

Following the scheme review in PCF Stage 0 the following options are being taken forward for further design and assessment during PCF Stage 1. The scheme options drawings are provided in Appendix C.

3.2 Option 1

Option 1 consists of widening the M25 Junction 25 roundabout circulatory carriageway to provide a minimum of three lanes throughout with an additional fourth lane between the A10 southbound entry and the A10 southbound exit from the roundabout. This would be achieved by narrowing the existing hardened verge on the west bridge deck at the inside of the roundabout from approximately 6.2m to 4.6m. This will provide three lanes across the bridge at a width of 4m for each lane. Over the east bridge deck, the existing hardened verge on the inside of the east bridge deck will be narrowed from approximately 6.2m to 3.0m. This will provide four 3.4m wide lanes across the bridge. In other locations the roundabout circulatory will be widened by up to 3.5m into the central island to accommodate the additional lane.

For a 250m length of the A10 on the southbound approach to the roundabout it is proposed to regularise the lane widths to provide three 3.65m traffic lanes. This ensures a consistent road width is maintained between the junction and A10 to the north, currently the existing carriageway width varies over this length. Additionally to achieve the maximum capacity from the four lanes on the roundabout circulatory carriageway, the A10 southbound entry to the roundabout is widened by an extra lane for a length of 30m from the existing signalised junction.

At present there is an existing footway/cycleway route that provides a grade separated north/south route across the M25. The route passes beneath the roundabout circulatory carriageway in two locations through subways and crosses over the M25 on the inside of the eastern side of the roundabout adjacent to the circulatory carriageway. To accommodate the circulatory carriageway widening the existing route across the eastern bridge would be removed and would be replaced by a separate pedestrian/cycle footbridge through the centre of the junction as one possibility. This would be achieved by installing a prefabricated steel truss girder footbridge over the width of the M25 Junction 25 carriageway. The design of the replacement facility would enable resolution of the lighting, flooding and security issues currently experienced in the underpasses.

3.3 Option 2

Option 2 comprises the proposals outlined in Option 1 with the addition of widening to the M25 Junction 25 eastbound and westbound diverge slips to three lanes along with a segregated left turn lane between the M25 eastbound diverge slip and the A10 northbound.

For this design option it is proposed to extend this third lane up to approximately 160m in advance of the roundabout entry. This will be achieved by widening into the nearside verge and existing earthworks cutting slope by approximately 4.5m.

It is proposed to provide a segregated left turn lane from the eastbound diverge slip to the A10 north of the roundabout. This dedicated left turn would commence approximately 220m upstream of the circulatory carriageway.

The segregated left turn lane will allow free flow of traffic from the M25 to the A10 northbound. It would be constructed as a single 6m wide carriageway marked out as a 3.5m wide lane with hatching in accordance with the design standards and segregated from the roundabout circulatory carriageway by a 2m wide physical island.

3.4 Option 3

Option 3 comprises the proposals outlined in Options 1 and 2 with the addition of widening the A10 southbound between Junction 25 and Bullsmoor Lane to provide an additional lane. In addition, a segregated left turn lane between the A10 northbound and the M25 westbound merge slip is proposed along with widening of the M25 westbound merge slip to accommodate the segregated left turn lane.

Between the M25 Junction 25 and the Bullsmoor Lane junction to the south, an additional lane will be provided southbound. This will extend the existing southbound left turn lane at the Bullsmoor Lane junction back to the M25 Junction 25. In order that the impact of this lane on the existing infrastructure is reduced, the central reserve on the A10 will be moved west and widening provided on the west of the A10. This will reinstate the three existing northbound lanes that will require the acquisition of land outside of the highway boundary. Widening the A10 to the west will mean that a service road to the residential properties on the east of the A10 can remain unaffected and A10 traffic will not be brought any closer to residential properties.

A segregated left turn lane will be constructed to allow free flow of traffic from the A10 northbound to the M25 Junction 25 westbound. This would be achieved by constructing a single 6.5m wide carriageway reduced down to a 3.5m wide lane width with hatched road markings in accordance with the design standards. This lane will be segregated from the roundabout circulatory carriageway by a 2m wide physical island. At the point the segregated left turn lane merges with the M25 Junction 25 westbound merge slip two lanes are required on the slip road. Currently the slip road has a single lane with a hard shoulder. The slip road will require widening as the standard cross-section for a motorway two lane merge also includes a hard shoulder. It is proposed that a Departure from Standard is then applied to reduce the two lanes on the slip road down to a single lane before the merge nosing at the end of the slip road. Unless the slip road is reduced to a single lane at this point a revised merge layout with the M25 will be required that would likely require the replacement of the existing Bulls Cross Ride overbridge as additional road widening required for a two lane merge layout would not fit below the existing structural supports.

4 Alternatives considered

4.1 Identification of strategic solutions

The aim of the solution generation process for Junction 25 in Stage 0 was to develop a range of potential Strategic Solutions to address the need for intervention. Based on the available information, a wide range of conceptual solutions were considered including public transport improvements, road pricing, demand management and new highway infrastructure.

Ten strategic solutions were initially considered and compared using a structured qualitative assessment where the scale of impact of each option was assessed against the problems/objectives identified in the PCF Stage 0 report².

'Junction Improvements', 'Bypass and 'Road User Charging' options all offered potentially strongly positive solutions in terms of addressing the transport related issues at Junction 25. The 'Bypass' and 'Charging' options were likely to have wider implications in terms of displaced traffic and its impacts. Furthermore these options did not score favourably when considered against the Early Assessment Sifting Tool (EAST) headings in terms of feasibility and deliverability. Similarly, the 'New M25 Junction' option was considered likely to have feasibility issues related to its proximity to adjacent M25 junctions as well as being high cost.

The 'Travel Demand Management' option was thought likely to provide good value for money, however was unlikely to provide any substantial contributions towards addressing the identified issues or achieving the identified scheme objectives on its own.

There was insufficient evidence to fully discount schemes at Stage 0, and further work with stakeholders has been carried out in Stage 1. However there was a recognition that, whilst bus, rail and demand management options may provide opportunities for modal transfer, these measures by themselves were unlikely to be able to adequately address the existing and future issues and scheme objectives at Junction 25.

Overall scoring indicated that a 'Junction Improvement' option was most likely to address identified issues as well as scoring well on feasibility, acceptability and delivering 'good value for money'. Accordingly, a range of 'Junction Improvement' Option Variants were considered.

4.2 Identification of option variants

Considering and building upon the previous Junction 25 proposal history, several 'Junction Improvement' Option Variants were considered incrementally. This included Do-Nothing and five Junction Improvement Variant Options, listed in Table 4-1 below.

² M25 J25 PCF Stage 0 Report 300915 Draft.pdf

Table 4-1 Description of junction improvement options considered

Option No.	Brief Overview of Option
0	- Signal improvements (part of the catch-up signal technology programme)
1	As Option 0 plus: - Widen the M25 J25 circulatory carriageway to three / four lanes throughout - Widen the A10(N) Southbound entry to the roundabout - Re-provide and improve the pedestrian/cycle facility that would be lost
2	As Option 1 plus: - Widen M25 Eastbound off-slip - Widen M25 Westbound off-slip - Segregated left turn lane from M25 West and A10 North
3	As Option 2 plus: - Segregated left turn lane from A10 South to M25 West - Widen A10(S) southbound on approach to Bullsmoor Lane junction to provide dedicated left turn lane between M25 and Bullsmoor Lane
4	As Option 3 plus: - Staggered junction on south side of Bullsmoor Lane (closure of Bullsmoor Lane (west) egress movements onto A10 and with only straight on movements from Bullsmoor Lane (east) permitted)
5	Flyover connecting A10 North and South

In addition to a Do-Nothing (Option 0), the five 'Junction Improvement' Variant Options were considered against a structured framework reflecting the Highways England Key Performance Indicators (KPIs) and the high level EAST headings. Four of the options (Options 1 to 4) build incrementally on Option 0, along with a 'Flyover' Option 5.

Based on the available evidence, Option 3 and 4 scored highest overall against Highways England KPIs. In summary:

- Do-Nothing – it was assumed that this option is going ahead therefore it has not been considered in any further detail.
- All Options scored positively against the 'Making the Network Safer', 'Encouraging Economic Growth', 'Supporting the Smooth Flow of traffic' and 'Improving user Satisfaction' KPIs. Options 3, 4 and 5 scored particularly well, being likely to offer higher capacity, safety improvement and therefore should contribute towards improving road user satisfaction.
- Other than the 'Do Nothing' Option 0 and Option 1, the higher capacity created by Options 2 to 5 scores negatively in terms of 'Delivering Better Environmental Outcomes'. This reflects the potential impact on sensitive environmental areas (noise and air). Options 3, 4 and 5 also require land take.
- None of the schemes were considered to address 'Keeping the network in good condition' or 'Achieving real efficiency.'

Against high level EAST headings Option 1, 2 and 3 scored highest overall. In summary:

- Options 1, 2 and 3 scored well in terms of offering solutions that were likely to be achievable, feasible, practical and 'good value for money'.
- Options 4 and 5 were likely to be higher cost, have greater land take implications and therefore uncertainty.

Overall scoring indicated that Option 1, 2 and 3 were likely to achieve the biggest contribution towards achieving Highways England KPIs as well as offering solutions that are achievable, feasible, practical and 'good value for money'. These three options have been taken forward for further consideration and are the subject of this EAR.

5 Environmental assessment methodology

5.1 General approach

This section sets out the approach taken to the ESR. Although there are methods and requirements specific to each assessment topic, the approach set out below is common to all topics and is in accordance with relevant guidance and best practice. Where there is a topic specific methodology, this will be described in the relevant topic chapter.

The ESR follows the assessment approach in the Design Manual for Roads and Bridges (DMRB) Volume 11 (Highways Agency³, 2009) and subsequent amendments and guidance provided in Interim Advice Notes (IANs). Section 3 of DMRB Volume 11 provides guidance on topic specific assessment. This guidance was followed in the assessment of the relevant environmental topics in the ESR.

The environmental topic headings described in Section 3 of Volume 11 of the DMRB were amended in IAN 125/15 (Table 5-1). Highways England has not yet issued environmental topic advice notes to reflect all the new topic headings. For those topics that have not been updated, DMRB guidance as published in Section 3 will be used as relevant. Where this is no longer considered appropriate, the methodology has been set out in the topic section.

Table 5-1 Comparison of environmental topics

Previous environmental topic heading	Revised environmental topic heading (October 2015)	Changes to the content of each topic at the time of writing
Air Quality	Air Quality	Individual Policies and Plans and Disruption due to Construction sections required as part of each topic.
Cultural Heritage	Cultural Heritage	
Landscape Effects	Landscape	
Ecology and Nature Conservation	Nature Conservation	
Geology and Soils	Geology and Soils	
	Materials (to include waste)	
Noise and Vibration	Noise and Vibration	Vehicle travellers, Pedestrians, Cyclists, Equestrians, Land Use and Community Effects assessments have been merged to become "People and Communities". Individual Policies and Plans and Disruption due to Construction sections required.
Vehicle Travellers	People and Communities	
Pedestrians, Cyclists, Equestrians and Community Effects		
Land Use		
Road Drainage and the Water Environment	Road Drainage and the Water Environment	Individual Policies and Plans and Disruption due to Construction sections required as part of each topic
Policies and Plans	N/A	To be included in every topic.
Disruption due to Construction	N/A	To be included in every topic.

5.2 Scoping

An initial DMRB scoping exercise was undertaken as part of PCF Stage 0 to determine the level of assessment that was appropriate at this early stage in the design. As this ESR has been undertaken to support early design work at PCF Stage 1, option identification, all topics have been scoped into this assessment at this stage. The findings of this ESR will therefore be used to scope out topics at a future assessment stage.

³ Now called Highways England

Generally, simple assessments were proposed to provide proportionate assessments for the options, and in view of the limited design and traffic information that was available.

The level of assessment and proposed approach for each topic is summarised in Table 5-2 .

Table 5-2 Findings from Scoping Exercise

Topic	Proposed level of assessment	Comments	Summary of proposed methodology for PCF Stage 1 ESR
Cultural Heritage	Simple	A simple assessment to determine whether the proposed scheme options would be likely to be granted Scheduled Monument Consent (SMC) given the anticipated significant effects on scheduled sites.	The Simple Assessment will follow the guidelines set out in DMRB Volume 11, Section 3, Chapter 5, and Annex 5 and 6 in relation to archaeological remains and built heritage, respectively.
Landscape character	Simple	Effects on character at local level only	Assessment in accordance with IAN135/10 and reference to GLVIA 3
Visual impact	Simple	Visual effects constrained by woodland	Assessment in accordance with IAN135/10 and reference to GLVIA 3
Water quality and drainage	Simple	A site walkover is proposed for the EAR, no water quality tests to be undertaken at this stage.	The assessment will be based on guidance contained in the DMRB Volume 11, Section 3, Part 10 HD45/09 - Road Drainage and the Water Environment (November 2009).
Noise – construction	Qualitative	As baseline noise monitoring will be undertaken at a future design stage, a full construction noise assessment using BS5228-1:2009+A1:2014 will be deferred until baseline noise monitoring data is available.	The assessment at this design phase will be qualitative.
Noise - operation	Proportionate / basic	The assessment will not provide detailed noise level predictions required for a WebTAG assessment or to meet the requirements of a 'Simple' or 'Detailed' level assessment described in DMRB. Noise level predictions at individual noise sensitive receptors will be deferred to a future design stage. A basic quantitative noise assessment will be undertaken to identify areas that may exceed DMRB's and NIAs threshold levels and trigger the need for a detailed assessment in a future design stage.	To provide a proportionate level of assessment for PCF Stage 1, an operational noise assessment will be undertaken generally in line with the guidance in DMRB 11:3:7.
Air quality - construction	Simple	A simple assessment approach will be undertaken for the air quality assessment at PCF Stage 1 using a proportionate risk assessment approach	At PCF Stage 1, construction impacts will be assessed qualitatively in accordance with relevant guidance given in DMRB HA207/07.
Air quality - operation	Simple	A simple assessment approach will be undertaken for the air quality assessment at PCF Stage 1 using a proportionate risk assessment approach.	Further qualitative air quality assessment will be undertaken for the ESR for PCF Stage 1 in accordance with HA207/07 DMRB Volume 11, Section 3, Part 1, IAN 170/12 v3, IAN 174/13, IAN 175/13, and Defra's Local Air Quality Management Technical Guidance (LAQM.TG(09)), where appropriate.

Topic	Proposed level of assessment	Comments	Summary of proposed methodology for PCF Stage 1 ESR
			Limitations in the availability of traffic data preclude completion of any quantitative assessment of potential air quality effects associated with each option. No baseline monitoring will be undertaken for the ESR for PCF Stage 1.
Nature conservation: Designated sites	Detailed	Potential for significant effects.	Breeding bird survey and consultation with Natural England.
Nature conservation: Notable habitats and protected species	Detailed	Potential for significant effects.	A targeted Extended Phase 1 Habitat survey will inform the scope for further habitat and protected species survey work. Habitats with greater botanical interest will be subject to NVC surveys. A search for evidence of invasive species subject to legal control will also be undertaken to inform plans for site clearance. Field surveys will be carried out for legally protected species where there is potential that a licence could be required and/ or the presence of a species could have a substantial effect on the design, planning or programming of site works. An ecological assessment will be undertaken to determine the value of receptors, characterise potential impacts and determine the significance of effects that may arise from the construction and operation phases of the M25 Junction 25 Improvements.
Geology, Soils and Materials	Simple	No comment	In accordance with DMRB Volume 11, Section 3, Chapter 11
People and Communities	Simple	No significant effects are considered likely so simple assessment level selected.	The assessment will use published guidance provided in DMRB Volume 11 – combining the NMU component of DMRB 11.3.8 - Pedestrians, Cyclists, Equestrians and Community Effects, and DMRB 11.3.9 - Vehicle Travellers, DMRB 11.3.6 for Land Use (DMRB 11.3.6) and the Community Effects component of DMRB 11.3.8 (Pedestrians, Cyclists, Equestrians and Community Effects) as set out in IAN 125/15.

5.3 Significance criteria

The assessment will identify the potential impacts that might occur due to the construction and operation of the options for the M25 Junction 25 Improvements. Impacts may be adverse/negative or beneficial/positive, direct, indirect, secondary or cumulative, temporary or permanent, short, medium or long term. The proposed scheme options can affect the environment in a variety of ways. The differing parts of the environment affected by a proposed scheme option are known as receptors (i.e. those things that receive an impact from a scheme). Receptors can range from individual plants, animals or human beings living in or passing through the area, through to the landscape as a whole and the physical,

ecological and cultural elements within it. Receptors can vary in terms of value and sensitivity.

Chapter 2 of DMRB Volume 11 Section 2 Part 5 introduces the general principle underlying the assessment process, which can be summarised generally, although not necessarily for every topic, as a three-step process:

- the evaluation of the value, importance or sensitivity of the receptors
- assessment of the magnitude of the impact of the scheme on the receptor, be it adverse or beneficial
- determination of the significance of the effect resulting from combining the impact (of a certain magnitude) on a receptor (of a particular value)

Significance criteria are set out for each assessment topic following this three step approach. Table 5-3 sets out an assessment matrix to determine the value or sensitivity of receptor and the magnitude of impact to determine the significance of effect. Moderate and major effects are considered 'significant' for the purposes of EIA regulations and might indicate the need for a statutory Environmental Impact Assessment Report (EIAR) later in the project lifecycle.

Table 5-3 Arriving at the Significance of Effects

		MAGNITUDE OF IMPACT (DEGREE OF CHANGE)				
		No change	Negligible	Minor	Moderate	Major
ENVIRONMENTAL VALUE (SENSITIVITY)	Very High	Neutral	Slight	Moderate or Large	Large or Very Large	Very Large
	High	Neutral	Slight	Slight or Moderate	Moderate or Large	Large or Very Large
	Medium	Neutral	Neutral or Slight	Slight	Moderate	Moderate or Large
	Low	Neutral	Neutral or Slight	Neutral or Slight	Slight	Slight or Moderate
	Negligible	Neutral	Neutral	Neutral or Slight	Neutral or Slight	Slight

Source: DMRB, Volume 11

5.4 Mitigation enhancement

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).

Some initial mitigation and enhancement measures have been identified in the topic sections. However, further measures will be considered at a later stage in the design process, once further design information is available. As the project develops, the mitigation and enhancement will be developed in consideration of all topic requirements.

Prior to construction, a Construction Environmental Management Plan (CEMP) would be compiled to provide guidance on specific areas during the construction process. This would detail both generic and specifically targeted instructions to enable construction to be undertaken with minimal impact on the environment.

6 Landscape

6.1 Introduction

This section assesses potential impacts on the landscape and on visual receptors from each option.

In accordance with IAN 135/10 Landscape and Visual Effects Assessment, a simple assessment has been produced as part of this ESR to assess the current proposed scheme options and whether it is likely that effects would be significant.

The simple assessment approach has been adapted, at an appropriate level of detail for the current stage. The assessment has been informed by desk study information and initial site visits. The approach has also been informed by the Guidelines for Landscape and Visual Impact Assessment, Third Edition, Landscape Institute and Institute of Environmental Management & Assessment, 2013 (GLVIA3).

From examining the proposed works, the landscape character, and the location of visual receptors, an assessment has been made and any potential significant effects on the landscape resource and on visual receptors, and recommendations provided for further assessment and for mitigation.

6.2 Assessment methodology

The assessment of landscape and visual effects was preceded by a review of baseline information to inform the landscape and visual context. This included analysis of the planning framework, statutory designations using variety of information sources i.e.: the Defra website (magic.defra.gov.uk) and relevant local planning authority documents.

The Guidelines for Landscape and Visual Impact Assessment 3rd edition (GLVIA) state that:

“LVIA must address both effects on landscape as a resource in its own right and effects on views and visual amenity...An assessment of landscape effects should consider how the proposal will affect the elements that make up the landscape, its aesthetic and perceptual aspects, its distinctive character and the key characteristics that contribute to this....An assessment of visual effects deals with the effects of change and development on the views available to the people and their visual amenity.”

The approach to the assessment is outlined below, the full methodology and associated criteria are provided in Appendix D.

6.2.1 Landscape sensitivity

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 GLVIA3).

6.2.2 Visual sensitivity

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 GLVIA3).

6.2.3 Magnitude of landscape impact

The magnitude of landscape impact is determined by taking into consideration size, scale, geographical extent, duration and reversibility of the improvement's works on the landscape resource.

6.2.4 Magnitude of visual impact

The magnitude of visual impact is determined by taking into consideration a degree of change in the composition of the view in comparison to the baseline of the view. In determining the magnitude of visual impact, the following has been considered: scale of

change, nature of change, duration of change, distance, screening, direction of the view, removal of vegetation, whether the receptor is static or moving and the numbers and type of receptor. The magnitude of visual impact is assessed by taking into consideration the potential for introduction of environmental design measures or mitigation measures.

6.2.5 Significance of effects

The significance of landscape or visual effects has been determined by taking into consideration both the magnitude and sensitivity of landscape resource or visual receptors. The effects can be adverse, neutral or beneficial. The assessment is determined using professional judgement, which relies on a consistent reasoning based on the current guidance including IAN 135/10 and GLVIA3.

Landscape or visual effects are generally considered as significant when moderate or higher level adverse effects have been identified.

6.3 Study area

The desk top study and a site visit informed the extent of the study area for both landscape and visual effects. It was expected that potentially significant effects may occur within 0.5km radius from the centre of the junction which was based on professional judgement and experience of assessing similar proposals. However consideration has also been given to landscape effects on designations and other places of public interest like Country Parks within a radius of 2km. Any effects beyond that considered area are unlikely to be significant and are not considered further in this report.

6.4 Baseline conditions

A desktop study has been undertaken to identify landscape and visual receptors. This included review of aerial imagery, Ordnance Survey (OS) maps, Natural England data, Historic England data, Campaign for the Protection of Rural England data and published landscape character assessments to define the potential study area and identify a range of possible landscape and visual effects. An initial site visit has also been undertaken to gain an understanding of the context and potential inter-visibility of features.

6.4.1 Landscape

The identification of landscape receptors was preceded by analysis of the existing landscape character and identification of elements and features of landscape character that may be affected. Key characteristics and value attached to landscape and landscape designations, along with identification of interactions with the proposed scheme options were also considered to inform identification of receptors.

The junction is located at the periphery of Waltham Cross to the north of Enfield. There are no designated landscapes here that could potentially be directly or indirectly affected by the proposed scheme options.

The following landscape receptors were scoped out from the assessment in the scoping report:

- Landscape character at regional and national level, as the proposed scheme options would not give rise to the alteration of key characteristics of landscape character at that scale.

6.4.2 Landscape character

The junction options are located at the border of Broxbourne Borough Council (BBC) and the London Borough of Enfield Council (LBE) within the Greater London Authority (GLA).

The landscape character of BBC is described within Broxbourne Landscape Character Assessment prepared by Chris Blandford Associates. This landscape character assessment identifies three Landscape Character Types (LTC) relevant to M25 Junction 25:

- Urban (Cheshunt)

- River Valley Floodplain: Farmland
- Plateau Ridges and Slopes: Wooded Farmland

Within each of the generic LCT, nine Landscape Character Areas (LCAs) are identified which reflect distinctive variations in local landscape character. Two relevant LCAs and one Urban Character type have been identified to the north of M25 Junction 25 and these are:

- Urban (Cheshunt)
- E1: Bury Green
- B3 Theobald's Estate

Table 6-1 below includes key characteristics of relevant landscape character areas and their extent is illustrated in Figure 6-1. The Broxbourne Landscape Character Assessment does not provide a characteristic for the urban character type and therefore key characteristics of the landscape local to the M25 Junction 25 have been included in Table 6-1 below.

Table 6-1 Summary of relevant attributes of Landscape Character Areas - Broxbourne

Broxbourne Borough Council		
Landscape Character Types	Landscape Character Areas	Key attributes and qualities of landscape character
Plateau Ridges and Slopes: Wooded Farmland	B3: Theobald's Estate Landscape Character Area	<ul style="list-style-type: none"> • strong pattern of regular, medium to large-scale fields, interspersed with discrete medium-sized woodland blocks • landscape is strongly influenced by Theobald's Estate • several of the hedgerows lining fields have a low, managed character • number of farmsteads are scattered throughout the estate • there is a relatively strong sense of tranquillity throughout much of the area. To the south, however, the corridor of the M25 road corridor introduces a constant and dominant source of noise, movement and light therefore reducing levels of tranquillity
River Valley Floodplain: Farmland	E1: Bury Green Landscape Character Area	<ul style="list-style-type: none"> • Strong sense of openness throughout this landscape due to the topography and lack of built features • Open and long distance views towards Central London (including views to Canary Wharf) to the south and more localised views towards the urban edges of Cheshunt and Waltham Cross • Predominantly flat landscape, which sits on the western edge of the floodplain of the River Lea and rises gently towards Plateau Ridges and Slopes: Wooded Farmland (Landscape Character Type B) to the west • Overall sense of tranquillity is disturbed by proximity to the A10 road corridor, which is a source of noise and visual intrusion • Land cover predominantly consists of a series of large-scale arable fields, which are delineated by mature low to medium hedgerows • A hotel and printworks to the east of the A10 main road corridor are prominent, both within views across the landscape and within views from other Landscape Character Types • The course of the New River corridor forms the western boundary to this Landscape Character Type
Urban	-	<ul style="list-style-type: none"> • Mixed character of small towns associated with urban fringe of London contrasting with rural landscape corridor along the M25 motorway • Industrial Estate located close to the junction and the railway • Presence of residential housing built within second half of 20th century

		<ul style="list-style-type: none"> • Low to moderate landscape value as there are some valuable belts of trees creating wildlife links, however majority of the area is sparsely vegetated with trees present largely within gardens
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To the south the proposed scheme options are located within the boundaries of Enfield Borough Council. The landscape character of Enfield is described in the Enfield Characterisation Study (February 2011) prepared by Urban Practitioners. The assessment has identified three distinct urban zones which are then defined more precisely as distinct Places. Enfield Borough Council has prepared an Area of Special Character Boundary Review (March 2013) to support the emerging policy in the Development Management Document. The report identifies proposed changes to the area of Special Character designated on the adopted Enfield Policies Map (2010). A summary of relevant attributes and characteristics of Enfield landscape character is presented in Table 6-2.

Table 6-2 Summary of relevant attributes of Landscape Character Areas - Enfield

London Borough of Enfield Council		
Urban Zones	Places	Key attributes and qualities of landscape character
Eastern Corridor	Enfield Wash	<ul style="list-style-type: none"> • Freezy Water, Enfield Wash and Enfield Highway are the key historic settlement cores along the main road • The predominant character is narrow traditional shop units with accommodation above • The area around Enfield Wash and Enfield Lock is characterised by Victorian terraces, gradually spreading into small inter-war suburbs. Further south around Enfield Highway one is more likely to find planned public sector estates, typified by the area south of Carterhatch Lane or south of Albany Park • There are some areas of more modern development, including clusters of towers at Eastfield Road and the western end of Ordnance Road
Urban/Rural interface	Forty Hall	<ul style="list-style-type: none"> • Mature mixed species native woodlands • Network of small water courses including Turkey Brook, Cuffley Brook and New River (Old Course) • Network of waymarked routes, public rights of way (PRoW) and informal paths • Range of recreational activities including walking, cycling, riding and golf • Allotment gardens on south side • Forty Hall and historic garden and parkland • Myddleton House and historic garden • Tottenham football club training grounds (under construction) • Whitewebbs park golf course • Whitewebbs House (Toby Carvery)
Urban/Rural interface	Theobalds Estate	<ul style="list-style-type: none"> • Gently undulating landform • Estate farmland • Geometric field pattern • Small woodlands • Mansions (e.g. Capel House) and isolated farms (e.g. Whitewebbs farm and Owls Hall Farm) • Low hedgerows (some poorly maintained) • Capel House and parkland (now Capel Manor College) • Owls Hall Farm and parkland • M25 embankments and moving traffic • Waymarked routes connecting under M25 to countryside to the north • Roman Road – Ermine Street • Electricity pylons
Area of Special Character Review 2012 – Enfield Local Plan (Evidence base)		

Area of Special Character	Theobalds Estate South	<ul style="list-style-type: none"> • Gently undulating landform • Estate farmland • Geometric field pattern • Small woodlands • Mansions (e.g. Capel House) • Isolated farms (e.g. Whitewebbs farm and Owls Hall Farm) • Low hedgerows • Owls Hall Farm and parkland
Area of Special Character	Whitewebbs and Forty Hall	<ul style="list-style-type: none"> • Mature mixed species native woodlands • Network of small water courses including Turkey Brook • Cuffley Brook and New River (Old Course) • Network of waymarked routes • Public rights of way and informal paths • Recreational activity hub including walking • Cycling • Riding and golf • Forty Hall and historic garden; and Myddleton House and historic garden • Whitewebbs park golf course • Bulls Cross

As the scheme is located on the border of various landscape character areas this assessment takes into consideration combined characteristics of key qualities and attributes of landscape character to judge its sensitivity in the assessment section of the report.

6.4.3 Designations

6.4.3.1 Scheduled monuments

Two scheduled monuments, Theobalds Palace (approximately 1.2km to the north east) and Elsyng Palace (approximately 1.4km to the south west), are located within the study area. As these are historic designations the assessment is considered in the cultural heritage section 7 of the report.

6.4.3.2 Registered parks and gardens

Two Grade II registered parks and gardens are located within the study area, Myddelton House (approximately 1km to the south west) and Forty Hall (approximately 1.4km to the south west).

6.4.3.3 Country parks

Whitewebbs Country Park lies approximately 1.9km to the west of the proposed scheme.

6.4.4 Visual

Sensitive visual receptors are the people who live in or visit the landscape and who will experience views of the proposed scheme options. Given the presence of the M25 in this area, it is considered the tranquillity is low.

The following five groups of people are considered to be the applicable visual receptors to the proposed scheme options:

- Local communities (e.g. villages and settlements) and isolated residential properties
- People at their places of work
- People using nationally designated or regionally promoted footpaths, cycle routes, bridleways, the local rights of way network and areas of open access land
- Visitors at publicly accessible sites including for example registered parks and gardens, historic sites and other visitor attractions
- Road users

At scoping stage the following receptors were scoped out of the assessment:

- Views from Theobalds Park camp site located to the north west of M25 Junction 25 as they are screened by a dense belt of woodland along New River
- Views from Grade II registered parks and gardens Forty Hall and Myddelton House and Whitewebbs Country Park are scoped out as they are located at a considerable distance from the proposed scheme options. There are a number of overlapping landscape elements that block the views of the proposed scheme options from these locations

It is expected that due to the relatively small scale of the junction improvements there will be no new receptors beyond those who already have views towards Junction 25. It is likely that the majority of them would perceive the proposed scheme options as an extension to the already established land use. There are large residential areas located to the south and east, however the presence of overlapping landscape elements restricts visibility.

The baseline studies identified the following receptors to represent different groups of people (shown in Appendix D), who may experience views of the proposed scheme options and the nature of their views:

- **Views of employees from within the business park adjacent to the M25 Junction 25**
- The views towards the M25 Junction 25 from within the business park are largely screened by belts of woodland along the M25 and the A10 as well as by warehouse buildings itself. Views into the adjacent landscape are likely to be blocked completely or partially as screening is provided by boundary vegetation, street lighting columns and built form obscuring the views.
- **Views from residential properties located along Teresa Gardens and Cameron Drive to the east of the M25 Junction 25** - Views from residential properties towards the M25 Junction 25 are blocked completely by a belt of trees along the perimeter of the residential estate and by overlapping houses in the view. Some views are available into Holmesdale Tunnel open space. As the views towards the existing junction are blocked completely by intervening vegetation the effects on these receptors are not considered further in this report.
- **Views from residential properties along Bullsmoor Way to the south east of the M25 Junction 25** - Views from houses along Bullsmoor Way towards the existing M25 Junction 25 are blocked completely by adjacent houses and belt of trees on the raised embankments of the M25 itself. Therefore the effects on these receptors are not considered further in this report.
- **Views from residential properties/businesses along Holmesdale to the south east of the M25 Junction 25** – The majority of views from these properties are directed towards the Holmesdale Tunnel open space. Views from the two storey blocks of flats are screened by adjacent mature trees along Holmesdale as well as by overlapping houses that obscure potential views towards the existing M25 Junction 25. Vegetation present along the railway line (West Anglia Main Line) contribute further to obscuring the views available to the east. Therefore, the effects on these receptors are not considered further in this report.
- **Views from plant nursery adjacent to the south west of the M25 Junction 25** - Views from the plant nursery towards the M25 Junction 25 are blocked by glasshouses and tunnels as well as by boundary vegetation around the perimeter of the nursery. The views from a house within the plant nursery are partially screened by surrounding trees and overlapping glasshouses.
- **Views from Capel Manor College to the south west of the M25 Junction 25** - The Capel Manor College consist of a variety of buildings including offices and surrounding glasshouses set within garden landscape with dense tree cover. Availability of views varies across the site, however it is expected that views into surrounding landscape beyond the grounds of the College will be possible from the upper storeys. This is likely to include views of the existing M25 Junction 25.

- **Views from Theobalds Park camp site to the north west of the M25 Junction 25 -** Views from Theobalds Park to the M25 Junction 25 are blocked by the woodland along the New River that completely screens the views into the adjacent landscape. Therefore, the effects on this receptor are not considered further in this report.
- **Views of PRoW users along New River to the north west of the M25 Junction 25 -** Open views are available from public footpaths into adjacent fields and the surrounding landscape. It is likely that views will encompass woodland along the New River and views of slightly raised landform towards Theobalds Park as well as views of the existing M25 Junction 25, the A10 and B198.
- **Views from Theobald's Park Farm, located to the north of the junction -** Theobald's Park Farm is well screened by trees that surround the farm, however partial views of the New River and road corridors of the M25, A10 and B198 are likely to be available from the upper storey of the building.
- **Views from residential properties/businesses located on the corner of Bullsmoor Lane and the A10 to the south of the M25 Junction 25 -** This group of receptors includes houses and businesses along the A10 and at the junction of the A10, the A1055 and Bullsmoor Lane, from where largely unobstructed views of the A10 are possible. The views include road corridor, street trees, road signage, pedestrian rail barriers and street lighting.

6.5 Regulatory / Policy framework

6.5.1 European Union and national legislation and policies

Legislation relevant to the scheme includes The Town and Country Planning Act 1990, Countryside and Rights of Way Act 2000, Planning Act 2008, 'Part 7 – Orders granting development consent', including PRoW and Green Belt, as well as 'Schedule 8 – Tree Preservation Orders: further amendments'. Legislation of specific relevance to this section is outlined below.

The European Landscape Convention (ELC) sets out an internationally agreed definition of landscape and key actions that countries should follow. The ELC provides an integrated, holistic approach and international context for landscape, under the headline banner that "All Landscapes Matter". The convention is a treaty between states (not an EU Directive) and seeks to influence governments' decisions rather than direct them. It was signed by the UK government in 2006 and came into effect in March 2007.

The National Planning Policy Framework (NPPF) was published in March 2012 and sets out the Government planning policies for England and how these are expected to be applied.

The NPPF sets out a clear presumption in favour of sustainable development which should be seen as a 'golden thread' running through plan-making and decision-taking. 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. These core aims are designed to guide and influence local authorities in developing their local plans, demonstrating the government's commitment to ensure the planning system does everything it can to support sustainable economic growth.

6.5.2 Local policies

At a local level, development is controlled through local planning policy prepared in accordance with national policy. Local Plans set out a vision and a framework for the future development of the area within boundaries of the local authorities.

The study area is located within the boundaries of LBE and BBC.

The Borough of Broxbourne Local Plan Second Review covers the period 2001-2011 and was adopted in December 2005. As the local plan is emerging currently, the saved policies of the local plan remain in force. Table 6-3 lists relevant saved policies of Broxbourne Local Plan.

Planning applications in Enfield are determined using the adopted Core Strategy policies (2010), relevant policies in the London Plan, and the policies of Enfield's Development Management Document (November 2014).

Table 6-3 below includes relevant policies of Borough of Broxbourne, Enfield Borough Council and relevant policies of London Plan written by the Mayor of London and publicized by the Greater London Authority.

Table 6-3 Summary of relevant local policies

Planning Policies	Summary of Policy Content
National Planning Policy Framework (NPPF)	Promotes conservation and enhancement of the natural and local environment, protection of valued landscapes and AONB areas.
Borough of Broxbourne	Borough of Broxbourne Local Plan (2005 saved policies)
Policy BGC2 Development within the Metropolitan Green Belt	<p>"In order to preserve openness within the metropolitan green belt, as defined on the proposals map, permission will not be granted for development other than:</p> <p>(i) the construction of new building(s) for the following purposes:</p> <p>(a) agriculture or forestry;</p> <p>(b) essential small scale facilities associated with outdoor sport or outdoor recreation and for cemeteries;</p> <p>(c) other uses of land which preserve the openness of the green belt and do not conflict with the purposes of including land within it;</p> <p>(d) limited extensions to, alteration or replacement of, existing dwellings subject to the requirements of policies gbc11 and gbc13</p> <p>(ii) the re-use of an existing building subject to fulfilment of the requirements of policy gbc15.</p> <p>(iii) minerals extraction which accords with the adopted minerals plan."</p>
Policy GBC16 Landscape character Areas and Enhancement	<p>"The council expects all development proposals affecting land within the metropolitan green belt to incorporate appropriate landscape enhancement measures appropriate to the local context.</p> <p>(ii) development likely to seriously detract from the character or appearance of the countryside will be resisted."</p>
Policy GBC 17 Protection and enhancement of public rights of way	<p>"Planning permission will not be granted for development which adversely affects any public right of way unless the proposal includes diversion of the public right of way to a route which is no less safe and convenient for public use. Development adjoining or otherwise affecting an existing public right of way will be expected to demonstrate that consideration has been given to the existence of the right of way in the design of the development.</p> <p>(ii) in association with the county council and other organisations, the council will seek to ensure that existing rights of way are maintained and enhanced wherever possible."</p>
Policy GBC 18 Protection of intentionally important wildlife sites	<p>"Development that would harm the nature conservation or geological interest of an internationally important wildlife site will not be permitted unless:</p> <p>(i) it is required in connection with the management or conservation of the site; and</p> <p>(ii) there is a clear need to support the development in the public interest; and</p> <p>(iii) there is no less environmentally damaging solution"</p>
Policy HD17 Retention/Enhancement of landscape features	<p>"The council will expect all development proposals to respect existing natural or built features which contribute positively to the character or appearance of the area and will seek to incorporate proposals for new or enhanced landscaping, including appropriate measures for the maintenance of all new landscaping, in all development schemes.</p>

Planning Policies	Summary of Policy Content
	(ii) planning permission may be refused for proposals which would result in the loss of important landscape features, water courses or natural habitats."
<p>Policy HD18 Trees, hedgerows and woodlands.</p>	<p>"Before the council will grant consent for felling, topping or lopping of protected trees or removal of protected hedgerows, it will be necessary to demonstrate that: -</p> <p>(a) the tree(s) or hedgerow(s) is/are diseased and in need of work on public safety and/or environmental grounds; and/or</p> <p>(b) removal of the tree(s) or hedgerows(s) is essential for the proper development of a site.</p> <p>(ii) when consent is granted for the removal of protected tree(s) or hedgerow(s) it will be accompanied by a requirement to undertake replacement planting. Replacement planting should be of an equivalent biomass, in a suitable location, and in sympathy with local landscape character (as assessed via a process of landscape character assessment.)</p> <p>(iii) any works which are authorised or required by the council to protect or replace trees or hedgerow(s) should be undertaken in accordance with good arboricultural practice."</p>
<p>Policy T10 Cycling provision</p>	<p>"Where appropriate, developers will be expected to consider provision for cyclists in new development through the following measures:</p> <p>(a) opportunities to promote development of the cycle network;</p> <p>(b) routes providing access to and around the site which can be ridden safely;</p> <p>(c) provision of cycle storage, covered cycle parking and, where appropriate, changing and shower facilities."</p>
<p>Enfield London Borough Council</p>	<p>Local Development Framework (LDF) November 2010</p>
<p>Core policy 23 The road network</p>	<p>"The council working with partners will seek to deliver improvements to the road network to contribute to Enfield's economic regeneration and development, support businesses, improve safety and environmental quality, reduce congestion, and provide additional capacity where needed....."</p>
<p>Core policy 25 Pedestrians and cyclists</p>	<p>"The Council, working with its partners, will seek to provide safe, convenient, and accessible routes for pedestrians, cyclists and other non-motorised modes by:</p> <ul style="list-style-type: none"> ▪ Developing and implementing improvements to strategic and local walking and cycle routes in the Borough; ▪ Improving the quality and safety of the public realm, implementing streetscape improvements to be outlined in the Enfield Design Guide and relevant area action plans, fostering road safety, and implementing 'Streets for People' initiatives; and ▪ Working with Department for Transport, Network Rail and Transport for London to ensure that West Anglia rail line improvements address the barrier to east-west movements for pedestrians and cyclists caused by the line in the east of the Borough, including the identification of alternative crossing points...."
<p>Core policy 33 Green Belt and Countryside</p>	<p>"The Council will continue to protect and enhance Enfield's green belt. The strategic green belt boundary is shown on the Proposals Map. Proposals for changes to the detailed boundary at the local level will be brought forward as part of the Development Management Document subject to criteria set out in Planning Policy Guidance 2 and reflecting more local priorities....."</p>
<p>Enfield London Borough Council</p>	<p>Local Development Framework (LDF) November 2010</p>

Planning Policies	Summary of Policy Content
<p>Policy DMD 80 Trees on development Sites</p>	<p>“All development including: subsidiary or enabling works that involve the loss of or harm to trees covered by Tree Preservation Orders, or trees of significant amenity or biodiversity value, will be refused.</p> <p>Where there are exceptional circumstances to support the removal of such trees, adequate replacement must be provided.</p> <p>All development and demolition must comply with established good practice, guidelines and legislation for the retention and protection of trees. Proposals must:</p> <ol style="list-style-type: none"> a. Retain and protect trees of amenity and biodiversity value on the site and in adjacent sites that may be affected by the proposals; b. Ensure that the future long term health and amenity value of the trees is not harmed; c. Provide adequate separation between the built form and the trees including having regard to shading caused by trees and buildings. <p>Works to Protected Trees</p> <p>Works to trees covered by a Tree Preservation Order or trees situated within a Conservation Area must ensure the long term health of the tree, and retain and enhance amenity value to the locality. Works must comply with current arboricultural best practice, guidelines and legislation.”</p>
<p>Policy DMD81 Landscaping</p>	<p>“Proposed development must provide high quality landscaping that enhances the local environment. Landscaping should add to the local character, benefit biodiversity, help mitigate the impacts of climate change and reduce water run-off. Priority should be given to planting large, shade-producing trees and indigenous species, or other species of high ecological value, where situations allow.”</p>
<p>Policy DMD82 Protecting the Green Belt</p>	<p>“Inappropriate development within the Green Belt will not be permitted. Development that is not inappropriate will only be permitted if all of the following criteria are met:</p> <ol style="list-style-type: none"> a. The siting, scale, height and bulk of the proposed development is sympathetic to and compatible with the prime aim of preserving the openness of the Green Belt; b. The development has regard to site contours, displays a high standard of design and landscaping to complement and improve its setting, and takes all measures to ensure that the visual impact on the Green Belt is minimised; c. The nature, quality, finish and colour of materials blend with the local landscape to harmonise with surrounding natural features; d. Where possible, existing trees, hedges, bushes and other natural features are retained and integrated with the scheme to ensure adequate screening. Where this is not possible, planning permission will only be granted if adequate mitigation measures are secured; and e. Appropriate parking provision, safe access, egress and landscaping is provided to ensure vehicles are parked safely and that the development does not prejudice the openness of the Green Belt.”
<p>Policy DMD 83 Development adjacent to the Green Belt</p>	<p>“Proposed development located next to or within close proximity to the Green Belt will only be permitted if all of the following criteria are met:</p> <ol style="list-style-type: none"> a. There is no increase in the visual dominance and intrusiveness of the built form by way of height, scale and massing on the Green Belt; b. There is a clear distinction between the Green Belt and urban area; c. Views and vistas from the Green Belt into urban areas and vice versa, especially at important access points, are maintained. <p>Proposals should maximise opportunities to incorporate measures to improve the character of land adjacent to the Green Belt through environmental improvements such as planting and earth moulding, and the removal or replacement of visually intrusive elements such as buildings, structures, hard standings, walls, fences or advertisements.</p>

Planning Policies	Summary of Policy Content
	Development must not restrict future public access/ rights of way from being provided. Where possible proposed development should increase opportunities for public access."
London Plan (2015-2016)	Relevant policies from the Draft Replacement London Plan (2015-2016) included below.
Policy 7.16 Green Belt	<p>"Strategic</p> <p>A. The Mayor strongly supports the current extent of London's Green Belt, its extension in appropriate circumstances and its protection from inappropriate development.</p> <p>Planning decisions</p> <p>B. The strongest protection should be given to London's Green Belt, in accordance with national guidance. Inappropriate development should be refused, except in very special circumstances. Development will be supported if it is appropriate and helps secure the objectives of improving the Green Belt as set out in national guidance."</p>
Policy 7.21 Trees and Woodlands	<p>"A Trees and woodlands should be protected, maintained, and enhanced, following the guidance of the London Tree and Woodland Framework (or any successor strategy). In collaboration with the Forestry Commission the Mayor has produced supplementary guidance on Tree Strategies to guide each borough's production of a Tree Strategy covering the audit, protection, planting and management of trees and woodland. This should be linked to a green infrastructure strategy.</p> <p>Planning decisions</p> <p>B Existing trees of value should be retained and any loss as the result of development should be replaced following the principle of 'right place, right tree'[1]. Wherever appropriate, the planting of additional trees should be included in new developments, particularly large-canopied species.</p> <p>LDF preparation</p> <p>C Boroughs should follow the advice of paragraph 118 of the NPPF to protect 'veteran' trees and ancient woodland where these are not already part of a protected site.</p> <p>D Boroughs should develop appropriate policies to implement their borough tree strategy."</p>

6.6 Design, mitigation and enhancement measures

Currently, the assessment deals with potential outline scheme options without associated environmental design measures, since these will be developed iteratively as the scheme progresses. Therefore some generic environmental design or mitigation measures that have the potential to be incorporated within the scheme have been identified. The assessment takes into consideration the potential for reduction of adverse effects through the introduction of environmental design or mitigation measures since in reality the scheme would not be progressed without mitigation measures as an inherent part of the design. A concept landscape and visual mitigation plan will be prepared to identify opportunities to reduce the significance of effects at future stages. Below there is a list of potential mitigation measures that could be applied to the considered schemes:

- Avoid the loss of trees and hedgerows through selection of the option that would result in minimal loss of trees and hedgerows of high quality or prefer alignment in which the loss of trees could potentially be avoided or mitigated
- Where possible provide mitigation measures for screening consisting of planting or mounds using native species that complement the local landscape character
- Where affected the field pattern should be replaced with new one that would aim to recreate the existing field pattern. Reinstatement of a field pattern may require the addition of woodland copses, tree belts, or planting of hedgerow with trees

- Where earth mounding or cuttings are proposed their profile should be modelled to fit with the local landscape character. Shallow gradients of slopes and shallow crests of embankments and cuttings would be generally preferred
- Give an opportunity for opening up or screening of the views into and from the altered sections of the network where appropriate following DMRB guidance on good road design for landscape
- Introduction of new vegetation using native species reflecting local character, could help absorb the junction into the landscape and provide wildlife corridor which links into the surrounding areas
- New planting should include native species appropriate to the locations favouring long lived tree species located at safe distance from the road but also hedgerows and woodland edge planting that are located outside constraints of sight lines to improve landscape quality and safety

6.7 Potential magnitude and significance of effects

6.7.1 Landscape

In general an assessment of landscape effects deals with the effects of change and development on landscape as a resource. The nature of potential effects on each receptor is assessed for both construction and operational phase of the proposed scheme options.

It is expected that potential significant landscape effects would be restricted to the land required or directly adjacent to the proposed scheme options centred on the existing M25 Junction 25 due to the enclosed nature of the surrounding area and the scale of the proposed options.

The assessment indicates the potential effects on valued landscapes or landscape elements and would indicate the potential for their conservation and enhancement where possible.

6.7.2 Key effects

The key effects of the scheme options are described below. Table 6-4 below considers the effects on landscape character during construction stage for each option. The landscape effects during operational stage of each option are considered in Table 6-5.

Key effects associated with the proposed scheme options will include the loss of land and removal of vegetation required to accommodate the scheme during construction stage.

Vegetation that is likely to be removed comprises man-made planting along embankments and within central area of the junction.

Construction activities will temporarily change land use around the junction introducing new albeit temporary, landscape pattern of construction activities. The alteration to land use will be barely perceptible in operational stage due to the scale of changes taking place within land associated with the existing road network.

During the operational phase it is expected that potential loss of vegetation can be compensated by the introduction of the landscape design measures that would help to integrate the development into the existing landscape over the years.

The proposed scheme introduces a new pedestrian footway that provides connectivity between the Bullsmoor area of Enfield and areas to the north of the junction along the existing A10 road improving pedestrian connectivity around the junction.

The alterations to the junction will be perceived at the local landscape character level only due to the relatively small scale of the scheme and limited geographical extent. The scheme occupies a very small portion of wider landscape character areas, therefore generally the proposed alteration would not affect key qualities and attributes of Landscape Character Types. During the construction phase the proposed changes are likely to be significant but temporary, particularly in relation to reduced tranquillity, whereas in the operational stage the

implemented landscape design measures will help to integrate the proposed scheme options into the existing landscape.

The significance of the proposed changes will depend on the option selected and potential for implementation of environmental design measures or mitigation measures.

The detailed assessment of landscape effects during construction stage and operational stages are presented in the Appendix D.

Table 6-4 Potential Effects on landscape receptors (Construction)

Potential landscape effects	Option 1	Option 2	Option 3
Effects on landscape character include: -introduction of compounds, parking and welfare facilities; - loss of vegetation; - alteration to landform (introduction of earthworks); -requirement for temporary construction land; and - temporary presence of material set down areas and stock piles.	Sensitivity: The sensitivity of landscape character is considered to be medium.		
	Magnitude		
	Negligible adverse	Minor adverse	Minor adverse
	Potential effects		
	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)

Table 6-5 Potential Effects on landscape receptors (Operation)

Potential landscape effects	Option 1	Option 2	Option 3
Effects on landscape character including: -Introduction of permanent viaducts and earthworks; -Introduction of gantries and other smaller elements of highway infrastructure e.g. signage; -Introduction of footway; -Realignment of kerb lines and -Introduction of new planting and other mitigation measures.	Sensitivity: The sensitivity of landscape character is considered at medium level.		
	Magnitude		
	Negligible adverse	Negligible adverse	Negligible adverse
	Potential effects		
	Neutral	Slight adverse (not significant)	Slight adverse (not significant)

6.7.3 Visual

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 loss of existing vegetation. The change in the views is likely to include earthmoving operations, formation of temporary spoil areas, and creation of earthworks. The visual receptors will also be affected by views of HGVs and other large machinery used on the construction site. The construction effects would be temporary, short term, temporary and reversible.

The M25 Junction 25 has some elevated sections including on and off slip roads, however views towards these elevated sections are generally well screened by adjacent vegetation and earthworks with the exception of some relatively short sections resulting in views from a limited number of receptors located close to the junction.

Therefore, any significant views would be limited to filtered, near distance views that would be available to some residents in surrounding properties through their surrounding garden vegetation in the construction stage and also through the proposed planting in the operational stage.

Visual impacts from introduced earthworks will arise in the operational phase of the proposed scheme options and will involve earthworks, strengthened earthworks, introduction of pedestrian bridge and footway as well as the widening of carriageway. It is expected that the proposed scheme options would be visible for some local receptors immediately adjacent to the site. The operational effects will also be permanent.

The proposed improvements will give an opportunity to introduce environmental design measures or/and mitigation measures to help reduce the effects and provide visual enhancements where possible. It is expected that proposed planting will mature over time to help reduce adverse visual effects arising from the improvements.

Table 6-4 below considers the effects on visual effects during construction stage. The visual effects during operational stage are considered in Table 6-7.

The detailed assessment of visual effects during construction stage and operational stages are presented in the Appendix D.

Table 6-6 Potential Effects on visual receptors (Construction)

Receptors	Options	Option 1	Option 2	Option 3
Receptor 1 Views of employees within the warehouse adjacent to the M25 Junction 25 Sensitivity: Medium	Magnitude	Minor	Minor	Minor
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 5 Views from plant nursery adjacent to the south west of the Junction 25. Sensitivity: Low	Magnitude	Minor	Minor	Major
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 6 Views from Capel Manor College to the south west of the Junction 25. Sensitivity: Medium	Magnitude	Minor	Minor	Minor
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 8 Views of PRoW users along New River to the north west of the Junction 25. Sensitivity: High	Magnitude	Minor	Moderate	Moderate
	Potential effects	Slight adverse (not significant)	Moderate adverse (significant)	Moderate adverse (significant)
Receptor 9 Views from Theobald's Park Farm, located to the north of the junction. Sensitivity: High	Magnitude	Minor	Moderate	Moderate
	Potential effects	Slight adverse (not significant)	Moderate adverse (significant)	Moderate adverse (significant)
Receptor 10 Views from residential properties/businesses located on the corner of Bullsmoor Lane and the A10 to the south of the Junction 25. Sensitivity: High	Magnitude	Minor	Moderate	Major
	Potential effects	Slight adverse (not significant)	Moderate adverse (significant)	Large adverse (significant)

Table 6-7 Potential Effects on visual receptors (Operation)

Receptors	Options	Option 1	Option 2	Option 3
Receptor 1 Views of employees within the warehouse adjacent to the M25 Junction 25 Sensitivity: Medium	Magnitude	Negligible	Negligible	Negligible
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 5 Views from plant nursery adjacent to the south west of the Junction 25. Sensitivity: Low	Magnitude	Negligible	Negligible	Moderate
	Potential effects	Neutral	Neutral	Slight adverse (not significant)
Receptor 6 Views from Capel Manor College to the south west of the Junction 25. Sensitivity: Medium	Magnitude	Negligible	Negligible	Negligible
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 8 Views of PRoW users along New River to the north west of the Junction 25. Sensitivity: High	Magnitude	Negligible	Minor	Minor
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 9 Views from Theobald's Park Farm, located to the north of the junction. Sensitivity: High	Magnitude	Negligible	Minor	Minor
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Slight adverse (not significant)
Receptor 10 Views from residential properties/businesses located on the corner of Bullsmoor Lane and the A10 to the south of the Junction 25. Sensitivity: High	Magnitude	Negligible	Minor	Moderate
	Potential effects	Slight adverse (not significant)	Slight adverse (not significant)	Moderate adverse (significant)

6.8 Summary of landscape and visual effects

6.8.1 Landscape effects

6.8.1.1 Construction

Although the construction activities will be associated with each considered options and their scale and duration is linked to the scale of the scheme, some loss of vegetation including trees, scrub and woodland edge will occur. However the potential loss will occur within the perimeter of the existing highway and there is a good potential for the re-introduction of trees, hedgerow and grassland due to land that would likely remain available. Therefore it is expected that in the longer term (>15 years) any lost vegetation would be compensated for through the proposed planting and enhancement where possible. During the construction stage there will be a requirement for a compound area, material set down areas, site office, welfare facilities, and parking area. A temporary and localised increase in construction traffic is also expected as well as some soil stockpiles will be present. These effects are not expected to give rise to the significant effects in the context of small scale of the construction activities and medium sensitivity of landscape character. Generally it is expected that the proposed scheme options will not affect significantly landscape receptors within the study area during the construction stage.

6.8.1.2 Operation

During the operational stage the selected option could be partially integrated through the implementation of the environmental design measures. It is expected that over a time the proposed vegetation would mature to accommodate the scheme within the existing landscape. As the proposed vegetation will mature the introduced elements of the scheme such as pedestrian footbridge, footway and small scale earthworks would become a barely perceptible alteration to the existing landscape. Generally it is expected that the proposed scheme options will not significantly affect landscape receptors within the study area during the operational stage.

6.8.2 Visual

6.8.2.1 Construction

During the construction stage significant effects are expected arising from the introduction of uncharacteristic elements including formation of earthworks, construction of the footbridge and potentially views of a compound with associated construction traffic. Some visual receptors are likely to have full or partial view of construction operations, construction traffic, and compound area with material set down areas, welfare facilities, site office and parking areas. Some identified receptors would be significantly albeit temporarily affected as a result of high sensitivity and the proximity to the potential construction activities.

A list of receptors that are likely to sustain significant effects during construction stage are given below:

- Option 1 - No significantly affected receptors were identified
- Option 2 - Significant effects are expected for receptors nos.8, 9 and 10 (PRoW users along New River to the north west of the M25 Junction 25; Theobald's Park Farm, located to the north of the junction; and residential properties/businesses located on the corner of Bullsmoor Lane and the A10 to the south of the M25 Junction 25).
- Option 3 - Significant effects are expected for receptors nos.8, 9 and 10 (PRoW users along New River to the north west of the M25 Junction 25; Theobald's Park Farm, located to the north of the junction; and residential properties/businesses located on the corner of Bullsmoor Lane and the A10 to the south of the M25 Junction 25).

6.8.2.2 Operation

During the operational stage adverse effects are expected as a result of deterioration to the view through the introduction of detracting features that could dominate the views. The views would include relatively small scale alterations to the existing junction including the proposed

footbridge, footway and small scale earthworks. It is expected that maturing vegetation will blend the proposed scheme options into the existing landscape so that the alteration introduced through the scheme would be barely perceptible.

A list of receptors that are likely to sustain significant effects operational stage given below:

- Option 1 - No significantly affected receptors were identified
- Option 2 - No significantly affected receptors were identified
- Option 3 - Significant effects are expected for receptor no.10

6.9 Recommendations for future assessment stages

No significant landscape effects are expected for any of the proposed scheme Options however significant adverse visual effects are expected for some visual receptors with Options 2 and 3.

Therefore a Detailed Assessment is recommended at the Stage 2 of the assessment according to the Highways England PCF procedures for Options 2 and 3.

At Stage 2 of the assessment further work will be required including detailed desk and fieldwork to confirm 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.

Further potential refinements to the design, should be considered in sufficient detail to establish potential mitigation for the landscape and visual effects. At Stage 2 the assessment will take into the consideration specific landscape and visual environmental and design measures.

The Stage 1 assessment will be extended in Stage 2 and will be accompanied by illustrative plans showing:

- Topography (1:25000)
- Landscape Character (1:25000)
- Viewpoint location plans (1:25000)
- Photographic Viewpoints (1:25000)
- Landscape Designations (1:25000)
- Outline Landscape Design (1:2500)

6.10 Limitations

The following limitations have been identified in production of this report:

- The report provides a broad indication of effects, reporting on the potential landscape and visual effects based on the simple assessment approach as set out in DMRB Volume 11
- Limited field survey was undertaken to gain a broad understanding of landscape and visual constraints. The visibility from visual receptors have been established from publicly accessible places in summer months with some locations being restricted due to safety considerations, for example, motorways or other locations along the highway network
- The landscape character description in the baseline section refers to the landscape character assessment at the local level
- At this stage there is no detailed information on the construction stage and therefore the assessment is based on assumptions and past experience

Taking into account the above, it is considered that the report has been carried out with the provision of sufficient knowledge and in sufficient detail for the current project stage.

7 Cultural heritage

7.1 Introduction

This section assesses potential impacts on the cultural heritage resource from each option. From examining the proposed works and location of heritage assets, an assessment has been made of the value / sensitivity of the heritage assets, the magnitude of the impacts in order to assess the potential significant effects upon the cultural heritage resource and recommendations provided for further assessment, mitigation and enhancements.

This section of the ESR also assesses potential impacts on the built heritage resource and buried archaeology. Information on designated and non-designated heritage assets was sourced from the following sources:

- Historic England's National Heritage List for designated assets⁴
- Hertfordshire and Greater London Historic Environment Records for both designated and non-designated heritage assets and previous investigations

Heritage assets are associated with a unique ID, for National Heritage List entries (NHLE) and the Historic Environment Record (HER). Appendix E provides a gazetteer of heritage assets by their unique ID.

7.2 Assessment methodology

This assessment has been carried out in accordance with the methodology set out in the DMRB Volume 11 Section 3, Part 2, HA208/07. It also reflects guidance for assessing impacts on the setting of heritage assets contained in 'Historic Environment Good Practice Advice in Planning Note 3: The Setting of Heritage Assets' (Historic England, 2015).

7.2.1 Sensitivity of resource

The value of each heritage asset is assessed, and determined to be Very High, High, Medium, Low or Negligible. Heritage value is determined by professional judgement, grounded in established criteria. These criteria are elaborated in English Heritage's (now Historic England) Conservation Principles (2008), which sets out four values: evidential, historical, aesthetic and communal. These encapsulate architectural, historic and archaeological interest and are consistent with the DMRB methodology. Table 7-1 sets out the criteria for assessing the value of historic environment assets.

Table 7-1 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.	

Source: DMRB, Vol11/section3/ha20807.pdf

As consistent with DMRB methodology, the significance of effect on the cultural heritage baseline is determined by consideration of a combination of the magnitude of the impact and the value of each asset with a level of professional judgement in the determination. The magnitude of impact to a heritage asset is identified by the degree of change that would be experienced by the asset and its setting if the scheme were to be completed as compared to a 'do nothing' situation. The definition of the magnitude of impact, and the matrix for determining the significance of effect, can be found in DMRB (Volume 11 Section 3, Part 2, HA208/07, 5/5).

7.3 Study area

For the PCF Stage 1 appraisal of effects on cultural heritage, designated and non-designated heritage assets were assessed within a 500m study area defined around the alignment of each option.

7.4 Baseline conditions

The study area contains eleven designated heritage assets which, according to DMRB, are of high or medium value. In summary, these comprise one Grade II* listed building and ten Grade II listed buildings.

7.4.1 Value / sensitivity of heritage asset

The designated assets located within the study area are listed below in Table 7-2 together with the value of the asset in accordance with DMRB. They are also mapped in Figure 7.1 in Appendix E. Appendix E provides a gazetteer of heritage assets by their unique ID.

Table 7-2 Designated Heritage Assets within the Study Area

Reference	Name	Description	Location to scheme	Value (refer to 7-1)
1078898	Capel House (Grade II* Listed Building)	Mid-late 18 th century house with surrounding gardens and associated structures.	Approximately 350m south west	High
1078892	The Pied Bull Public House (Grade II Listed Building)	Public house, of 17 th century or earlier appearance.	Approximately 500m south west	Medium
1078899	Garden Walls to east of Capel House (Grade II Listed Building)	18 th century red brick walls of varying heights around enclosed garden.	Approximately 350m south west	Medium
1079476	Bulls Cross Lodge (Grade II Listed Building)	Mid-19 th century picturesque lodge.	Approximately 200m west	Medium
1100555	Large Barn at Theobalds Park Farm (Grade II Listed Building)	18 th century timber framed barn.	Approximately 100m north	Medium
1100613	Bulls Cross Farm Barns on north side of farmyard (Grade II Listed Building)	17 th century timber frame barn, extended in 18 th or early 19 th century.	Approximately 450m north west	Medium
1348340	Bulls Cross Farmhouse (Grade II Listed Building)	Early 18 th century square red brick farmhouse, with mid-19 th century extension.	Approximately 450m north west	Medium
1348390	Theobalds Park Farmhouse (Grade II Listed Building)	Early 19 th century farmhouse.	Approximately 100m north	Medium
1348391	Cob Outbuilding south-south-west of Theobalds Park Farm (Grade II Listed Building)	Late 17 th or early 18 th century outbuilding, probably a former calf shed or shelter shed. A rare survival for Hertfordshire of a pre-improvement type of cob farm building.	Approximately 100m north	Medium
1358742	Stables and former Coach House Range at Capel Manor (Grade II Listed Building)	Late 19 th century red brick stable and coach house, the latter now a cafeteria, with late 19 th and 20 th century alterations.	Approximately 300m south west	Medium
1358986	The Orchards (Grade II Listed Building)	18 th century house.	Approximately 450m south west	Medium

In addition to the designated assets, the study area also contains twenty-eight non-designated assets. These non-designated assets are of low or negligible value. The non-designated assets are listed in a gazetteer in Appendix E. Non-designated assets are referred to with their HER asset numbers (containing HT for Hertfordshire or LO for Greater London) which correspond to those used in the gazetteer and Figure 7.1 in Appendix E.

The non-designated assets recorded on the HERs within the study area consist of a mixtures of non-designated historic buildings and archaeological sites. In summary, these include:

- A late Bronze Age occupation site (MHT12839)
- Medieval ditches (MHT12840), an early medieval longhouse and clamp kiln (MHT16278), and the site of a medieval cross (MLO1826)
- A medieval or post medieval manor house (MLO20695), and a medieval or post medieval settlement of Bulls Cross (MLO73224)

- Post medieval moats (MHT2959, MLO67570), the post medieval deer park and later ornamental parkland of Theobalds Park and associated earthworks (MHT2961, MHT17410, MHT18695), a post medieval river channel (MHT5999), post medieval features along Bullsmoor Lane (MLO38844, MLO38849, MLO38860), and the post medieval Capel Manor and associated features (MLO20444, MLO67381, MLO98349, MLO104090)
- The site of a post medieval and modern plant nursery (MHT12838)

In addition, the HER also records a number of archaeological findspots, including prehistoric flints dating from the Palaeolithic, Mesolithic, Neolithic and Bronze Age (MHT30982, MLO12160, MLO12182), Roman pottery sherds (MHT6265), medieval and later medieval pottery sherds (MHT6266), and previous archaeological investigations. Findspots are not assets in themselves, as there cannot be impacts on archaeological finds which have been removed. However, they provide evidence of the potential for unknown archaeological deposits within the study area. Similarly, records of previous archaeological investigations provide evidence of the potential for archaeology within the study area, as well as providing context for the previous assessment of archaeological sites or findspots.

Within the study area there is also part of the Whitewebbs Hill, Bulls Cross and Forty Hill Archaeological Priority Area (DLO35150). Greater London Archaeological Priority Areas are defined areas where, according to existing information, there is significant known archaeological interest or high potential for new discoveries.⁵ This is considered a low value non-designated asset within itself, and also further indicates the potential risk for previously undiscovered archaeology within the study area.

Similarly, Hertfordshire HER records an archaeological area identifying the potential for previously undiscovered archaeology relating to Cullings Manor (AHT14). Features associated with this site, including the manor moat (MHT2959) have already been identified. This is considered a low value non-designated asset within itself, and also indicated the potential for undiscovered archaeology within the area.

7.5 Regulatory / Policy framework

The National Planning Policy Framework (NPPF) was introduced in March 2012. It sets out national policy for the determination of planning applications and for plan making. Section 12 of the NPPF contains specific policy relating to the historic environment. It discusses how the importance of a heritage asset should be considered in the light of new development proposals. In any proposal there should be:

- A description of the significance of heritage assets, where the level of detail should be proportionate to the assets' significance and no more than is sufficient to understand the potential impact of the proposal on significance (NPPF, paragraph 128)
- Minimisation of any conflict between the preservation of the significance of the heritage asset and the proposal (NPPF, paragraph 129)
- Provision of a clear and convincing justification for the development (NPPF, paragraph 132)
- Where there are potential adverse impacts to an asset, the harm should be weighed against the public benefits of the proposal (NPPF, paragraph 134)

Enfield Council and Broxbourne Borough Council planning authorities in which the scheme options are located have planning policy (adopted or emerging) which is of relevance to the assessment of significant effects on cultural heritage.

⁵ Information on Archaeological Priority Areas from Historic England can be found here: <https://www.historicengland.org.uk/services-skills/our-planning-services/greater-london-archaeology-advisory-service/greater-london-archaeological-priority-areas/>

Enfield Council are currently in consultation over a new Local Plan, and the policies relevant to this assessment are located within the Core Strategy, adopted in November 2010. In summary, this is:

- Core Policy 31 'Built and Landscape Heritage'. This states that the council will implement national and regional policy with regard to the historic environment, and work with partners to pro-actively preserve and enhance all heritage assets within the Borough. It identifies that developments which impact on heritage assets have regard to their special character and demonstrate that proposals will respect and enhance the assets in question.

Enfield's Heritage Strategy (2008) defines heritage as "all inherited resources which people value for reasons beyond utility" and identifies that Enfield has a responsibility to understand and care for the distinctiveness of its valued places.

Broxbourne Borough Council have submitted a draft Local Plan for parliamentary consideration, in place of a Core Strategy which it was decided not to adopt in 2011. The draft Local Plan contains draft policies relevant to this assessment. In summary, these are:

- Policy HA1 'Heritage Assets'. This identifies that development should aim to retain and enhance heritage assets and put them to viable and appropriate use. It states that development proposals that would harm the significance of a heritage asset will not be permitted.
- Policy HA2 'Non-Designated Heritage Assets'. This identifies that where proposals would adversely affect a non-designated heritage asset, the scale of harm or loss will be considered against the significance of the heritage asset.
- Policy HA7 'Works within the setting of Listed and Locally Listed Buildings'. This identifies that proposals within the setting of a nationally designated asset or locally listed building should safeguard features of its setting in order to sustain and enhance its appearance and character.
- Policy HA10 'Archaeology'. This identifies that proposals which adversely affect nationally important archaeological remains or their setting will not be permitted. Where proposals will have an impact on archaeological remains, methods of preserving them in situ should be pursued.
- Policy HA12 'Works affecting the setting of a Nationally Designated Building, Structure, Landscape, Park or Garden or Other Feature'. This identifies that proposals outside the curtilage of a nationally designated asset should not adversely affect that asset's setting, and should sustain and enhance its appearance, character and setting.

7.6 Design mitigation and enhancement measures

There are opportunities to introduce mitigation and enhancement measures into the scheme design, and the management of the scheme. These include:

- The maintenance, enhancement or replacement of existing vegetation screening along the M25 and A10 to ensure that any operational impact following completion of the scheme on the setting of heritage assets is reduced
- Minimising the size of signage along the route, and ensuring it is sympathetic to any surrounding screening, which can prevent the introduction of further impacts on the setting of heritage assets within view of the scheme route. This could constitute the installation of roadside signage as opposed to gantry signs, or the painting of highways equipment to complement vegetation screening
- The installation of noise fencing along the scheme route which could reduce the level of harm from increased traffic noise on the setting of heritage assets
- Compliance with best practice guidance during the construction phase to reduce the level of harm to the setting of heritage assets. For example, keeping construction plant

and hoardings to a minimum within the vicinity of assets would reduce the temporary impacts of such work on their settings

- Preservation in situ where possible, for discovered buried archaeological assets

Prior to construction, a CEMP would be compiled to provide guidance on specific areas during the construction process. An outline CEMP is provided in Section 16 of this ESR.

7.7 Potential effects

In line with DMRB methodology, this assessment defines impacts as changes to the cultural heritage resource caused by the mitigated scheme. It should be noted that while details of the construction activities are not currently available at this stage, an indicative assessment of the construction stage impacts has been made below.

7.7.1 Option 1

The construction of Option 1 would have the potential to negatively impact on the setting of the listed buildings at Theobalds Park Farm (Grade II NHLE 1100555, 1348390, 1348391), assets of medium value. These are located within 200m of the scheme, and potential noise and dust during construction for the widening of the A10 would alter the setting of the listed buildings. Construction works, plant and hoardings may also be visible in filtered views from the listed buildings. This would result in temporary minor adverse magnitude of impact on the setting of the listed buildings, resulting in slight adverse effects, which are not significant.

The construction of Option 1 would have the potential to negatively impact on the setting of the listed buildings associated with Capel Manor. These include Capel House (Grade II* NHLE 1078898), an asset of high value, its associated garden walls (Grade II NHLE 10788999) and the stables and former coach house (Grade II NHLE 1358472), both assets of medium value. These assets do not have direct views of the scheme, but potential noise and dust during construction from the scheme could affect their setting. This would result in a negligible impact on the setting of the listed buildings, resulting in at most temporary slight adverse effects, which are not significant. In operation this would have no discernible effect.

There is the potential for impacts on unknown buried archaeology within the areas of land take and construction associated with the scheme. Option 1 will be constructed entirely within the existing road boundary, and therefore it is highly likely that any surviving archaeological deposits would have been removed by construction of the existing road network.

7.7.2 Option 2

The construction of Option 2 would have the potential to negatively impact on the setting of the listed buildings at Theobalds Park Farm (Grade II NHLE 1100555, 1348390, 1348391), assets of medium value. These are located within 200m of the scheme, and potential noise and dust during construction for the widening of the A10, the junction and the off-slip road from the clockwise M25 could affect the setting of the listed building. Construction works, plant and hoardings would also be visible in filtered views from the listed buildings. This would result in temporary minor adverse magnitude of impact on the setting of the listed buildings, resulting in slight adverse effects, which are not significant.

The widening of the A10 has the potential to result in increased traffic flow along the road adjacent to the listed buildings at Theobalds Park Farm. For Option 2, the widening of both carriageways would potentially improve traffic flow along both carriageways adjacent to the listed buildings. This would result in less standing traffic in the vicinity of the listed buildings, thereby reducing adverse impacts from noise, pollution and vibration on the setting of the assets. This would constitute a permanent minor beneficial magnitude of impact on the listed buildings, resulting overall in permanent slight beneficial effects.

As with Option 1, the construction of Option 2 would have the potential to negatively impact on the setting of the listed buildings associated with Capel Manor. This would result in the

same negligible impacts on the settings of the listed buildings, resulting in at most slight adverse effects, which are not significant. In operation this would have no discernible effect.

As with Option 1, there is the potential for impacts on unknown buried archaeology within the areas of land take and construction associated with the scheme. Though Option 2 will be constructed within the existing road boundary, the work on the north-west side of the M25, A10 and the junction is close to the Manor of Cullings Archaeological Alert Area (AHT14), and therefore there is some potential for unknown archaeological deposits on any undisturbed land in the area.

7.7.3 Option 3

As with Option 2, the construction of Option 3 would have the potential to temporarily negatively impact on the setting of the listed buildings at Theobalds Park Farm. This would result in the same temporary minor adverse magnitude of impact on the setting of the listed buildings, resulting in slight adverse effects, which are not significant.

As with Option 2, the operation of Option 3 would have the potential to permanently positively impact on the setting of the listed buildings at Theobalds Park Farm. The improvement of traffic flow through the widening of the carriageways would reduce adverse impact of standing traffic on the setting of the listed buildings. This would result in the same minor beneficial impact on the listed buildings, resulting overall in permanent slight beneficial effects.

The construction and operation of Option 3 would have the potential to negatively magnitude of impact on the setting of the listed buildings associated with Capel Manor (Grade II* NHLE 1078898, Grade II NHLE 10788999, 1358472) assets of high and medium value. The widening of the A10, the junction and the M25 anticlockwise on-slip road on the south-west side of the scheme option would result in potential impacts on the setting of the listed buildings. Potential noise and dust during construction would alter the setting, while construction work, plant and hoardings would potentially be visible in filtered views from the listed buildings. There is also the potential for the completed scheme to be visible in filtered views from the listed buildings. These would constitute temporary and permanent minor adverse magnitude of impact on the setting of the listed buildings, which have the potential to result in both temporary and permanent moderate adverse effects on the Grade II* listed Capel Manor, which are significant. The adverse effects on the Grade II listed buildings would be slight, which are not significant.

The construction of Option 3 would have the potential to negatively impact on the setting of Bulls Cross Lodge (Grade II NHLE 1079476), an asset of medium value. The building is located approximately 200m of the scheme, and potential noise and dust during construction for the widening of the M25 anticlockwise on-slip road would alter the setting of the listed building. Construction works, plant and hoardings may also be visible in filtered views from the listed building. This would result in a temporary minor adverse magnitude of impact on the setting of the listed building, resulting in a slight adverse effect, which is not significant.

As with Option 1, there is the potential for impacts on unknown buried archaeology within the areas of land take and construction associated with the scheme. Part of Option 3 lies within the Whitewebbs Hill, Bulls Cross and Forty Hill Archaeological Priority Area (DLO35150). This, along with other non-designated archaeological assets and find spots close to the line of the scheme, would suggest that there is the potential for unknown buried archaeology within areas of previously undisturbed land.

7.7.4 Conclusion

Potential temporary and permanent significant adverse effects are recorded in relation to the cultural heritage resource from the construction and operation of Option 3. There are no significant adverse effects recorded from Option 1 or Option 2.

Table 7-3 below shows a summary of the effects arising from the proposed scheme options on heritage assets.

Table 7-3 Summary of effects

Asset Name	Significance of Effect					
	Option 1		Option 2		Option 3	
	Construction	Operation	Construction	Operation	Construction	Operation
Capel House (Grade II* Listed Building NHLE 1078898)	Temporary Slight Adverse	n/a	Temporary Slight Adverse	n/a	Temporary Moderate Adverse	Permanent Moderate Adverse
Garden Walls to east of Capel House (Grade II Listed Building NHLE 1078899)	Temporary Neutral	n/a	Temporary Neutral	n/a	Temporary Slight Adverse	Permanent Slight Adverse
Bulls Cross Lodge (Grade II Listed Building NHLE 1079476)	n/a	n/a	n/a	n/a	Temporary Slight Adverse	n/a
Large Barn at Theobalds Park Farm (Grade II Listed Building NHLE 1100555)	Temporary Slight Adverse	Permanent Neutral	Temporary Slight Adverse	Permanent Slight Beneficial	Temporary Slight Adverse	Permanent Slight Beneficial
Theobalds Park Farmhouse (Grade II Listed Building NHLE 1348390)	Temporary Slight Adverse	Permanent Neutral	Temporary Slight Adverse	Permanent Slight Beneficial	Temporary Slight Adverse	Permanent Slight Beneficial
Cob Outbuilding south-south-west of Theobalds Park Farm (Grade II Listed Building NHLE 1348391)	Temporary Slight Adverse	Permanent Neutral	Temporary Slight Adverse	Permanent Slight Beneficial	Temporary Slight Adverse	Permanent Slight Beneficial
Stables and former Coach House Range at Capel Manor (Grade II Listed Building NHLE 1358742)	Temporary Neutral	n/a	Temporary Neutral	n/a	Temporary Slight Adverse	Permanent Slight Adverse

For all the options, there is the potential for impacts on unknown buried archaeology in areas of land take and construction which have not been developed previously. While the majority of the work is being conducted within the existing road corridor, and therefore unknown deposits are likely to have been removed, Option 3 lies partly within an Archaeological Priority Area and therefore buried archaeology should be considered a possibility.

7.8 Limitations to assessment

The assessment of impacts on the setting of designated and non-designated assets has been conducted pending on site assessment in the form of walkover surveys.

The baseline assessment has been undertaken using existing data. The assessment of impacts and effects on this baseline is reliant on the sources of data outlined above. We are not responsible for the accuracy of this data, and though no errors within the data available have been identified, the assessment in this section is still reliant on its accuracy. There were limitations to the sources consulted for the baseline: paper records and grey literature held by Hertfordshire and Greater London HERs have not been consulted for this stage of the scheme assessment.

7.9 Summary and recommendations

Temporary and permanent significant adverse effects are recorded in relation to the cultural heritage resource for Option 3. These consist of temporary and permanent moderate adverse effects in relation to the setting of Capel Manor listed building (Grade II* NHLE 1078898). No significant effects are recorded as arising from the construction and operation of Option 1 or Option 2.

Mitigation, in the form of vegetation or other screening of construction works and the operation of the completed scheme, could reduce the scale of impact and harm on the setting of listed buildings.

For all the options, there is the potential for impacts on unknown buried archaeology in areas of land take and construction, which have not been developed previously. In the case of Option 3, these may be in relation to the Whitewebbs Hill, Bulls Cross and Forty Hill Archaeological Priority Area (DLO35150).

It is recommended that a PCF Stage 2 assessment for cultural heritage includes the following scope:

- Impact assessment of the frozen scheme design options
- Built heritage setting assessment for both designated and non-designated built heritage assets
- Assessment of historic mapping to inform the potential for archaeology within anticipated areas of undisturbed ground
- Assessment of any available geotechnical data and reports for previous archaeological investigations to inform the potential for buried archaeology
- Consultation with the local authority Conservation Officer on settings issues and the Archaeological Advisor, in regard to the Archaeological Priority Areas

8 Nature conservation

8.1 Introduction

This section includes a description of the ecological baseline and an evaluation of the ecological receptors (hereafter referred to as 'ecological features') present within the Ecological Zone of Influence (EZOI) for the proposed scheme options. The potential impacts on ecological features are characterised, methods of avoidance, mitigation, compensation and enhancement are set out, and the significance of the residual effects of the proposed scheme options on these ecological features is determined.

The assessment presented in this section has been undertaken with reference to Interim Advice Note (IAN) 130/10⁶, current industry good practice for Ecological Impact Assessment produced by the Chartered Institute for Ecology and Environmental Management (CIEEM)⁷ and the DMRB Volume 11, Section 2, Part 5⁸.

Ecological information was obtained from a desk-study undertaken in January 2016 and a targeted walkover survey undertaken in July 2016.

8.2 Assessment methodology

8.2.1 Desk study

In January 2016, up-to-date ecological records of the following were obtained from Greenspace Information for Greater London (GiGL) and Hertfordshire Environmental Records Centre (HERC):

- Records of non-statutory designated sites - including locally designated Sites of Importance for Nature Conservation (SINC)⁹ in Greater London and Local Wildlife Sites (LWS) in Hertfordshire
- Records of notable and legally protected species¹⁰ (fauna and flora)

The Multi-Agency Geographic Information for the Countryside (MAGIC) website¹¹ (www.magic.gov.uk) was reviewed for information on designated sites of nature conservation importance (statutory sites only). These included:

- Internationally designated Special Areas of Conservation (SACs), Special Protection Areas (SPAs), and Wetlands of International Importance (Ramsar sites)
- Nationally designated Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR)
- Locally designated Local Nature Reserves (LNR)

MAGIC was also used to identify notable habitats¹² and ancient woodland.

The extent of the Study Area for ecological features used during the desk study is defined in Section 8.3.

⁶ Highways Agency (2010) *Ecology and Conservation: Criteria for Impact Assessment*. Interim Advice Note 130/10. HA, Bristol

⁷ Chartered Institute of Ecology and Environmental Management (2016). *Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal 2nd edition*. CIEEM, Winchester

⁸ Highways Agency (2008) Assessment and Management of Environmental Effects. *Design Manual for Roads and Bridges*, Volume 11, Section 2, Part 5. HA, Manchester

⁹ SINC in Greater London are classified into four categories: Sites of Metropolitan Importance (SMI); Sites of Borough Importance Grade 1 (SBI Grade 1); Sites of Borough Importance Grade 2 (SBI Grade 2); and Sites of Local Importance (SLI).

¹⁰ Notable species are those determined as Species of Principal Importance (SPI), listed under Section 41 of the Natural Environment and Rural Communities Act (2006); 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 a local Biodiversity Action Plan (London BAP, LB Enfield BAP or Hertfordshire BAP), or as national or county rare or scarce.

¹¹ www.magic.gov.uk

¹² Notable habitats are those determined as Habitats of Principal Importance (HPI), listed under Section 41 of the Natural Environment and Rural Communities Act (2000).

Ordnance Survey (OS) maps were used to initially identify the presence of water bodies within 500m of the proposed scheme, in order to establish if the land within and immediately surrounding the proposed scheme could be used as terrestrial habitat for great crested newts. This species typically uses suitable terrestrial habitat up to 500 m from a breeding pond¹³. However, there is a notable decrease in great crested newt abundance beyond a distance of 250m from a breeding pond¹⁴.

The Hertfordshire Biodiversity Action Plan (BAP)¹⁵, Enfield BAP¹⁶ and London BAP¹⁷ were reviewed for details of priority habitats and species within those plans that may potentially be affected by the proposed scheme. A review of local planning policy relevant to the proposed scheme was also undertaken as part of the desk study.

8.2.2 Targeted ecological walkover survey

A targeted ecological walkover survey was undertaken in July 2016 to confirm on the ground the presence and characteristics of some ecological features identified during the desk study. The survey was undertaken from publically accessible land within and adjacent to the proposed scheme ('the Survey Area', see Section 8.3 for extent) and broadly followed current good practice guidance¹⁸.

The targeted ecological walkover survey recorded the presence of notable habitats within the Survey Area. Plant names recorded in this survey follow *The New Flora of the British Isles*, Third Edition¹⁹. In addition, information on the presence of notable or protected species within the Survey Area, or the potential for such species to occur, was recorded. In particular the survey focussed on:

- Potential roosting sites for bats within trees and structures, identified from the ground only
- The potential of terrestrial and aquatic habitats to support great crested newts
- Signs of badger activity such as setts, tracks, forage marks and latrines, etc.
- The suitability of habitats for nesting birds (including any old nests)
- The suitability of habitats for common species of reptile (adder, grass snake, slow worm and common lizard)
- The suitability of watercourses for water vole, otter and white-clawed crayfish
- The suitability of woodland and scrub habitats for hazel dormouse
- The suitability of habitats for notable invertebrates

8.2.3 Nature conservation evaluation

Accepted criteria²⁰ (e.g. diversity, rarity and naturalness) were used to assess the nature conservation value of a defined area of land, such as a designated site or notable habitat.

The nature conservation value or potential value of ecological features was determined using professional judgement within the following geographic context:

- International – such as SAC, SPA and Ramsar sites
- National – such as SSSI and NNR
- Regional – such as Environment Agency regional biodiversity indicators, important features in Natural England Natural Areas

¹³ English Nature (2001). *Great Crested Newt Mitigation Guidelines*.

¹⁴ Natural England (2004). *An assessment of the efficiency of capture techniques and the value of different habitats for the great crested newt* (ENRR576). <http://publications.naturalengland.org.uk/publication/134002>.

¹⁵ Hertfordshire Biodiversity Partnership (2006). *A 50-year vision for the wildlife and natural habitats of Hertfordshire – A Local Biodiversity Action Plan*. Revised edition. Online at http://www.hef.org.uk/nature/biodiversity_vision/index.htm.

¹⁶ London Borough of Enfield (2011) *Nature for People: A Biodiversity Action Plan for Enfield*

¹⁷ London Biodiversity Partnership. *London's Biodiversity Action Plan*. Summarised online at <http://www.gigl.org.uk/about-gigl/londons-biodiversity-action-plan>.

¹⁸ Chartered Institute of Ecology and Environmental Management (2012). *Guidelines for Preliminary Ecological Assessment*. CIEEM, Winchester

¹⁹ Stace C.E. (2010). *New Flora of the British Isles, 3rd edition*. Cambridge University Press.

²⁰ Set out in Ratcliffe (1977) *A Nature Conservation Review*. Cambridge University Press.

- Metropolitan (i.e. Great London) or County (i.e. Hertfordshire) – such as Sites of Metropolitan Importance, LWS
- Borough – such as Sites of Borough Importance (Grade 1 or 2) in London Borough of Enfield, or LNR
- Local (parish) – such as Sites of Local Importance, or undesignated ecological features such as old hedges, woodlands and ponds
- The proposed scheme boundary – such as small ponds, marshy grassland, mature trees and species-rich hedgerow
- Negligible e.g. areas of hardstanding and amenity grassland

Populations of notable species affected by the proposed scheme are also attributed a value if, based on professional judgement, it is considered appropriate.

8.2.4 Impact assessment

The significance of effects on ecological features identified has been categorised where appropriate according to Highways England Interim Advice Note (IAN) 130/10. This IAN allows characterisation of impacts and determination of effects which are significant following CIEEM guidance, with the significance of effects categorised according to Table 3 in IAN 130/10.

The assessment of the potential effects of the proposed scheme has taken into account both effects within the proposed scheme and those that may occur to adjacent and more distant ecological features. Impacts can be permanent or temporary and can include:

- Direct loss of wildlife habitats
- Fragmentation and isolation of habitats
- Disturbance to species from noise, light or other visual stimuli
- Changes to key habitat features
- Changes to the local hydrology, water quality and/or air quality

Effects are unlikely to be significant where features of low value or sensitivity are subject to small or short-term impacts. However, if a number of small scale effects occur that are not significant alone, an assessment has been made as to whether, cumulatively, these may result in an overall significant effect. Impacts have been assessed as being either negative or positive and significant or not significant.

For designated sites, effects were considered significant if the potential effects of the proposed scheme is likely to either undermine (or support) the conservation objectives or condition of the site(s) and its features of interest.

For habitats, which may constitute, either whole or in part, an ecosystem, effects were considered significant if the potential effects of the proposed scheme is likely to result in a change in ecosystem structure and function.

Consideration was given to whether:

- Any processes or key characteristics of the ecosystem would be removed or changed
- There will be an effect on the nature, extent, structure and function of component habitats of the ecosystem
- There is an effect on the population size and viability of component species within an ecosystem

Functions and processes acting outside the formal boundary of a designated site were also considered, particularly where a site falls within a wider ecosystem e.g. wetland sites.

Some ecosystems can tolerate a degree of minor changes, such as localised or temporary disturbance or changes in physical conditions, without such changes harming their function

or value. Ecological effects were considered in the light of any information available about the capacity of ecosystems to accommodate change.

The conservation status of undesignated habitats and species within a defined geographical area is described as follows:

- For habitats, conservation status was determined by the sum of the influences acting on the habitat that may affect its extent, structure and functions as well as its distribution and its typical species within a given geographical area
- For species, conservation status is determined by the sum of influences acting on the species concerned that may affect its abundance and distribution within a given geographical area

The conservation status was used to determine whether the effects of the proposed scheme options on habitat or species are likely to be significant.

In assessing the potential effects on conservation status, the known or likely background trends and variations in baseline status have been taken into account. The level of ecological resilience or likely level of ecological conditions, that would allow the population of a species or area of habitat to continue to exist at a given level, continue to increase along an existing trend, or reduce a decreasing trend, was estimated where appropriate to do so.

The proposed mitigation measures described within Section 8.6 have been taken into account in the assessment of the residual significance of effects. These mitigation measures include those required to achieve the minimum standard of established good practice to reduce any negative impacts of the proposed scheme. The mitigation measures also include those required to reduce or avoid the risk of committing legal offences.

In addition to measures required to ameliorate negative impacts on valued ecological features, further ecological enhancement measures have been identified to be incorporated into the proposed scheme as it is progressed in accordance with the Highways England Biodiversity Action Plan²¹.

Where species are protected by law (see 8.4.4 and refer to Appendix F for a summary of relevant nature conservation legislation), specific impacts on individuals including direct harm to species were considered in the impacts assessment; in order to identify any potential activities associated with the proposed scheme that may lead to an offence with respect to protected species.

8.3 Study area

The Study Area was determined by the predicted EZoI, which is defined as the area in which there may be ecological features subject to impacts and subsequent effects as a result of the proposed scheme. Where appropriate to do so, the EZoI was reviewed and amended throughout the assessment.

An Initial EZoI used to inform the desk study and walkover survey was based on the proposed scheme option area boundaries (which encompasses the proposed extent of the combined option designs, as shown on Figure 8.1), with assumptions made of the potential construction and operation effects based on the proposed options including an initial review of the landscape surrounding the proposed scheme. The EZoI was reviewed and amended once the survey was complete, and records received for the desk study.

The Amended EZoI was used for the assessment of impacts and potential significance of effects on ecological features reported in this section.

The EZoI also encompasses potentially beneficial effects of habitat creation and establishment of new ecological networks.

²¹ Highways England (2015) *Our Plan to Protect and Increase Biodiversity*. HE, Guildford

Depending on their relative importance for nature conservation (and the mobility of related species), information on designated sites was sought from within the following search areas (measured from the limits of the proposed scheme options:

- 30km for SACs where bats are one of the qualifying species (DMRB guidance²² recommends this wide search area due to the mobility of bats)
- 2km for other statutory designated sites
- 1km for non-statutory designated sites and ancient woodland

Based on the predicted extent of impacts on habitats and species, and the mobility for certain species, information was sought from the following search areas:

- 5km for records of bat roosts
- 500m for water bodies that may potentially be used as breeding ponds by great crested newts
- 500m for notable habitats, and all other notable or legally protected species

The Survey Area for the targeted ecological walkover survey included publically accessible land within the footprint of the proposed scheme options and adjacent land up to 500m.

8.4 Baseline conditions

8.4.1 Designated sites

There are three statutory designated sites within 2km of the proposed scheme boundary, as shown on the designated site map Figure 8.1 in Appendix F. These designations are summarised in Table 8-1 below, and include Lee Valley, which is afforded a European-level designation as an SPA, and is also a Ramsar site. These two designations occupy the same site. Lee Valley SPA/Ramsar overlaps the nationally-important Turnford and Cheshunt Pits SSSI, which is within 2km of the proposed scheme boundary.

There are no SAC's within 30km that have bats as qualifying species.

Table 8-1 Summary of statutory designated sites within 2km

Site name	Approximate distance and direction from junction	Description	Total site area	Grid reference
Lee Valley SPA and Ramsar site	1.85km north-east	Designated for important populations of over-wintering shoveler and gadwall and breeding bittern	451.3 ha	TQ351888
Turnford & Cheshunt Pits SSSI	1.85km north-east	Former gravel pits of national importance for wintering and breeding birds, invertebrates and aquatic flora.	174.4 ha	TL370027

Four non-statutory designated sites are present within 1km of the proposed scheme boundary as shown on Figure 8.1. Information on these sites is provided in Table 8-2 below.

²² Highways Agency (2009) Assessment of Implications on European Sites. *Design Manual for Roads and Bridges* Volume 11, Section 4 Part 1. HA, London

Table 8-2 Summary of non-statutory designated sites within 2km

Site name	Approximate distance and direction from junction	Description	Total site area	Grid reference
New River SMI	250m west	A man-made waterway stretching from Hertfordshire to London supporting a range of aquatic plants, fish, birds and amphibians.	30.4 ha	TQ323878
Broom Hills LWS	850m north-west	Old secondary woodland with a predominantly semi-natural canopy and varied structure.	5.4 ha	TL345011
Temple Bar Meadow LWS	980m	Rough, damp unimproved grassland with a reasonably species-rich sward.	2.2 ha	TL344011
Forty Hall Park and Estate SMI	1.2km south-west	A large section of relict countryside which includes important grassland communities of London-wide significance, hedgerows, scrub, secondary woodland and a number of ancient oaks.	61 ha	TQ329990

8.4.2 Ancient woodland

There are no parcels of ancient woodland within 1km of the proposed scheme boundary.

8.4.3 Habitats

The main habitat on the northern (clockwise) and southern (anticlockwise) motorway verges within and immediately adjacent to the proposed scheme boundary is young mixed plantation woodland with pine, birch, sweet chestnut and other broadleaved trees. The southern (anticlockwise) motorway verge within the junction is identified as the notable habitat Lowland Mixed Deciduous Woodland Habitats of Principal Importance (HPI) on the MAGIC website. There are patches of semi-improved (coarse) grassland with tall ruderal vegetation on the verge within 500m of the junction.

The A10 verge north of the junction has semi-improved grassland, whereas the A10 south of the junction has reduced or no verges and is bounded by pavement and urban housing.

There are arable fields to the north-west of the junction bisected by a hedgerow. Within the hedgerow there is a pond shown on the OS map, but the presence or condition of this pond could not be confirmed during the targeted ecological walkover survey due to lack of access. To the north-east of the junction is an industrial development (newspaper printers). To the south-east of the junction, beyond a small area of young plantation woodland is urban development. To the south-west of the junction is a field dominated by tall ruderal plants (e.g. nettles, etc.), which was recently re-instated following use as a construction compound. Further to the south-west are nurseries and a college.

The New River, a canal originally constructed in the 17th Century is located approximately 250m west of the centre of the junction. This canal crosses the M25 from north to south via an aqueduct. The banks of the canal are made of vertical steel or wooded revetments, or sloped concrete sides. There is no marginal vegetation, and the habitat on the banks is mown, poor, semi-improved grassland, hardstanding, or access track. The western side of the canal is flanked by broadleaved woodland 400m to the north-west of the junction within a property known as Theobalds Park. This woodland is identified as Lowland Mixed Deciduous Woodland HPI on the MAGIC website.

8.4.4 Notable and protected species

8.4.4.1 Notable plants

No specific records of notable plants within the 500m search area were identified during the desk study. However, nine records of SPI that are plants, from within the OS 10km grid square that includes the junction area, were identified, although no recent (within the last 10 years) records exist. These plants were recorded at 10km resolution, and therefore an accurate location or distance from the proposed scheme boundary was not available. No notable plant species were identified within the Survey Area during the targeted walkover survey.

8.4.4.2 Invertebrates

The desk study provided 13 records of invertebrate SPI from within the local 10km or 1km grid square. An accurate location or distance from the proposed scheme boundary was not available for these species. The only recent (within the last 10 years) records available include small heath butterfly, and white-letter hairstreak which had been recorded within 1km of the proposed scheme boundary. Both these species are SPI. White-letter hairstreak butterfly has been recorded at Theobalds Park, a part of which is within 500m of the junction, to the north-west.

8.4.4.3 Amphibians and reptiles

The desk study returned no specific records of amphibians or reptiles within 500m of the junction. However, suitable terrestrial habitat, along the hedgerows and on the motorway verge is present for amphibians, including great crested newt, and reptiles. Great crested newts are European Protected Species and are protected under the Conservation of Habitats and Species Regulation 2010 (as amended), and are also protected under the Wildlife and Countryside Act 1981 (as amended). Refer to Appendix F for a summary of relevant nature conservation legislation.

There is a potentially suitable breeding pond for great crested newts within the hedgerow boundary between arable fields north-west of the junction. This pond is 65m north-west of the proposed scheme boundary. A second pond, which is a square pool flanked by nettles, thistles and bramble, is present less than 50m from the motorway boundary, at a point approximately 300m west of the centre of the junction. The water quality of this pond is poor and it is considered unsuitable for breeding great crested newts.

Although no records of reptiles were returned from the data search, the semi-improved grassland habitat on the M25 motorway and A10 verges provides suitable habitat for common reptiles, particularly common lizard, grass snake, slow worm or adder. These reptile species are protected under the Wildlife and Countryside Act 1981, as amended (see Appendix F).

8.4.4.4 Birds

The desk study identified a number of notable bird species that have been recorded within 500m of the junction, including skylark, Montague's harrier, lapwing and house sparrow, which are SPI. All wild birds are protected under the Wildlife and Countryside Act 1981, as amended (refer to Appendix F). Barn owl and red kite have been recorded at Theobald's Park within 500m to the north-west of the junction. These species are listed on Schedule 1 of the Wildlife and Countryside Act, as amended, and therefore afforded extra protection (see Appendix F). The Lee Valley SPA and Ramsar site supports internationally important populations of wintering and breeding birds, notably shoveler, gadwall and bittern. However suitable wintering or breeding habitat for these species is not present within the proposed scheme boundary. The desk study identified woodland and scrub within the search area that may offer suitable nesting opportunities for breeding birds.

8.4.4.5 Bats

The desk study returned records of nine species of bats from within 5km of the junction. These are: common pipistrelle, soprano pipistrelle, Natterer's, whiskered, Daubenton's,

brown long-eared, noctule, Leisler's and serotine. All bats are European Protected Species (see Appendix F). The woodland, scrub and hedgerows may provide habitat for foraging bats, and these features may also be used by bats for navigation whilst commuting between roosts and foraging areas. Trees with features suitable for roosting bats, such as cavities, cracks or splits may be present within woodland on the verge or adjacent to the junction. There may also be suitable roosting sites within structures, such as the motorway overbridges.

8.4.4.6 Hazel dormouse

The desk study returned no records of dormice from within 500m of the junction. The hazel dormouse is a European Protected Species (see Appendix F). The desk study and targeted ecological walkover survey identified mixed woodland and scrub on the motorway verge that may be suitable for dormice.

8.4.4.7 Otter and water vole

The desk study returned no records of otters or water voles from within 500m of the junction. Otter is a European Protected Species, and water vole is protected under the Wildlife and Countryside Act 1981 (as amended), see Appendix F. The New River, which is located 250m to the east of the junction may be used by otters for commuting. However, the suitability of the watercourse for foraging or shelter for otter or water vole is negligible. The river has vertical steel or wooded revetments and open grassy banks that do not provide suitable sites for water vole burrows. Although there may be suitable sites for otter holts with woodland adjacent to the New River, the M25 motorway verge is considered to be largely unsuitable for otters due to the noise disturbance and lack of access to the river (as the verge is below the river which crosses the motorway within a viaduct).

8.4.4.8 Badger

The desk study returned no records of badgers from within 500km of the junction. Badgers are protected under the Protection of Badgers Act, 1992 (as amended), see Appendix F. Suitable habitat exists within the proposed scheme boundary and the surrounding habitat that badgers may use for foraging or making setts, such as plantation, scrub and hedgerows. No badger setts were identified within the proposed scheme boundary during the targeted walkover survey. However there remains the potential for setts to be present that were not recorded during the walkover.

8.4.4.9 Non-native invasive species

The desk study provided numerous non-native invasive species of plants from within 2km of the junction listed on Schedule 9 of the Wildlife and Countryside Act 1981 (as amended), see Appendix F. No invasive plant species were identified within the proposed scheme boundary during the targeted walkover survey. However there remains the potential for such species to be present that were not recorded during the walkover.

8.5 Regulatory / Policy framework

8.5.1 National Planning Policy Framework 2012

The National Planning Policy Framework (NPPF) 25 sets out the Governments planning policies for England and how these are expected to be applied by Local Authorities within their Local Development Frameworks (LDF). Chapter 11 of the NPPF 'Conserving and enhancing the natural environment' sets out the requirements to consider biodiversity in planning decisions.

The paragraphs within Chapter 11 relevant to the proposed scheme are summarised below:

109 The planning system should contribute to and enhance the natural and local environment by:

- *Protecting and enhancing valued landscapes, geological conservation interests and soils;*

- *Recognising the wider benefits of ecosystem services; and*
- *Minimising impacts on biodiversity and providing net gains in biodiversity where possible, contributing to the Government's commitment to halt the overall decline in biodiversity, including by establishing coherent ecological networks that are more resilient to current and future pressures.*

114 Local planning authorities should set criteria based policies against which proposals for any development on or affecting protected wildlife or geodiversity sites or landscape areas will be judged. Distinctions should be made between the hierarchy of international, national and locally designated sites, so that protection is commensurate with their status and gives appropriate weight to their importance and the contribution that they make to wider ecological networks.

117 Local planning authorities should set out a strategic approach in their Local Plans, planning positively for the creation, protection, enhancement and management of networks of biodiversity and green infrastructure.

To minimise impacts on biodiversity and geodiversity, planning policies should:

- *Plan for biodiversity at a landscape-scale across local authority boundaries; identify and map components of the local ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity, wildlife corridors and stepping stones that connect them and areas identified by local partnerships for habitat restoration or creation;*
- *Promote the preservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species populations, linked to national and local targets, and identify suitable indicators for monitoring biodiversity in the plan; and,*
- *Aim to prevent harm to geological conservation interests; and where Nature Improvement Areas are identified in Local Plans, consider specifying the types of development that may be appropriate in these Areas.*

118 When determining planning applications, local planning authorities should aim to conserve and enhance biodiversity by applying the following principles:

- *If significant harm resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or, as a last resort, compensated for, then planning permission should be refused.*
- *Proposed development on land within or outside a Site of Special Scientific Interest likely to have an adverse effect on a Site of Special Scientific Interest (either individually or in combination with other developments) should not normally be permitted. Where an adverse effect on the site's notified special interest features is likely, an exception should only be made where the benefits of the development, at this site, clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of Sites of Special Scientific Interest;*
- *Development proposals where the primary objective is to conserve or enhance biodiversity should be permitted;*
- *Opportunities to incorporate biodiversity in and around developments should be encouraged; and,*
- *Planning permission should be refused for development resulting in the loss or deterioration of irreplaceable habitats, including ancient woodland and the loss of aged or veteran trees found outside ancient woodland, unless the need for, and benefits of, the development in that location clearly outweigh the loss.*

8.5.2 Local planning policy

At a local level, development is controlled through local planning policy prepared in accordance with national policy. Local Plans set out a vision and a framework for the future development of the area within boundaries of the local authorities.

The study area is located within boundaries of Broxbourne Borough and the London Borough of Enfield.

Broxbourne Borough Council have submitted a draft Local Plan for parliamentary consideration, in place of a Core Strategy which it was decided not to adopt in 2011. The draft Local Plan contains draft policies relevant to this assessment.

Enfield Council are currently in consultation over a new Local Plan, and the policies relevant to this assessment are located within the Core Strategy, adopted in November 2010.

Table 8-3 includes relevant policies of Broxbourne Borough Council and Enfield Council as well as relevant policies of London Plan written by the Mayor of London and publicised by the Greater London Authority.

Table 8-3 Summary of relevant local policies

Planning Policies	Summary of Policy Content
Broxbourne Borough Council	Broxbourne draft Local Plan (2016)
Policy NEB1: Wildlife, Wildlife Sites and Biodiversity	<p>“Protected species</p> <p>I. When there is a reasonable likelihood of the presence of protected species or their habitats, development will not be permitted until it has been demonstrated that the proposed development will not result in a negative impact on these populations.</p> <p>Internationally and nationally designated wildlife sites</p> <p>II. Development which would harm the nature conservation or geological interest of an internationally or nationally important wildlife site, as shown on the Policies Map, will not be permitted unless:</p> <p>(a) it is required in connection with the management or conservation of the site; or</p> <p>(b) there are Imperative Reasons of Overriding Public Interest for the development; and</p> <p>(c) there is no alternative to the development.</p> <p>Compensation for the harm will be required.</p> <p>Locally designated sites of wildlife value</p> <p>III. Development on, or which negatively affects, a Local Wildlife Site or Local Nature Reserve, as shown on the Policies Map, will not be permitted unless:</p> <p>(a) the local development needs significantly outweigh the nature conservation value of the site; and</p> <p>(b) the development provides appropriate avoidance/mitigation/compensation measures to offset any detriment to the nature conservation interest on the site.</p> <p>Conservation and enhancement of biodiversity</p> <p>IV. When determining relevant development proposals the Council will ensure that decisions will minimise impacts and result in net gains to biodiversity.</p> <p>V. In granting permission the Council will impose conditions or seek planning obligations that secure appropriate management regimes to deliver biodiversity gain in perpetuity.”</p>
Policy NEB4: Protected Trees and Hedgerows	“I. Applicants who wish to fell, top or lop protected trees or remove protected hedgerows should demonstrate that:

Planning Policies	Summary of Policy Content
	<p>(a) the tree(s) or hedgerow(s) is/are dead, dying, diseased or dangerous and in need of work on public safety and/or environmental grounds; and/or</p> <p>(b) removal of the tree(s) or hedgerow(s) is essential for the proper development of a site; or</p> <p>(c) work is required for general maintenance or up-keep of the tree(s).</p> <p>II. Replacement planting will be required if permission is granted to fell protected trees or hedgerows. Replacement specimens should be where possible of an equivalent size and of similar species, in the same or most suitable location and in sympathy with local landscape character. The Council will seek replacement with two trees if they are of a lesser species or size than the removed tree.”</p>
Enfield Council	Core Strategy (2010)
Core Policy 36	<p>“BIODIVERSITY</p> <p>The Council will seek to protect, enhance, restore or add to biodiversity interests within the Borough, including parks, playing fields and other sports spaces, green corridors, waterways, sites, habitats and species identified at a European, national, London or local level as being of importance for nature conservation by:</p> <p>Continuing to protect, restore, and enhance sites, habitats and species identified for their biodiversity importance at the national, London, or borough level. The Development Management Document will set out criteria to assess development proposals that are likely to have an adverse ecological impact;</p> <p>Requiring improvements to biodiversity provision, with priority given to areas of deficiency identified in the Enfield Open Space Study and proposals which assist in achieving Biodiversity Action Plan objectives;</p> <p>Reviewing the schedule of Sites of Importance for Nature Conservation in light of the findings of GLA survey of the Borough and other appropriate evidence, in order to set out a hierarchy of locally important sites in the Development Management Document; and</p> <p>Preparing a Local Biodiversity Action Plan to set out the Borough’s actions and objectives with regard to biodiversity, and to contribute towards the UK and London Biodiversity Action Plan targets and objectives.”</p>
London Plan (2015-2016)	Relevant policies from the Draft Replacement London Plan (2015-2016) included below.
Policy 7.19 Biodiversity and access to nature	<p>“Development Proposals should:</p> <ol style="list-style-type: none"> a. wherever possible, make a positive contribution to the protection, enhancement, creation and management of biodiversity; b. prioritise assisting in achieving targets in biodiversity action plans (BAPs); c. not adversely affect the integrity of European sites and be resisted where they have significant adverse impact on European or nationally designated sites or on the population or conservation status of a protected species or a priority species or habitat identified in a UK, London or appropriate regional BAP or borough BAP. <p>On Sites of Importance for Nature Conservation development proposals should:</p> <ol style="list-style-type: none"> a. give the highest protection to sites with existing or proposed international designations (SACs, SPAs, Ramsar sites) and national designations (SSSIs, NNRS) in line with the relevant EU and UK guidance and regulations; b. give strong protection to sites of metropolitan importance for nature conservation (SMIs). These are sites jointly identified by the Mayor and boroughs as having strategic nature conservation importance;

Planning Policies	Summary of Policy Content
	<p>c. give sites of borough and local importance for nature conservation the level of protection commensurate with their importance.</p> <p>When considering proposals that would affect directly, indirectly or cumulatively a site of recognised nature conservation interest, the following hierarchy will apply:</p> <ol style="list-style-type: none"> 1. avoid adverse impact to the biodiversity interest 2. minimize impact and seek mitigation 3. only in exceptional cases where the benefits of the proposal clearly outweigh the biodiversity impacts, seek appropriate compensation.”
Policy 7.21 Trees and Woodland	<p>“Planning decisions</p> <p>Existing trees of value should be retained and any loss as the result of development should be replaced following the principle of ‘right place, right tree’[1]. Wherever appropriate, the planting of additional trees should be included in new developments, particularly large-canopied species”.</p>

8.5.3 Local biodiversity policy

The London Mayor’s Biodiversity Strategy²³ sets out the policies that are necessary to ensure the conservation of London’s natural environment and improve the ecology of the city. The objective of the strategy is to promote the conservation of biodiversity, by providing direction to London authorities to:

- establish a network of SINCs
- support and encourage boroughs, land-owners and Londoners to take practical actions to improve the ecology of land they own or manage, including private gardens
- use the planning system to green the urban environment through the installation of green roofs, planting of street trees and restoring rivers
- create more semi-natural green spaces to increase habitat for wildlife and provide Londoners with better access to nature

8.5.4 Biodiversity action plans

The UK BAP is the UK’s initiative to maintain and enhance biodiversity in response to the Convention on Biological Diversity signed in 1992.

The UK BAP was used to draw up the ‘England Biodiversity List’ (see below) and has been succeeded by the UK Post-2010 Biodiversity Framework in 2012, due to a change in government strategy by all UK countries, focussing on managing the environment as a whole rather than dealing with different aspects of biodiversity and environment separately. However, the UK BAP list of priority habitats and species continue to be regarded as conservation priorities in the UK Post-2010 Biodiversity Framework²⁴.

The London Biodiversity Partnership published the London BAP in 2002. There are 11 priority habitats and 214 priority species included within the plan. All 11 habitats and eight of the species have specific Action Plans.

The Hertfordshire BAP has seven priority habitats and 19 priority species. The Enfield BAP focusses on 10 priority habitats and three Action Plans for species or species groups.

8.5.5 Summary of relevant ecological legislation

A summary of UK wildlife legislation relevant to the proposed scheme is provided in Appendix F.

Section 40 of the Natural Environment and Rural Communities (NERC) Act 2006 sets out the duty for public authorities to conserve biodiversity in England. Habitats and species of

²³ Greater London Authority (2002) *Connecting with London’s nature: The Mayor’s Biodiversity Strategy*.

²⁴ JNCC and Defra (on behalf of the Four Countries’ Biodiversity Group). 2012. *UK Post-2010 Biodiversity Framework*. July 2012. Online at: <http://jncc.defra.gov.uk/page-6189>.

principal importance for the conservation of biodiversity as identified by the Secretary of State for England, in consultation with Natural England, are referred to in Section 41 of the NERC Act 2006 for England. The list of Habitats of Principal Importance (HPI) and Species of Principal Importance (SPI) was based on UK BAP priority habitats and species and was updated in 2008. It is known as the 'England Biodiversity List'.

8.6 Design, mitigation and enhancement measures

8.6.1 Notable habitats

Any proposed loss of woodland HPI, Hertfordshire BAP priority and Enfield BAP priority habitat within the proposed scheme boundary will be mitigated for through the creation of new habitats of similar value to ensure no net loss of the habitats affected. These new habitats will be subject to appropriate management to ensure successful establishment.

8.6.2 Notable and protected species

Mitigation will be provided within the design and construction practices to avoid or reduce potentially significant impacts to notable species. This will be implemented through establishment of the detailed baseline and continual review throughout the design and construction process of potential impacts. Good communication between the designers, contractor and ecologists will be established to facilitate this. Mitigation will allow the majority of potentially significant effects on populations of notable species to be avoided or reduced to a level where they are not significant.

Potential impacts on legally protected species that could lead to offences under 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 (as amended) will be avoided or reduced through appropriate mitigation provided in the design and construction phases. Such mitigation may include capture and translocation of animals, licensed works, and precautionary methods of working, such as avoiding works during the bird breeding season. Further survey will be undertaken in order to provide a detailed baseline for legally protected species that will inform decisions on mitigation.

8.6.3 General mitigation measures

In accounting for all the proposed scheme options, the following general mitigation measures will be implemented during the design and construction:

- Avoidance and minimisation of habitat loss, particularly within woodland habitat
- Maintenance and, where possible, enhancement of habitat connectivity and commuting routes for species, including hedgerows and woodland connections, and flower-rich grassland
- Retention of features with potential to provide bat roosting sites where possible (i.e. mature trees and suitable structures)
- Provision of a sensitive lighting design that takes bats and other wildlife into account
- Creation and enhancement of habitat as compensation for areas of habitat loss, using native species appropriate to the local area where possible, and taking into consideration pollinating insects
- Appropriate management of compensation habitat and monitoring of species mitigation measures where required
- Creation of log piles and other potential wildlife refuges using material from site clearance where practical

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

- Protection of habitats outside the working area from accidental incursion

- Protection of retained trees following standard practice
- Use of mitigation measures under licence if habitats or features afforded legal protection due to their use by protected species (such as badger, bat roosts, dormice habitat, great crested newt habitat) would be damaged during the works
- Use of precautionary method of working during construction to minimise risk to individual animals of protected species where licences would not be required, such as avoiding sensitive seasons for notable or protected species (i.e. bird breeding season), and provision of Ecological Clerk of Works (ECoW)
- Measures for dealing with unexpected finds of protected species, explained to construction staff via toolbox talks
- Avoidance of the spread of invasive species subject to control under the Wildlife and Countryside Act 1981 (as amended), and listed on Schedule 9 of the Act

8.7 Potential effects

8.7.1 Designated sites

No designated sites are located within the proposed scheme boundary.

Lee Valley SPA and Ramsar site, and Turnford and Cheshunt Pits SSSI are located approximately 1.85km east of the junction (see Figure 8.1). This site is designated at national and international level and as such is considered to have International value for nature conservation. There is not anticipated to be any significant effect of the proposed scheme options on Lee Valley SPA and Ramsar site, or Turnford and Cheshunt Pits SSSI, due to the small scale of the proposed highways works, the distance to these designated sites, and the lack of specific impact pathways, such as connections via waterways.

No effects on the SPA or Ramsar site are anticipated due to changes in air quality due to the proposed scheme, as air quality close to the designated sites is likely to be more directly affected by local traffic than by traffic conditions in and around M25 Junction 25. Further details of potential impacts from air pollution that may affect designated sites are provided in the Air Quality section of this report.

The proposed construction or operation of the proposed scheme is not expected to cause additional disturbance to key species within the SPA, above the existing levels of disturbance from sources closer to the SPA, due to the distance of the proposed scheme from the SPA. The construction and operation of the proposed scheme is not expected to cause disturbance to the key species during migration as the proposed scheme is situated close to a largely urbanised area, and would not cause an additional significant disturbance over existing levels.

An Assessment of Implications on European Sites (AIES) has been undertaken for the proposed scheme, which has concluded that there are no significant effects. This conclusion is subject to Natural England agreement.

There are four non-statutory designated sites located within 1km of the proposed scheme options (see Figure 8.1). These are listed in Table 8-2 above. Option 3 requires widening of the anticlockwise carriageway beneath the New River aqueduct. New River Site of Metropolitan Importance (SMI) has Metropolitan value within Greater London.

The works are not anticipated to require alterations to the bridge structure and therefore would not impact on the New River SMI or any species that may be found in or use the river habitat (i.e. notable plants, otters or water voles).

8.7.2 Notable habitats

Habitats within the proposed scheme boundary includes mixed plantation woodland and on the M25 verge and within the junction. The woodland habitat is an HPI, Hertfordshire BAP and Enfield BAP priority habitat and has Local value for nature conservation. Semi-improved

neutral grassland on the northbound verge of the A10 north of the junction, and on the M25 verge has value within the context of the proposed scheme boundary.

The current proposed scheme options require carriageway widening, but do not result in habitat loss outside of the boundaries of the M25 motorway or the A10, except for Option 3, which requires land purchase within the south-western quadrant of the junction in order to re-align an access track. However, Option 3 will affect land that has recently been disturbed for use as a construction compound. This land is likely to have negligible value for nature conservation.

The proposed carriageway widening would result in disturbance and land take from the habitats within the M25 and A10 boundaries, and subsequent loss of mixed plantation woodland, semi-improved neutral grassland and tall ruderal habitats. The carriageway widening proposed within the options does not affect the Lowland Mixed Broadleaved Woodland HPI identified on the anticlockwise verge of the M25 within the junction. Any major loss or damage to these habitats would have an effect that would be significant on a local scale at most.

8.7.3 Notable and legally protected species

Habitats within the proposed scheme boundary have potential to support notable and legally protected species including great crested newt, reptiles, breeding birds, bats, hazel dormouse and badger within the proposed scheme boundary.

Based on a preliminary assessment of the potential impacts of the proposed scheme options on nature conservation features, significant effects on notable habitats or species is considered to be unlikely.

There is potential for the proposed scheme to have impacts on legally protected species (including European protected species), including killing, injury or disturbance during construction; or disturbance, loss of foraging areas, population fragmentation, or disruption of migratory or commuting routes over the long term.

Any of the above impacts 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, implementation of industry good practice, through mitigation measures and the Construction Environmental Management Plan (CEMP) will ensure such offences are avoided.

Further surveys are required for notable and legally protected species to confirm presence or absence, the status of any population, and its potential value for nature conservation.

8.8 Limitations to assessment

Due to the predicted low impacts of the proposed scheme on ecological features, a full extended Phase 1 Habitat Survey following the Phase 1 habitat survey methodology as set out in Joint Nature Conservation Committee guidance²⁵ was not considered appropriate for PCF Stage 1. The targeted ecological walkover survey was undertaken from publically accessible land and rights of way, and therefore access to view potential ecological features such as ponds on private land was not available. For highway verges, the walkover survey was supplemented by a 'drive-by' inspection. This level of survey was considered appropriate and proportionate to the current stage of the proposed scheme and the predicted level of significance of effects on ecological features, and is in accordance with IAN 125/15²⁶.

Ecological surveys are limited by factors which affect the presence of plants and animals such as the time of year, migration patterns and behaviour. The targeted ecological walkover

²⁵ Joint Nature Conservation Committee (2010). *Handbook for Phase 1 habitat survey - a technique for environmental audit*. JNCC, Peterborough.

²⁶ Highways England (2015) *Environment Assessment Update*. Interim Advice Note 125/15. HE, Exeter

survey undertaken to support this assessment has 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. However, the results of the desk study and targeted ecological walkover survey are considered to be sufficient to undertake the assessment for this stage in the proposed scheme.

8.9 Summary

The PCF1 assessment for effects of the proposed scheme options on nature conservation features has not identified any potential significant effects of the options on designated sites, ancient woodland or populations of notable species.

All proposed scheme options may potentially impact on legally protected species during construction, if mitigation is not provided during, or in advance of construction. Subject to further survey and confirmation of presence, the construction may cause harm or disturbance of individuals, or cause damage or destruction of roosts, nests or places of shelter of great crested newts, reptiles, breeding birds, bats, hazel dormouse or badger.

The presence of notable or legally protected species must be taken into account throughout the design and construction process, so that mitigation measures can be identified that will reduce or avoid impacts on these species.

9 Air Quality

9.1 Introduction

This chapter describes air quality constraints in the study area and presents the findings of a preliminary air quality study of the potential air quality effects associated with each of the proposed scheme options as described in Chapter 3. Recommendations for further assessment are also provided.

9.2 Assessment methodology

9.2.1 Construction

In line with a proportionate and appropriate approach for PCF Stage 1 construction impacts have not been assessed at this stage, on the assumption that these can usually be mitigated by following best practice. Construction effects will be considered in later PCF Stages.

9.2.2 Operation

For the assessment of operational impacts, the DMRB HA207/07²⁷ provides methodologies for undertaking simple and / or detailed levels of assessment. A simple assessment has been undertaken for the air quality assessment at PCF Stage 1 using an appropriate and proportionate risk assessment approach. A review of baseline air quality conditions has been undertaken and potential constraints identified. The PCF Stage 1 VISSIM traffic model²⁸ provided indicative AADT variables (flow, composition and speed) for a baseline year (2014) and opening year (2022) for the Do-Minimum (DM) and Do-Something (DS) scenarios associated with each Option Variant. The assessment is based on the opening year as the influence of the vehicle exhaust emissions standards is likely to be greater than any additional growth in traffic in subsequent assessment years. The data have been considered in accordance with traffic change criteria defined in the DMRB HA207/07 Volume 11 Section 3 Part 1 (Air Quality) to determine a broadly defined affected road network (ARN) for each proposed option.

The DMRB HA207/07 traffic change criteria are as follows:

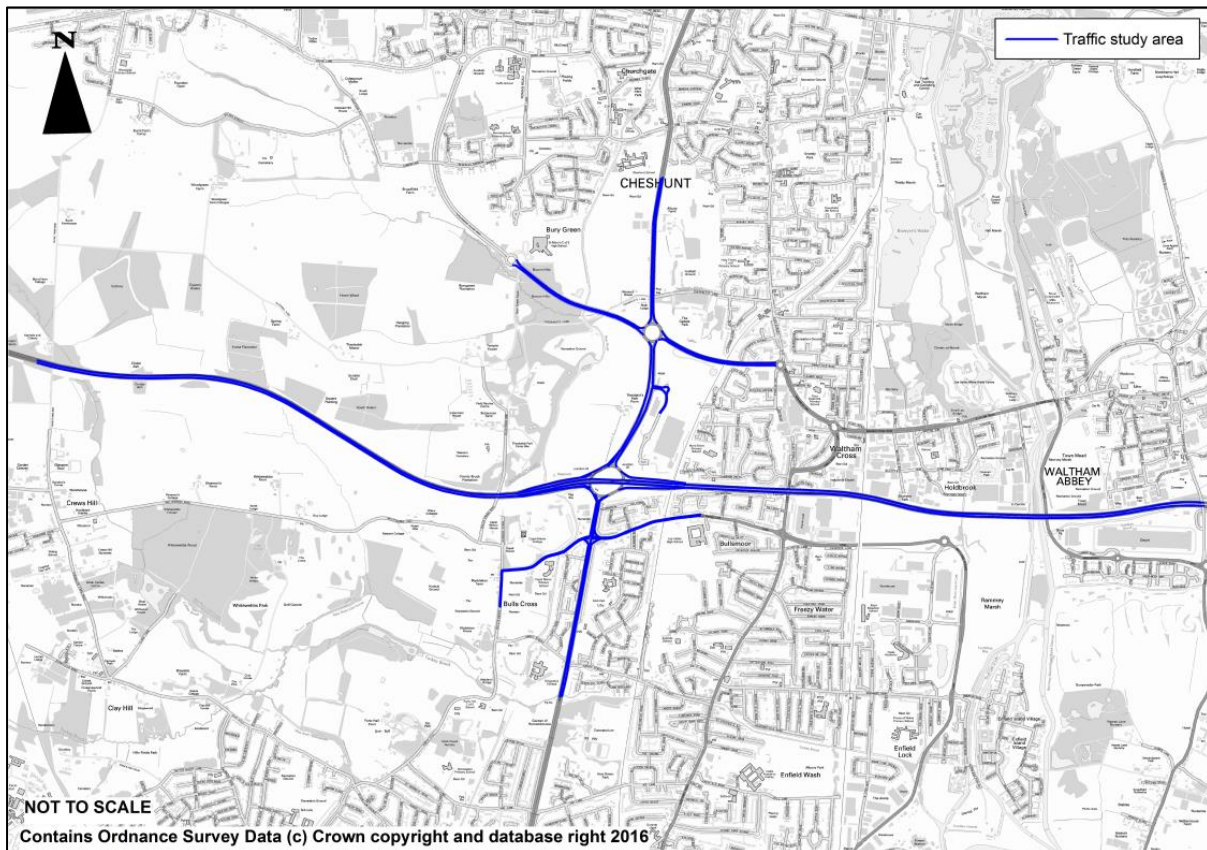
- Road alignment will change by 5 metres or more
- Daily traffic flows will change by 1,000 Annual Average Daily Traffic (AADT) or more
- Heavy Duty Vehicle (HDV) flows will change by 200 AADT or more
- Daily average speed will change by 10 kilometres per hour (km/hr) or more
- Peak hour speed will change by 20 km/hr or more

The changes are applied to roads (not links), and so where relevant are determined under two-way traffic conditions. Traffic data was provided, and an air quality assessment undertaken, for Options 1, 2, and 3. The extent of the area for which traffic data were provided is shown in Figure 9-1 below. Detailed descriptions of all Scheme options are provided in Chapter 3.

²⁷ Design Manual for Roads and Bridges Volume 11 Section 3 Part 1 HA 207/07 Air Quality
<http://www.standardsforhighways.co.uk/>

²⁸ 'AQ_Noise_Assessment_Traffic_Data_template_v3.1_12-2-15.xlsm', provided by Atkins Transportation in July 2016

Figure 9-1 Traffic Study Area



Qualitative commentary, in the context of existing air quality conditions, on the potential risk of air quality impacts associated with each option has been given. Calculation of air pollutant concentrations at receptors and of regional emissions across the ARN are not included in this PCF Stage 1 air quality assessment.

9.3 Study area

For the PCF Stage 1 air quality assessment, the air quality study area has been defined as the area within 200 metres of the proposed scheme options and associated ARN. This is industry best practise screening criteria, specified in HA207/07, which is derived from calculations using atmospheric dispersion modelling. These dispersion profiles have also been reviewed in a series of field measurements²⁹.

The extent of the ARN determined for each option has been limited by the spatial extent of the traffic data provided within the PCF Stage 1 traffic model which is focussed on Junction 25 and approaches on the M25 and A10 as well as the A1023.

9.3.1 Receptors

Sensitive human health receptors for the purposes of air quality assessment include residential properties, locations of susceptible populations e.g. schools, hospitals and care homes for the elderly, or any other location where a member of the public may be exposed to an air pollutant for the relevant regulated time period. Sensitive human health receptors within 200 metres of the scheme and roads which form the ARN with all options are provided in Table 9-1 and shown in Figure 9-2.

In terms of sensitive receptors around the M25 Junction 25, there are residential properties to the south east, the Capel Manor horticultural college to the south west, hotel to the north east and agricultural land to the north west. There are residential properties on either side of

²⁹ HA207/07 DMRB Volume 11 Section 3 Part 1, May 2007 Paragraph C3.1 <http://www.standardsforhighways.co.uk/dmrb/>

the M25 carriageway and Holmesdale tunnel east of Junction 25 in Waltham Cross, Bullsmoor, and Waltham Abbey. Lee Valley High School and Hurst Drive Primary School are both within 200 metres of the M25 to the east of Junction 25.

There are a few isolated residential properties within 200 metres of the M25 to the west of Junction 25, and also within 200 metres of the A10 to the north of Junction 25.

To the south of Junction 25, the A10 extends through the residential area of Bullsmoor, with Honilands Primary School, Capel Manor Primary School and St Ignatius College all within 200 metres.

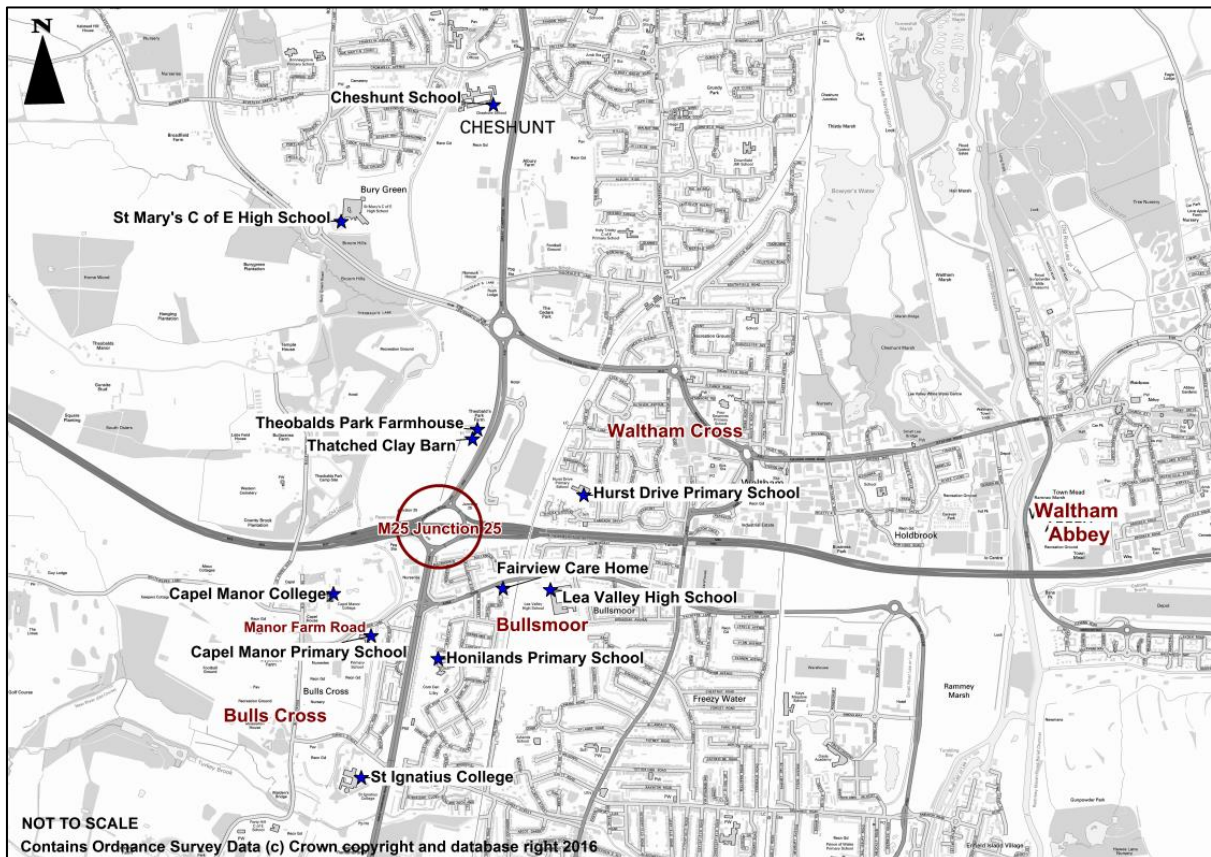
A number of receptors are located on the A1055 Bullsmoor Lane west of the A10 including residential properties and the Capel Manor Primary School.

In addition, designated ecological sites may contain features that are sensitive to air pollutants, whereby vegetation may be adversely affected by elevated pollutant concentrations. DMRB HA207/07 requires assessment of air quality effects on ecological designations (SACs, SPAs, SSSIs and Ramsar sites) within 200 metres of any road affected by the proposed scheme options. There are no statutory ecological designations identified within 200 metres of roads expected to be affected by any of the proposed scheme options at this stage.

Table 9-1 Sensitive receptors in the vicinity of the scheme and ARN

Affected Road	Sensitive human health receptors
M25 east of Junction 25	Residential properties at the southern end of Waltham Cross to the north of the M25 and in Bullsmoor south of the M25. Hurst Drive Primary School, Lea Valley High School. Residential properties in Waltham Abbey.
M25 west of Junction 25	Capel Manor College, isolated residential properties.
A10 Great Cambridge Road north of M25 Junction 25	Isolated residential properties. Cheshunt School.
A10 south of M25 Junction 25	Residential properties in the west of Bullsmoor. St Ignatius College. Honilands Primary School
A1055 Bullsmoor Lane west of A10/ Bull's Cross	Residential properties on Manor Farm Road and Bull's Cross. Capel Manor College. Capel Manor Primary School.
A1055 Bullsmoor Lane east of A10 (affected road with options 2 and 3)	Residential properties in Bullsmoor. Lea Valley High School. Fairview Care Home.
Great Eastern Road (affected road with options 2 and 3)	Theobalds Park Farmhouse and Thatched Clay Barn.
B198 Lieutenant Ellis Way between the A10 roundabout and St Mary's High School roundabout (affected road with options 2 and 3)	Residential properties on Theobalds Lane. St Mary's Church of England High School.

Figure 9-2 Sensitive receptors in the vicinity of the scheme and ARN



9.4 Baseline conditions

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

- Air Quality Management Area (AQMA) mapping³⁰
- Department for Environment, Food and Rural Affairs (DEFRA) Pollution Climate Model (PCM) GIS data for the latest available year (2014)³¹
- Local Authority Local Air Quality Management (LAQM) Reports^{32,33,34}
- Local authority monitoring data
- Highways England project specific NO₂ diffusion tube survey data^{35,36}
- DEFRA Automatic Urban and Rural Network (AURN) continuous monitoring data³⁷
- Ordnance Survey base mapping to identify locations of sensitive receptors (residential properties, schools, hospitals and elderly care homes)³⁸
- DEFRA MAGIC website³⁹ to identify boundaries of designated ecological sites

9.4.1 Air Pollutants

Vehicle exhausts contain a number of pollutants including oxides of nitrogen (NO_x), carbon monoxide (CO), hydrocarbons, carbon dioxide (CO₂) and particles. The quantities of each

³⁰ <http://uk-air.defra.gov.uk/agma/maps>

³¹ <http://uk-air.defra.gov.uk/data/gis-mapping>

³² Broxbourne Borough Council (2015) 2015 Updating and Screening Assessment for Broxbourne Borough Council.

³³ London Borough of Enfield (2016) London Borough of Enfield Air Quality Annual Status Report for 2015.

³⁴ London Borough of Enfield (2015) 2015 Air Quality Updating and Screening Assessment for London Borough of Enfield

³⁵ Atkins (2015) M25 DBFO Air Quality Monitoring (Quarter 4): Connect Plus Services.

³⁶ Atkins (2016) M25 DBFO Air Quality Monitoring 2014 – 2015 Annual Report: Connect Plus Services.

³⁷ <https://uk-air.defra.gov.uk/data>

³⁸ <https://www.ordnancesurvey.co.uk/business-and-government/products/opendata-products.html>

³⁹ <http://magic.defra.gov.uk/>

pollutant emitted depend on the type and quantity of fuel used, engine size, speed of vehicle and abatement equipment fitted. Once emitted, the pollutants disperse and subsequently are diluted in the ambient air. Pollutant concentrations in the air can be measured or modelled and then compared with ambient air quality criteria (discussed below).

The air pollutants of concern in the context of the air quality study for the M25 Junction 25 are nitrogen dioxide and particulate matter. 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 of vehicle emissions associated with the proposed scheme options.

National assessments have demonstrated that there is no risk of exceedance of the air quality objectives set for 1,3-butadiene, benzene or carbon. These pollutants are therefore not considered further as there is not considered to be a potential for significant effects associated with these pollutants.

9.4.1.1 Nitrogen Dioxide

Nitrogen dioxide (NO₂) is a secondary pollutant produced by the oxidation of nitric oxide (NO). NO and NO₂ are collectively termed nitrogen oxides (NO_x). Almost a third of the UK NO_x emissions are from road transport⁴⁰. The majority of NO_x emitted from vehicles is in the form of NO, which oxidises rapidly in the presence of ozone (O₃) to form NO₂. In high concentrations, NO₂ can affect the respiratory system 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. 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.

9.4.1.2 Particulate Matter

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 PM10 emissions in the UK are derived from road transport⁴¹. 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.

9.4.2 Local Air Quality Management

The physical area of each scheme option lies within the boundaries of the London Borough of Enfield (LBE) and Broxbourne Borough Council (BBC). The ARN at PCF Stage 1 further extends into the local authority area of Epping Forest District Council (EFDC) further east of Junction 25.

A summary of local air quality conditions in each of these local authority areas is provided below, providing context in proximity to Junction 25 and the wider area.

The whole of the LBE has been declared an AQMA due to exceedances of both the annual mean AQS objective for NO₂ and the 24-hour mean AQS objective for PM10. This AQMA encompasses M25 Junction 25.

BBC has declared five AQMAs, three of which are located along the M25 corridor. Broxbourne AQMA No. 1 is 970 metres to the east at the eastern limit of Holmesdale Tunnel and was declared for exceedances of the NO₂ 1-hour mean AQS objective and the PM10 24-hour mean AQS objective. AQMA No. 2 is located at the western end of Holmesdale Tunnel and was declared for exceedances of the annual mean NO₂ AQS objective. AQMA No.3 Tile Kiln Cottage on Burnt Farm Ride is located adjacent to the M25 more than 3

⁴⁰ NAEI (2015). Pollutant Information: Nitrogen oxides (NO_x, expressed as NO₂). Retrieved from National Atmospheric Emissions Inventory: http://naei.defra.gov.uk/overview/pollutants?pollutant_id=PMFINE

⁴¹ NAEI (2015) Pollutant Information: PM_{2.5}, PM₁₀ and PM_{0.1} (Finer Particulates). Retrieved from National Atmospheric Emissions Inventory: http://naei.defra.gov.uk/overview/pollutants?pollutant_id=PMFINE

kilometres west of Junction 25, and was declared for exceedances of the NO₂ annual mean AQS objective.

In addition the Monarchs Way/Winston Churchill Way AQMA, and AQMA No.4 Eleanor Cross Road/Monarchs Way, are both located approximately 1 kilometre to the north east of the M25 Junction 25 and both AQMAs were declared for exceedances of the annual mean AQS objective for NO₂.

The sole AQMA (Bell Vue Cottage) declared for exceedances of both the 1-hour and annual mean NO₂ AQS objectives within the administrative area of EFDC is located approximately 10 kilometres to the east of the air quality study area and therefore is highly unlikely to be affected by the scheme.

The AQMAs in the vicinity of the scheme and ARN, are described below in Table 9-2 and shown on Figure 9.1 in Appendix G to the ESR.

Table 9-2 AQMAs near to the scheme

Local Authority	Name	Air Quality Criteria Exceeded	Description
London Borough of Enfield	Enfield AQMA	NO ₂ annual mean PM ₁₀ 24 hour mean	An area encompassing the entire Borough of Enfield.
Broxbourne Council	AQMA No.1	NO ₂ 1 hour mean PM ₁₀ 24 hour mean	A number of residential properties close to the M25, including Arlington Crescent, Parkside and Nos. 13 – 21 High Street, Waltham Cross.
Broxbourne Council	AQMA No.2	NO ₂ annual mean	Properties Nos. 33 – 55 Teresa Gardens, Waltham Cross.
Broxbourne Council	AQMA No.3	NO ₂ annual mean	An area incorporating Tile Kiln Cottage on Burntfarm Ride, just north of the M25
Broxbourne Council	AQMA No.4	NO ₂ annual mean	Eleanor Cross Road / Monarchs Way roundabout.
Broxbourne Council	Monarchs Way / Winston Churchill Way	NO ₂ annual mean	Monarchs Way / Winston Churchill Way roundabout.

9.4.3 DEFRA Mapping

9.4.3.1 Pollution Climate Mapping (PCM)

Further information on areas exceeding EU limit values is available from DEFRA's PCM model. This model provides estimates of roadside concentrations of pollutants, including annual mean NO₂ and PM₁₀, which are used in annual reporting to the EU regarding compliance with limit values. The modelled roadside concentration comprises a background component together with a roadside increment. Not all roads are included within the PCM model. The PCM model indicates that for the most recent year of available data (2014), of the roads that were included in the model there were exceedances of the NO₂ annual mean EU limit value of 40 µg/m³ within the air quality study area on A1055 Bullsmoor Lane east of the A10 and on the A10 south of Junction 25. However there were no exceedances of the annual mean PM₁₀ EU limit value.

DEFRA PCM links and exceedances are illustrated on Figure 9.1 in Appendix G to the ESR.

9.4.3.2 Background Mapping

Estimates of current and future year background pollutant concentrations in the UK are available on the DEFRA UK-Air website. 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.

Estimated annual mean background concentrations for the grid squares covering the M25 Junction 25 air quality study area for the current year (2016) are presented below in Table 9-3 for the pollutants NO₂ and PM10.

Background concentrations of NO₂ and PM10 were expected to be below relevant air quality criteria in 2016. This indicates that concentrations at background locations in the vicinity of the proposed scheme and associated ARN are likely to currently meet relevant air quality criteria for these pollutants.

Table 9-3 DEFRA Background Air Quality Mapping Pollutant concentrations for 2016 (µg/m³)

Grid Square x,y	NO ₂	PM10
538500, 199500	22.42	18.83
531500, 200500	20.30	17.98
532500, 200500	22.15	19.05
533500, 199500	16.02	16.29
534500, 199500	21.06	18.08
535500, 199500	20.01	17.74
536500, 199500	22.91	18.85
537500, 199500	23.04	18.45
534500, 198500	19.20	17.29
534500, 201500	16.43	16.37
535500, 201500	18.55	17.17
533500, 200500	21.09	18.27
534500, 200500	19.63	17.88
535500, 200500	23.72	18.72
536500, 200500	21.04	18.14
Average	20.51	17.94

9.4.4 Air Quality Monitoring

9.4.4.1 Highways England Monitoring

Connect Plus measure NO₂ concentrations using diffusion tubes at a number of sites around the M25 on behalf of Highways England. The survey started in September 2013 and has continued for a further two years. Two of the sites are located in close proximity to the scheme as shown in Figure 9.1 in Appendix G to the ESR. The annual mean NO₂ concentrations for these monitoring sites between September 2013 and 2015 are presented in Table 9-4. The results show that during both monitoring periods there were exceedances of the NO₂ annual mean air quality criterion at site CP41. Site CP41 is located immediately south east of M25 Junction 25. Site CP13 is located approximately 3 km east of Junction 25, within 200 metres of the M25.

Table 9-4 Connect Plus monitoring results ($\mu\text{g}/\text{m}^3$)^{42,43}

Location	Bias Adjusted Annual Mean	
	Sept 2013 – Sept 2014	Sept 2014 – Sept 2015
CP13	36.4	35.7
CP41	50.6	59.0
Note : data in bold represents exceedance of the air quality criterion of $40 \mu\text{g}/\text{m}^3$		

Highways England has also conducted a diffusion tube survey for the purposes of informing the M25 Junction 25 Improvement scheme. The survey consists of 28 diffusion tubes 14 of which are located within the air quality study area as shown in Figure 9-3. The results are provided in Table 9-5.

The six month unadjusted NO_2 concentrations were annualised for 2015 using a factor of 0.97 following analysis of data from three background continuous monitoring stations within 50 miles of the scheme (Enfield Prince of Wales School, Haringey Priory Park South and Harrow Stanmore) in accordance with LAQM.TG(16). The annualised mean results were then adjusted using a factor of 0.85 derived from DEFRA's bias adjustment spreadsheet for diffusion tubes prepared by Staffordshire Scientific Services using 20% TEA in water. The results show that the NO_2 annual mean AQS objective of $40 \mu\text{g}/\text{m}^3$ was exceeded at nine sites, with the majority of exceedances recorded within the air quality study area, particularly along the A10 Great Cambridge Road.

Table 9-5 Highways England NO_2 concentrations ($\mu\text{g}/\text{m}^3$)

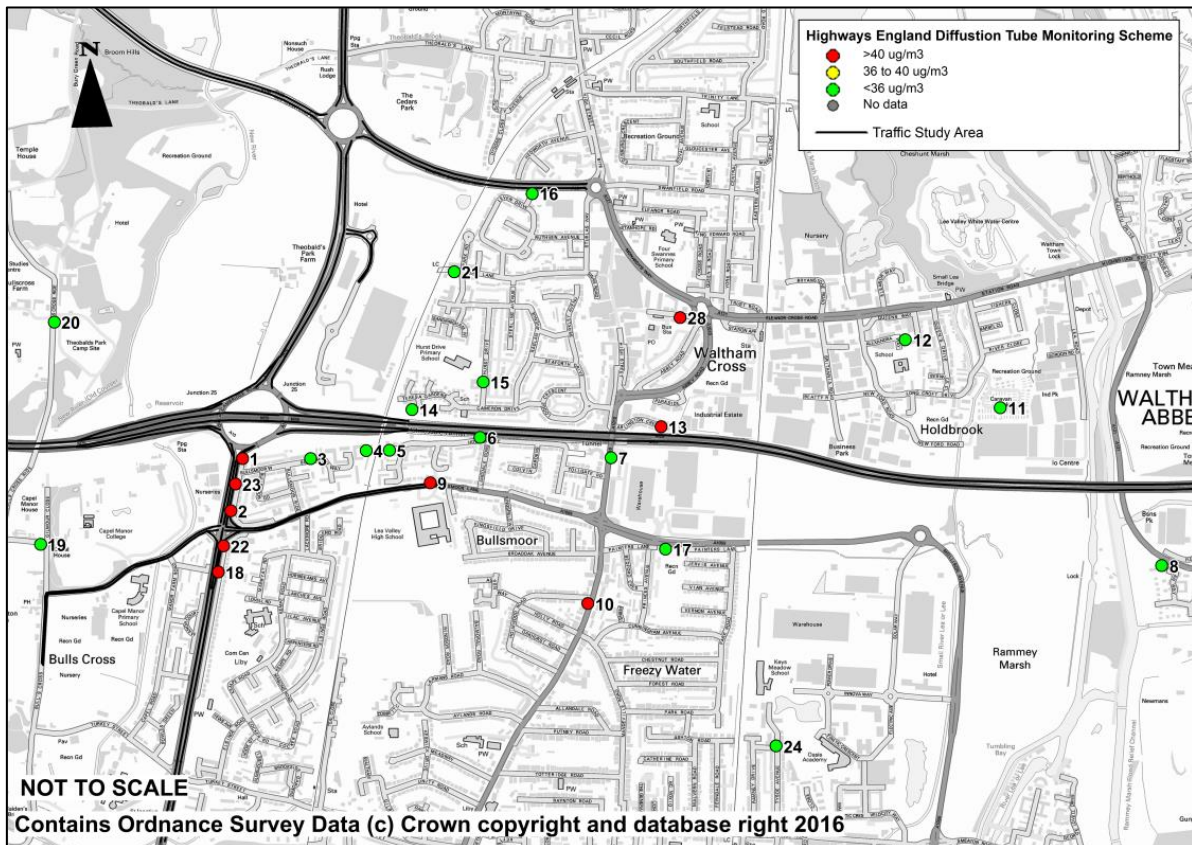
Grid Ref	Location	Site Type	2016 six month unadjusted mean	2015 annualised mean	2015 adjusted mean
534905, 199938	Great Cambridge Rd	Roadside	57.6	55.7	47.4
534869, 199776	Great Cambridge Rd	Roadside	77.6	75.1	63.9
535116, 199938	Bullsmoor Way	Roadside	40.9	39.6	33.7
535289, 199963	Bullsmoor Way	Roadside	40.5	39.2	33.3
535361, 199968	Holmesdale	Roadside	38.6	37.4	31.8
535642, 200004	Holmesdale	Roadside	29.9	28.9	24.6
536049, 199941	High Street	Roadside	42.2	40.8	34.7
537758, 199606	Roman Way	Roadside	30.8	29.8	25.4
535488, 199863	Bullsmoor Lane	Roadside	49.2	47.6	40.5
535977, 199488	Hertford Road	Roadside	48.9	47.4	40.3
537257, 200096	Fowley Mead Park	Roadside	31.2	30.2	25.7
536962, 200307	Alexandra Way	Roadside	29.2	28.2	24.0

⁴² Atkins: M25 DBFO: Air Quality Monitoring (Quarter 4). February 2015

⁴³ Atkins: M25 DBFO: Air Quality Monitoring, 2014-2015 Annual Report (draft). February 2016

Grid Ref	Location	Site Type	2016 six month unadjusted mean	2015 annualised mean	2015 adjusted mean
536204, 200037	Arlington Crescent	Roadside	51.1	49.4	42.0
535431, 200090	Teresa Gardens	Roadside	33.7	32.6	27.7
535652, 200176	Hurst Drive	Roadside	30.5	29.5	25.1
535804, 200761	Leven Close	Roadside	32.5	31.5	26.8
536218, 199657	Painters Lane	Roadside	34.8	33.6	28.6
534830, 199586	Great Cambridge Road	Roadside	76.9	74.4	63.3
534278, 199672	Whitewebbs Lane	Roadside	30.5	29.6	25.1
534321, 200362	Bulls Cross Ride	Roadside	26.3	25.4	21.6
535562, 200518	Park Lane	Roadside	29.1	28.2	23.9
534846, 199667	Great Cambridge Road	Roadside	78.3	75.8	64.5
534883, 199859	Great Cambridge Road	Roadside	81.1	78.6	66.8
536561, 199046	Tysoe Avenue	Roadside	29.3	28.4	24.1
535809, 197420	Westmoor Gardens	Background	26.2	25.4	21.6
536263, 200376	Eleanor Cross Road co-location	Roadside	51.8	50.1	43.4
Exceedances of annual mean NO ₂ UK AQS objective are highlighted in bold .					

Figure 9-3 Highways England Diffusion Tube Survey



9.4.4.2 Local Authority Monitoring

LBE, BBC and EFDC also undertake monitoring in the vicinity of M25 Junction 25 and the air quality study area.

9.4.4.3 Continuous Monitoring

Neither BBC nor EFDC operate any continuous monitoring stations. LBE operates four CMS, none of which is within the air quality study area. The nearest CMS to the study area is an urban background site located at Prince of Wales School, approximately 2.5 km to the south west of Junction 25 which monitors NO₂ concentrations. The annual mean NO₂ concentrations are presented in Table 9-6, and show that concentrations met the air quality criterion of 40 µg/m³ in all years. The 1-hour mean criterion was also met in all years. The monitoring site is shown on Figure 9.1 in Appendix G to the ESR, and is colour coded by the annual mean concentration measured during the base year 2014.

Table 9-6 Annual mean NO₂ concentrations at Prince of Wales CMS (µg/m³)

Site ID	Site Name	Local Authority	Grid Ref	Site Type	2011	2012	2013	2014
LBE_4	Prince of Wales School	London Borough of Enfield	536886, 198497	Urban background	n/a	31	27	25
n/a = data not available								

LBE also operate two CMS which monitor PM10 at roadside sites, although both of these sites are over 5 km away from Junction 25, and would not be representative of the study area. At both sites, both the annual mean and 24-hour mean criteria were met.

9.4.4.4 Passive Monitoring

Passive monitoring of NO₂ using diffusion tubes has been undertaken by the LBE, EFDC and BBC. Figure 9.1 in Appendix G presents an overview of the locations of monitoring sites within the locality of the air quality study area. The monitoring sites are colour coded by the concentration measured during the base year 2014.

Annual mean concentrations recorded at sites within the locality of the air quality study area are tabulated for the period of 2011 to 2014 inclusive in Table 9-7 below. Six diffusion tube sites operated by BBC (Bx_3, Bx_7 to Bx_15 and Bx_17) within the area surrounding the air quality study area consistently recorded exceedances of the annual mean NO₂ AQS objective for the period of 2011 to 2014 inclusive. These diffusion tube sites are located within AQMA's designated for exceedances of NO₂ AQS objectives. As such exceedances at these sites are not unexpected.

The two key areas and traffic corridors where exceedances of the annual mean air quality criterion for NO₂ were measured in 2014 include:

- Abbey Road, Waltham Cross
- The junction between the A121 Winston Churchill Way and the A121 Monarch's Way

Table 9-7 Annual Mean Nitrogen Dioxide Diffusion Tube Monitoring Results (µg/m³)

Site ID	Site Name	Local Authority	Grid Ref	Site Type	2011	2012	2013	2014
LBE_11	Enfield 7	London Borough of Enfield	535460, 199849	Roadside	35	31	38	32
Bx_3	BB05	Broxbourne BC	536200, 200000	M25	71	73	79	77
Bx_6	BB10	Broxbourne BC	535400, 200100	Background	34	40	32	38
Bx_7	BB11	Broxbourne BC	536100, 200100	Kerbside	78	78	75	73
Bx_10	BB17	Broxbourne BC	536190, 200100	Background	49	57	48	54
Bx_14	BB21	Broxbourne BC	536290, 200370	Kerbside	62	55	54	64
Bx_15	BB22	Broxbourne BC	536000, 200750	Kerbside	49	59	50	56
Bx_16	BB23	Broxbourne BC	536000, 200680	Background	39	37	45	45
Bx_17	BB24	Broxbourne BC	535990, 200800	Kerbside	58	55	66	63
E_20	20	Epping Forest DC	537808, 200644	Urban background co-location	33	32	32	28
E_21	21	Epping Forest DC	538570, 199509	Urban background co-location	29	28	31	27
E_22	22	Epping Forest DC	538386, 199557	Urban background co-location	30	32	34	31
E_23	23	Epping Forest DC	537956, 199565	Urban background co-location	30	32	33	29
E_24	24	Epping Forest DC	538710, 199860	Roadside triplicate	38	37	32	36
E_25	25	Epping Forest DC	538954, 199973	Urban background co-location	-	-	-	34

Exceedances of annual mean NO₂ UK AQS objective are highlighted in **bold**.

9.5 Regulatory / Policy framework

9.5.1 Air Quality Criteria

For the local air pollutants of concern (NO₂ and PM₁₀), there are two sets of ambient air quality criteria for the protection of public health, namely those set by the EU and transposed in to UK law by The Air Quality Standards Regulations 2010⁴⁴ and those implementing the UK National Air Quality Strategy (AQS)^{45,46,47}.

The criteria set out in the AQS include standards and objectives for local authorities to work towards achieving. These apply in locations with relevant public exposure which are defined in the DEFRA Technical Guidance LAQM.TG(16)⁴⁸. The standards set by the EU are legally binding, mandatory limit values (LV) requiring national Government compliance.

Local air quality criteria relevant to the air quality assessment for the scheme are summarised in Table 9-8.

Table 9-8 Relevant Air Quality Criteria (Human Health)

Pollutant	Criteria
NO ₂	Hourly average 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 concentrations should not exceed 40 µg/m ³

9.5.1.1 National Planning Policy

The National Planning Policy Framework (NPPF) 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: "*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.*"

9.5.1.2 Highways England Air Quality Policy

The National Networks National Policy Statement (NN NPS), prepared by the Department for Transport (DfT), provides policy and guidance relating to the development of nationally significant infrastructure projects. 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 5.9 of the NN NPS). Paragraph 5.11 of the NN NPS states "*Air quality considerations are likely to be particularly relevant where schemes are proposed: within or adjacent to Air Quality Management Areas (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.*"

Furthermore, paragraph 5.13 of the NN NPS, states "*The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the scheme will: result in a zone/agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant; or affect the ability of a non-compliant area to*

⁴⁴ The Air Quality Standards Regulations 2010: <http://www.legislation.gov.uk/ukxi/2010/1001/contents/made>

⁴⁵ The Air Quality (England) Regulations 2000: <http://www.legislation.gov.uk/ukxi/2000/928/contents/made>

⁴⁶ The Air Quality (England) (Amendment) Regulations 2002: <http://www.legislation.gov.uk/ukxi/2002/3043/contents/made>

⁴⁷ <https://www.gov.uk/government/publications/the-air-quality-strategy-for-england-scotland-wales-and-northern-ireland-volume-47>

⁴⁸ DEFRA (2016) Local Air Quality Management Technical Guidance (TG16) <http://laqm.defra.gov.uk/technical-guidance/>

achieve compliance with the most recent timescales reported to the European Commission at the time of the decision.”

The DfT Road Investment Strategy (RIS) published in 2015 sets out the DfT’s aspirations for the Strategic Road Network 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”*.

The Highways England Delivery Plan 2015-2020 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”*. Key Performance Indicators (KPIs) and Performance Indicators (PI) are also identified including the following PI performance specification in relation to air quality: *“Suite of PIs to provide additional information about environmental performance*. These should, at a minimum, include: - Air Quality”. The Delivery Plan includes a commitment to develop a PI for vehicle derived emissions of carbon dioxide, and other greenhouse gases arising from the use of the Strategic Road Network by March 2016.

9.5.1.3 Local Planning Policy

Within the Enfield Plan Core Strategy 2010 - 2025⁴⁹, as part of LBE’s Local Development Framework, Core Policy 32 states that *“the Council will work with its partners to minimise air [pollution].”* In addition, new developments will be required to: *“improve air quality by reducing pollutant emissions and public exposure to pollution, particularly in areas identified as having poor air quality in the Air Quality Action Plan.”*

The LBE Air Quality Action Plan⁵⁰ outlines the Council’s commitment to improving air quality in the borough through monitoring and the provision of information to the public through the London Air Quality Network. Within the AQAP road transport is identified as the principal source of NO_x and PM₁₀. The aims of Enfield’s Transport Strategy include encouraging the use of sustainable transport, improving bus links, and smoothing traffic flows to reduce congestion and the impacts of climate change. Options to reduce emissions include: using vehicle/ fuel technology; reducing the demand for travel or achieving better travel choices; and optimisation of traffic movement through the AQMA.

Broxbourne Borough Council’s Local Plan Second Review 2001 - 2011⁵¹ sets out the framework for guiding and controlling development within the Broxbourne Borough. Sustainability Policy 6 (SUS6 Air Quality) states: *“In considering proposals for development, the borough council will have regard to its impact on air quality...Development that would lead to national air quality guidelines being exceeded would not be permitted.”* In addition, Sustainability Policy 7 (SUS7) states: *“The Council, in determining planning applications for development within Air Quality Management Areas, will have regard to the local Air Quality Action Plan.”*

Broxbourne’s new Local Plan⁵² which is expected to be adopted in 2017 and will replace the existing one is currently out for consultation. Policy EQ1 states *“I. Applicants should consider the impact of their proposals on air quality. Where necessary they should provide details of how adverse effects on air quality have been mitigated in order to comply with EU limit values... III. Proposals which will result in a reduction in air quality will need to offer measures to mitigate this effect. IV. If the proposal exceeds EU limit values or national policy objectives for pollutants, particularly in Air Quality Management Areas...it will be refused.”*

⁴⁹ <https://new.enfield.gov.uk/services/planning/planning-policy/local-plan/planning-policy-information-enfield-core-strategy.pdf>

⁵⁰ <https://new.enfield.gov.uk/services/environment/environmental-issues/pollution/>

⁵¹ Broxbourne Borough Council (2005) Local Plan Second Review 2001 – 2011

https://www.broxbourne.gov.uk/sites/default/files/documents/Planning_Policy/pp_2013-12-17-Full_Adopted_Local_plan-2001-2011.pdf

⁵² <http://consult.broxbourne.gov.uk/portal/planning/dlp/dlpc?pointId=s1461748613853#section-s1461748613853>

The Broxbourne Borough Council Air Quality Action Plan (AQAP)⁵³, published in 2004, considers options for improving air quality in the borough. The AQAP recognises the significant contribution of traffic on the M25 to elevated levels of nitrogen dioxide in its AQMAs and its own impotence as the M25 is under the regulation of Highways England. According to the AQAP, Broxbourne BC will liaise with Highways England and Hertfordshire County Council:

- to ensure that air quality in the Borough is a consideration in the Environmental Impact Assessment for all relevant M25 projects
- to ensure that local objectives are considered in the next local transport plan
- to take into account a development's impact on air quality when considering planning applications, especially when it could impact upon the AQMA
- the Council will investigate the development of a sustainable travel plan

The council has also committed to providing information to encourage greener vehicle fleets and to generally raise the profile of air quality as an issue.

Epping Forest District Council's existing Local Plan (Combined Policies of Epping Forest District Local Plan (1998) and Alterations (2006)⁵⁴) was adopted in 2008. Policy RP5A states that *"The Council will not grant planning permission for: (i) development where it could cause excessive noise, vibration, or air...pollution for neighbouring land uses, protected wildlife species and habitats; or (ii) sensitive development...which could be subject to...forms of adverse environmental conditions such as air pollution."* Epping Forest is in the process of preparing a new Local Plan which is expected to be adopted in 2018 whereupon it will replace the existing document.

9.6 Design, mitigation and enhancement measures

9.6.1 Construction

Construction impacts will be assessed and mitigation measures proposed at a later PCF stage, where relevant, in line with a proportional assessment.

9.6.2 Operation

The main route for mitigation is to influence the scheme option design to reduce potential impacts on air quality once a scheme is complete. This could include such measures as realignment of roads away from receptors, and maximising the benefits of free-flow traffic conditions to reduce vehicle emissions near receptors.

The need for and the effectiveness of any design suggestions would be investigated with further air quality modelling at PCF Stage 2 if required.

Mitigation measures during operation will also be considered at PCF Stage 2.

9.7 Potential significant effects

The proposed scheme options have 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 preferred scheme route option 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) as a result of the scheme options

⁵³ Broxbourne Borough Council (2004) Air Quality Action Plan https://uk-air.defra.gov.uk/assets/documents/no2ten/Local_zone29_Broxbourne_AQActionplan_1.pdf

⁵⁴ Epping Forest District Council (2008) Combined Policies of Epping Forest District Local Plan (1998) and Alterations (2006) Epping Forest District Council: Essex

- Operationally, air quality could also be affected by any changes to the distance between sources of emissions and air quality sensitive receptors.

9.7.1 Construction

Demolition and construction activities can give rise to dust emissions under particular circumstances, if not effectively managed. Construction of any of the proposed scheme options 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 (HGV) onto the local road network. Implementation of best practice mitigation measures will generally control construction dust and minimise any short term adverse effects.

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).

9.7.2 Operation

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 emissions sources and air quality sensitive receptors as a result of the change to road alignment for the operational scheme.

Three proposed Option Variants (1, 2 and 3) have been considered for the PCF Stage 1 air quality study. In all options, road links immediately around the junction meet specified ARN criteria for either increased or reduced traffic volume. These are described for each option in turn below.

9.7.2.1 Option 1

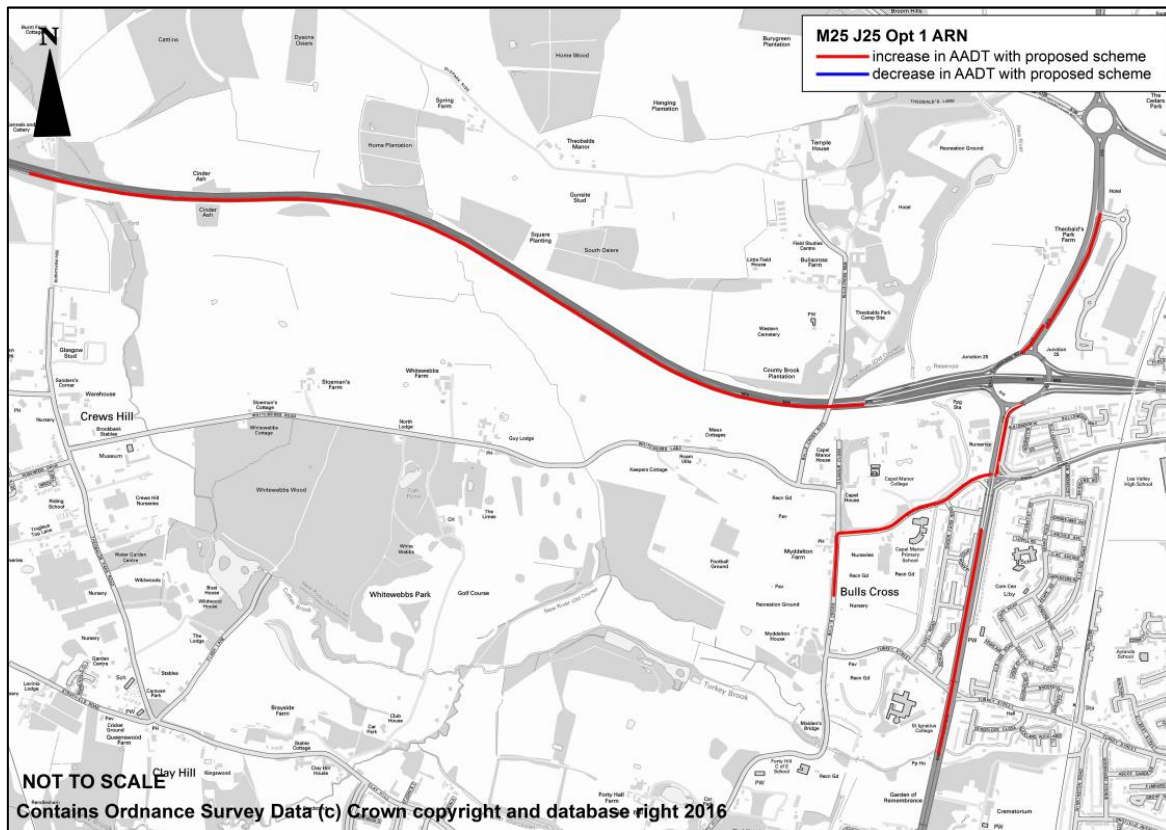
With Option 1 the proposed works are mostly within the inner boundaries of the junction itself. Widening of the M25 Junction 25 roundabout circulatory carriageway would be achieved by narrowing the existing verge at the inside of the roundabout as described in Chapter 3. Widening of the entry to the junction from the southbound A10 within the existing highway boundary is not expected to affect any sensitive receptors.

The affected roads within the study area for Option 1 are shown below in Figure 9-4. Affected roads are expected to experience an increase in AADT with the proposed scheme. Any road links that are not shown in red do not meet the AADT traffic change criteria. There is not expected to be a reduction in distance between the road and nearby residential properties to the south east of M25 Junction 25. As shown in Figure 9-4 there is expected to be an increase in AADT with the proposed scheme on the following roads:

- M25 west of J25
- A10 north of J25 including the A10 northbound off slip
- A10 south of J25 including the A10 southbound off slip
- A1055 Bullsmoor Lane west of the A10 south
- Bulls Cross south of Bullsmoor Lane

Receptors near these roads could potentially be affected by an increase in pollutant concentrations, including those within the Enfield AQMA and Broxbourne AQMA No. 3. However, the DEFRA PCM mapping showed that roadside concentrations at all links included within the model around Junction 25 are expected to be compliant with the NO₂ annual mean EU limit value by 2020.

Figure 9-4 M25 J25 Opt 1 AADT Affected Road Network



9.7.2.2 Option 2

Option 2 consists of the proposals for Option 1 with the addition of a segregated left turn lane from the eastbound slip road onto the A10 north of J25 and widening of the eastbound and westbound slip roads at J25. Receptors on Bullsmoor Way which are close to these slip roads could potentially have an increase in pollutant concentrations as a result of the reduction in distance. However, the reduction in congestion could lead to a reduction in emissions, potentially offsetting any increase in pollutant concentrations.

The affected routes within the study area for Option 2 are shown below Figure 9-5 including proposed scheme links. Figure 9-5 shows that there is expected to be an increase in AADT with the proposed scheme on the following roads:

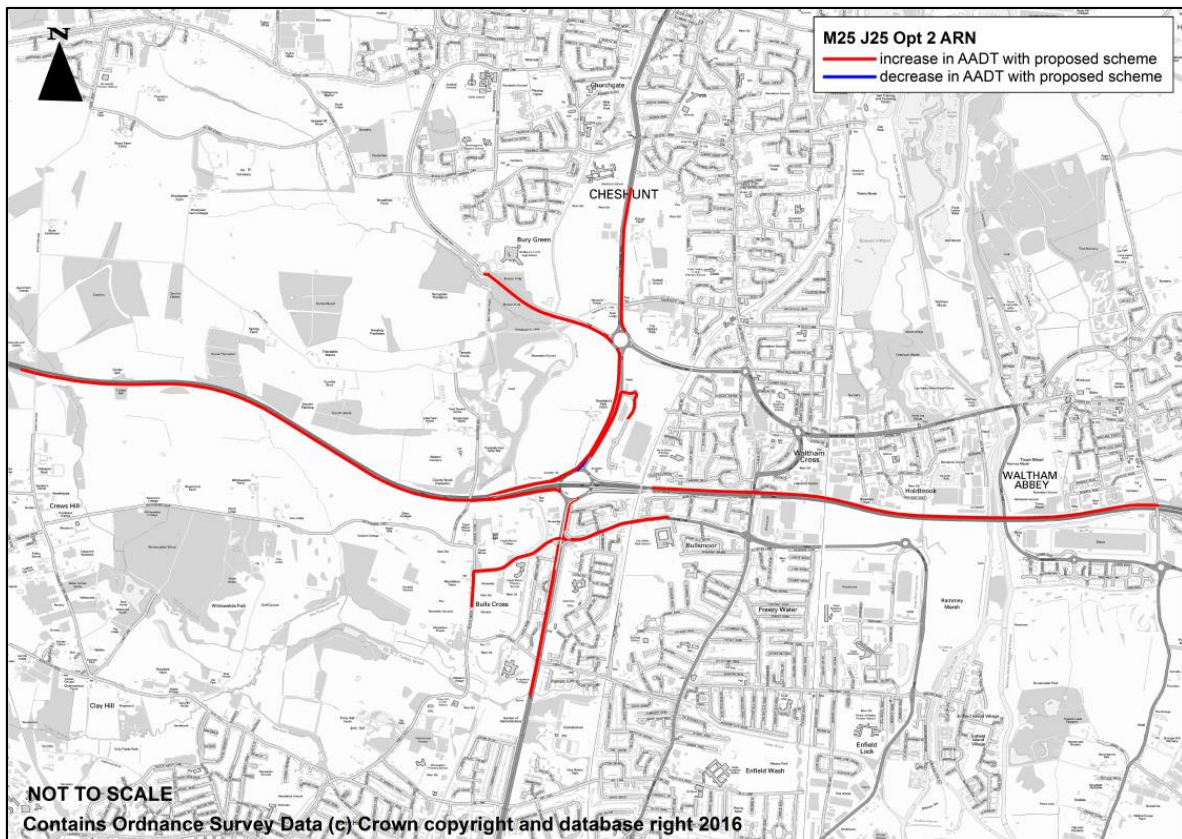
- M25 west of J25 including the westbound off slip links
- M25 westbound on slip
- M25 east of J25
- A10 south of J25
- A10 southbound off slip
- Bullsmoor Close east and west of the A10 south
- Bulls Cross south of Bullsmoor Close
- A10 north of J25
- A10 northbound off slip
- B198 Lieutenant Ellis Way between St Mary's High School roundabout and the B198 / A121 / A10 roundabout

It is expected that Option 2 could cause a potential increase in pollutant concentrations at receptors close to these roads due to the expected increases in AADT with the scheme, including those within the Enfield AQMA and Broxbourne AQMA Nos. 1, 2 and 3.

It should be noted that the A10 northbound off slip is expected to have a decrease in AADT, as illustrated by the blue link in Figure 9-5, however there are few if any properties within 200 metres of this road link which could be affected.

The DEFRA PCM mapping showed that roadside concentrations at all links included within the model around Junction 25 are expected to be compliant with the NO₂ annual mean EU limit value by 2020.

Figure 9-5 M25 J25 Opt 2 AADT Affected Road Network



9.7.2.3 Option 3

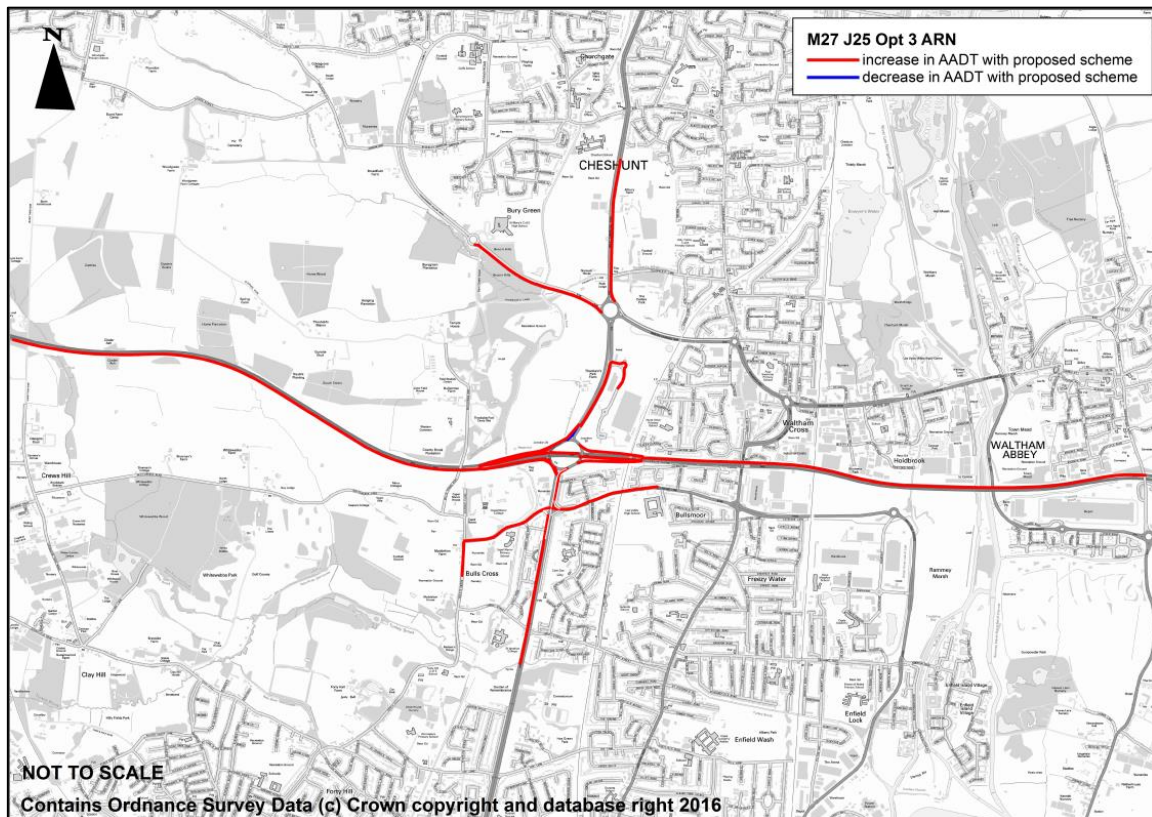
In addition to the proposals outlined in Options 1 and 2, Option 3 includes further proposals for widening of the A10 southbound between Junction 25 and Bullsmoor Lane. This in conjunction with widening of the M25 Junction 25 westbound off-slip will provide a dedicated left turn lane. The affected roads for Option 3 are described below. Figure 9-6 shows that there is expected to be an increase in AADT with the proposed scheme on the following roads:

- M25 east and west of J25
- M25 east and westbound on and off-slips
- A10 north and south of J25
- A10 southbound on slip and off-slip
- Bullsmoor Close east and west of the A10 south
- Bulls Cross south of Bullsmoor Close
- B198 Lieutenant Ellis Way between St Mary's High School roundabout and the B198 / A121 / A10 roundabout

Similarly to Option 2, the A10 northbound off-slip is expected to have a decrease in AADT as illustrated by the blue link in Figure 9-6 below, however, there are few if any properties within 200 metres of this road link which could be affected. Receptors within Enfield AQMA and Broxbourne AQMA Nos. 1, 2 and 3 could potentially be adversely affected by any increase in

pollutant concentrations. However the DEFRA PCM mapping showed that roadside concentrations at all links included within the model around Junction 25 are expected to be compliant with the NO₂ annual mean EU limit value by 2020.

Figure 9-6 M25 J25 Opt 3 AADT Affected Road Network



9.8 Limitations to assessment

The ARN for PCF Stage 1 is based on the current version of the VISSIM traffic model which is limited to the traffic study area and not the entire traffic model network. Requirements for further, detailed quantitative modelling of pollutant concentrations from which significance of effects may be determined will be reviewed at PCF Stage 2. In addition, at PCF Stage 2 the need to consider vehicle speed changes within the ARN will be reviewed.

Assessment in accordance with relevant Highway England Interim Advice Notes (IAN) has not been completed in this PCF Stage 1 assessment as quantitative assessment of air quality has not been undertaken.

9.9 Summary and Recommendations

The scheme is located within the boundaries of the London Borough of Enfield (LBE) and Broxbourne Borough Council (BBC) although the ARN extends into the boundaries of Epping Forest District Council (EFDC). At this stage there are four AQMAs within the air quality study area: the whole of LBE has been declared for exceeding both the annual mean NO₂ AQS objective and the 24-hour mean PM₁₀ AQS objective; Broxbourne AQMA No. 1 for exceeding both the NO₂ 1-hour mean AQS objective and the PM₁₀ 24-hour mean AQS objective; Broxbourne AQMA No. 2 for exceeding the annual mean NO₂ AQS objective; and Broxbourne AQMA No.3 for exceeding the NO₂ annual mean AQS objective. All four AQMAs could be affected by all three options as they are within 200 metres of the scheme or ARN.

Defra PCM mapping shows that for 2014, of the roads that were included in the model there were exceedances of the NO₂ annual mean EU limit value of 40 µg/m³ within the air quality

study area on A1055 Bullsmoor Lane east of the A10 and on the A10 south of Junction 25. However there were no exceedances of the annual mean PM₁₀ EU limit value.

The traffic model for the opening year has shown that there are likely to be a number of roads affected with each option. In all cases the following roads are expected to have an increase in traffic, indicating a potential increase in pollutant concentrations at nearby receptors: M25 west of J25; A10 south and north of J25; A1055 Bullsmoor Lane west of the A10 south; Bulls Cross south of Bullsmoor Lane. In addition with options 2 and 3 the M25 east of J25, A1055 Bullsmoor Close east of the A10, and the B198 Lieutenant Ellis Way between St Mary's High School roundabout and the B198 / A121 / A10 roundabout are expected to have an increase in traffic.

With Options 2 and 3 the A10 northbound off-slip is expected to have a decrease in traffic, with a potential decrease in pollutant concentrations at any nearby receptors.

At this stage, all three options are considered to pose a risk of a potentially significantly adverse effect at nearby receptors, particularly those within the Enfield and Broxbourne AQMAs. Options 2 and 3 are likely to affect traffic flows over a wider area than option 1, thus potentially adversely affecting a larger number of receptors. However given that the DEFRA PCM mapping for 2020 showed that roadside concentrations at all links included within the model around Junction 25 are expected to be compliant with the NO₂ annual mean EU limit value, there may be less risk of pollutant concentrations at nearby receptors exceeding criteria.

It is recommended that a simple air quality assessment at PCF Stage 2 is undertaken which should include calculation of air pollutant concentrations at representative receptors for the scheme opening year using the DMRB screening tool to allow the potential significant effects to be determined for each option.

10 Noise and vibration

10.1 Introduction

This chapter provides an indication of the potential noise and vibration impacts resulting from of the three potential options for the improvement of J25 of the M25. The options are described in full in Chapter 3. Traffic data has been supplied for all three options, and this data has been used to undertaken basic noise level calculations and predict the likely noise impact from each of the options.

10.2 Assessment methodology

10.2.1 Construction

As baseline noise monitoring will be undertaken at a future design stage (PCF stage 3), a full construction noise assessment using BS5228-1:2009+A1:2014⁵⁵ will be deferred until baseline noise monitoring data is available.

The significance criteria for construction noise will be confirmed at a future design stage as the significance criteria used in BS5228-1:2009+A1:2014 are set depending on the ambient noise levels measured at noise sensitive receptors in proximity to the proposed construction works.

The assessment at this design phase will be qualitative. The construction assessment will identify those activities which have the highest potential to cause disturbance at nearby noise sensitive receptors.

10.2.2 Operation

Noise impacts arising from the design options for the Proposed Scheme have been assessed in accordance with the guidance provided in DMRB 11:3:7.

DMRB 11:3:7 presents the threshold criteria that could trigger a detailed traffic noise assessment if the criteria are likely to be met or exceeded, which are:

- A change in daytime traffic noise impacts in the short term (opening year) of 1 dB $L_{A10,18h}$. This can be caused by traffic flow increases of 25% or decreases of 20%, provided that the traffic speed and composition remains constant, or where there is a new or altered road alignment
- A change in daytime traffic noise impacts in the long term (typically 15 years after the project opening) of 3 dB $L_{A10,18h}$. A change of 3 dB $L_{A10,18h}$ is equivalent to doubling or halving the traffic flow, provided that the speed and proportion of heavy vehicles remains constant, or where there is a new or altered road alignment
- A change in night-time traffic noise impacts of 3 dB $L_{night,outside}$ in the long term where $L_{night,outside}$ is predicted to be greater than 55 dB $L_{night,outside}$ in any scenario

The short term and long term impact magnitude criteria from DMRB 11:3:7 are reproduced below.

Table 10-1 Classification of magnitude of noise impacts in the short term and the long term

Short Term Noise Change $L_{A10,18h}$	Long Term Noise Change $L_{A10,18h}$	Magnitude of Impact
0	0	No Change
0.1 – 0.9	0.1 – 2.9	Negligible
1.0 – 2.9	3.0 – 4.9	Minor

⁵⁵ BRITISH STANDARDS INSTITUTION (2014) BS5228:2009 + A1:2014 CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES, PART 1: NOISE. LONDON BSI.

3.0 – 4.9	5.0 – 9.9	Moderate
5+	10+	Major

It is important that an appropriate and proportionate approach is taken throughout the design process of the Proposed Scheme. At this design stage (PCF Stage 1), a basic quantitative noise assessment has been undertaken to identify areas that may exceed DMRB's threshold levels and trigger the need for a detailed assessment in a future design stage. This has been achieved using traffic data obtained through microsimulation of the M25 J25. Any baseline noise monitoring in the study area will be carried out at a future assessment stage.

The noise assessment has been completed by computing the Basic Noise Level (BNL) at 10m from the edge of the carriageway for each traffic link within the study area, using the calculation methodology presented in the Calculation of Road Traffic Noise⁵⁶ (CRTN). The Basic Noise Level is calculated using the following output from the traffic model for each road link:

- 18 hour (06:00 to 24:00) Annual Average Weekday Traffic Flows (AAWT)
- Traffic speed
- Percentage of Heavy Duty Vehicles (HDV) defined as all vehicles with an unladen weight greater than 3.5 tonnes
- The road surfacing of the traffic link
- The gradient of the road link

In the absence of better information at this stage, the road gradient and road surfacing corrections have been assumed to be zero.

No information is currently available about existing mitigation in the study area and therefore this has not been taken into account in the assessment at this stage.

It has not been possible to indicate the number of properties affected by the predicted BNL changes as detailed property data is currently not available. This will be included in a future design stage assessment.

Road traffic noise levels will be calculated for seven traffic scenarios for the Opening Year (2022) and Design Year (2037). Comparisons will be made for each design option against the Do Minimum in the Opening Year as described within DMRB.

The traffic scenarios that will be assessed are:

- Do Minimum Opening Year
- Option 1 Opening Year, Design Year
- Option 2 Opening Year, Design Year
- Option 3 Opening Year, Design Year

10.3 Study area

The study area for the assessment is defined in DMRB 11:3:7 as 600m from the carriageway edge of any proposed new routes and existing routes to be bypassed or improved, and 600m from any other affected routes within 1km of the proposed new routes or altered existing routes. An affected route is where there is a possibility of a change of 1 dB $L_{A10,18h}$ in the short term and 3 dB $L_{A10,18h}$ in the long term.

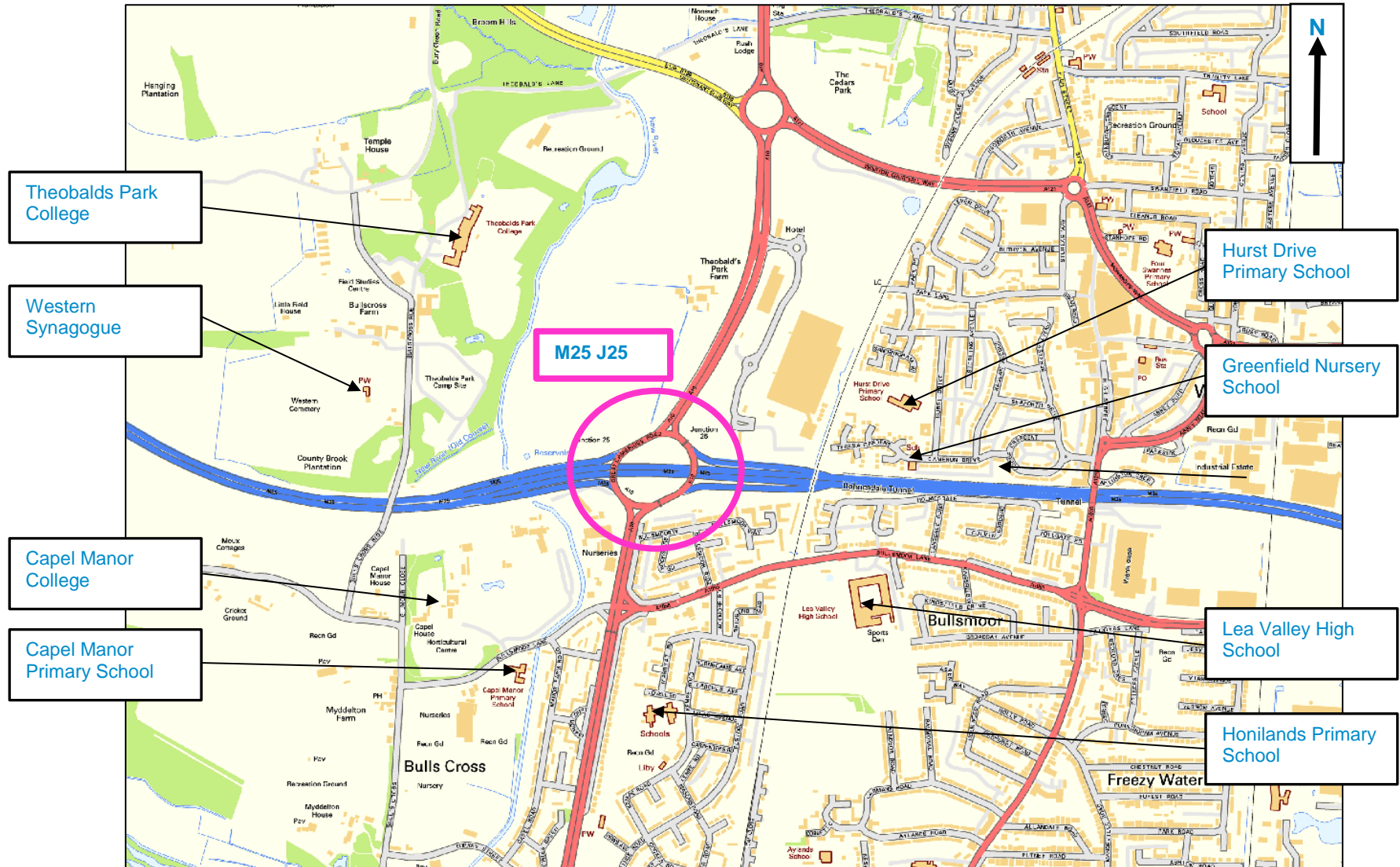
The proposed scheme options are located in proximity to Bulls Cross, Bullsmoor and Waltham Cross, located immediately adjacent to the M25 J25. The land use within 600m of the M25 J25 is generally residential (and thus noise sensitive), with commercial properties

⁵⁶ DEPARTMENT OF TRANSPORT AND THE WELSH OFFICE (1988). CALCULATION OF ROAD TRAFFIC NOISE. LONDON: HMSO.

dispersed across the area and agricultural land to the north west of the junction. Residential receptors near to M25 J25 Improvements are shown in Figure 10-1 (not to scale).

The closest residential buildings are located at Bullsmoor Way and Great Cambridge Road, approximately 30m south-west of the M25 J25. There are several non-residential noise sensitive receptors within 600m of the junction, including Lea Valley High School, Western and West End Synagogue, Hurst Drive Primary School, Honilands Primary School, Capel Manor Primary School, and Capel Manor College. Non-residential noise sensitive receptors are shown in Figure 10-2 (not to scale).

Figure 10-2 Non-residential sensitive receptors near M25 J25 Improvements



Contains Ordnance Survey data © Crown copyright and database right 2016 [NOT TO SCALE]

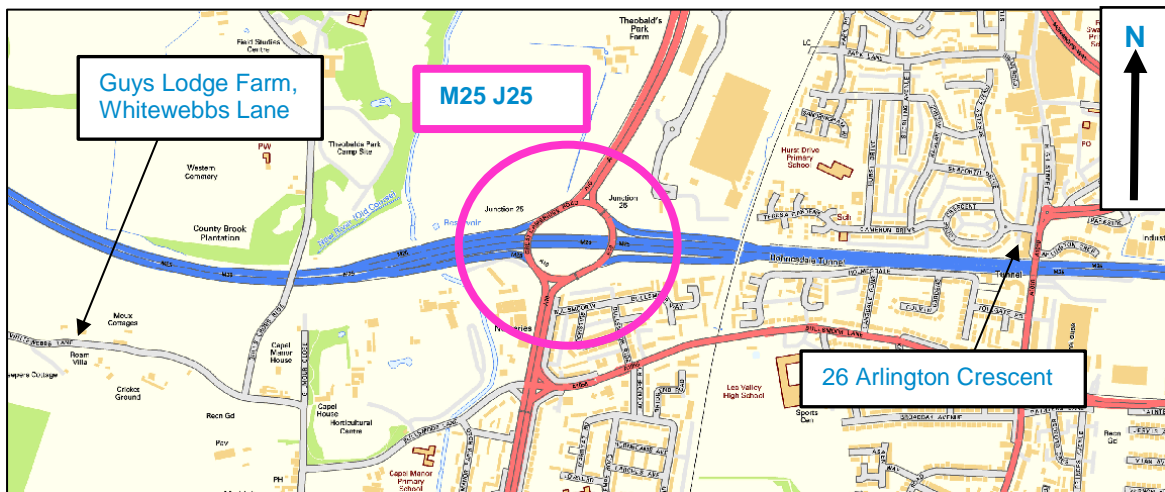
10.4 Baseline conditions

A baseline noise survey has not been undertaken for this scheme at this stage (will be undertaken at PCF Stage 3), however noise surveys were completed close to the study area in 2015 for a Smart Motorways scheme. Although the survey positions are outside of the study area they provide an initial overview of baseline noise levels in the area. The measured noise levels from the 2015 surveys are presented in Table 10-2 and a map of the measurement locations is shown in Figure 10-3 (not to scale). The dominant source of noise at the measurements positions was noted to be road traffic noise, from the M25 motorway.

Table 10-2 Noise Measurements for Smart Motorways

Measurement Address	Approximate distance to M25 J25	Survey Dates	L _{Aeq,16hour} , (07:00 – 23:00)	L _{Aeq,8hour} , (23:00 – 07:00)
26 Arlington Crescent, Waltham Cross	1km	30/01/15 – 09/02/15	71.1	67.4
Guys Lodge Farm, Whitewebbs Lane	1.5km	02/03/15 – 13/03/15	78.3	75.6

Figure 10-3 Smart Motorways noise monitoring locations in proximity to M25 J25 (not to scale)



Strategic noise maps were published during 2015 by Defra for major road and railways sources to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended). The strategic noise maps for road traffic noise during the daytime (07:00-23:00) and night-time (23:00-07:00) periods are shown in Appendix L.

The noise maps in Appendix L represent the annual average noise levels from road traffic sources during 2012, in areas with populations of 100,000 people (agglomerations) and along major traffic routes. The noise levels shown were calculated for a receptor height of 4m above ground level, using the L_{Aeq,T} (A-weighted equivalent continuous sound pressure level during time period T) and L_{night} (outdoor sound pressure level defined in the Environmental Noise Directive that is equivalent to L_{Aeq,8h}) noise indices.

The noise maps in Appendix L show that road traffic noise from the M25 and A10 dominate the study area, particularly areas west of the A10 where the land is less developed and there are fewer obstacles screening road traffic noise. At the closest residential areas to the M25

or A10, the strategic noise maps show that daytime noise levels exceed 65dB $L_{Aeq,16h}$ and night time noise levels are above 60dB L_{night} . Lower noise levels are shown at the tunnelled section of the M25 at Waltham Cross, where road traffic noise levels at adjacent properties are at least 60dB $L_{Aeq,16h}$ and 55dB L_{night} . This suggests that a Significant Observed Adverse Effect Level of 68dB $L_{A10,18h}$ or higher may be experienced at these properties already (see 10.5 below).

The 'Important Areas' for noise were identified to highlight any particular constraints on the design options for the proposed scheme options. 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 these Important Areas in proximity to the proposed scheme options are also shown in Appendix L and in the Constraints Plan in Appendix B, where it is evident that there are three Important Areas located close to the M25 J25.

10.5 Regulatory / Policy framework

Current noise policy in England is based on the Noise Policy Statement for England (NPSE)⁵⁷, which through the effective management and control of environmental noise within the context of Government policy on sustainable development, aims to:

- avoid significant adverse impacts on health and quality of life
- mitigate and minimise other adverse impacts on health and quality of life
- contribute to improvements to health and quality of life, where possible

These aims are reflective of those contained in the National Planning Policy Framework (NPPF) and are further echoed in the National Policy Statement for National Networks (NPSNN)⁵⁸ and Planning Practice Guidance concerning noise⁵⁹.

The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with the following concepts:

- 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.
- LOAEL – lowest observed adverse effect level. This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – significant observed adverse effect level. This is the level above which significant adverse effects on health and quality of life occur.

The Government policy and guidance do not state values for the NOEL, LOAEL and SOAEL, rather, it considers that they are different for different noise sources, for different receptors and at different times and should be defined on a strategic or project basis taking into account the specific features of that area, source or project.

NPSE also states that sustainable development is a core principle underpinning all government policy. The goal is pursued in ways that protect and enhance the physical and natural environment, and that use resources and energy as efficiently as possible.

The Highways England Licence states that Highways England should ensure the best practicable environmental outcomes across its activities, while working in the context of sustainable development and delivering value for money.

⁵⁷ DEFRA (2010). "NOISE POLICY STATEMENT FOR ENGLAND (NPSE).

⁵⁸ DEPARTMENT FOR TRANSPORT (DEC 2014). "NATIONAL POLICY STATEMENT FOR NATIONAL NETWORKS".

⁵⁹ DEPARTMENT FOR COMMUNITIES AND LOCAL GOVERNMENT, PLANNING PRACTICE GUIDANCE (<http://planningguidance.planningportal.gov.uk/>).

Section 5(2) of the Infrastructure Act 2015 and the Highways England Licence seek to minimise the environmental impacts of projects, protect and enhance the quality of the surrounding environment and conform to the principles of sustainable development.

In line with this, the Department for Transport RIS 2015-2020 aspires to the target that by 2040 over 90% fewer people are impacted by noise from the strategic road network. The target for the first Road Period 2015-2020, is to mitigate at least 1,150 noise Important Areas expecting to reduce the number of people severely affected by noise from the strategic road network by at least 250,000.

The legislation and policies considered in undertaking this noise assessment are detailed in Table 10-3 and 10-4 for construction and operation respectively.

Table 10-3 Regulatory and policy framework for construction noise and vibration

Regulation/policy	Summary of requirements
NPSE NPPF Planning Practice Guidance Noise to NPPF (PPGN) National Policy Statement for National Networks (NPSNN)	Within the context of Government policy on sustainable development: <ol style="list-style-type: none"> i. Avoid significant adverse effects as a result of the scheme. ii. Mitigate and minimise adverse effects as a result of the scheme. iii. Contribute to the enhancement of the acoustic environment.
Control of Pollution Act 1974 (as amended)	Section 60 – Control of noise on construction sites. Section 61 – Prior consent for work on construction sites. Section 71 – Codes of practice for minimising noise. Section 72 – Best practicable means.
Environmental Protection Act 1990 (as amended)	Section 79 (1) (ga) noise that is prejudicial to health or a nuisance and is emitted from or caused by a vehicle, machinery or equipment in a street is a statutory nuisance; (NB if so should be inspected by the local authority) (9) interpretation of “best practicable means”
The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015	Approves BS 5228:2009+A1:2014 Part 1 Noise and Part 2 Vibration for the purpose of giving guidance on appropriate methods for minimising noise and vibration
Noise Insulation Regulations 1975 (as amended)	Regulation 5 provides relevant authorities with discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings with respect to construction noise. This is subject to meeting certain criteria given in the Regulation.

Table 10-4 Regulatory and policy framework for operational noise and vibration

Regulation/policy	Summary of requirements
Environmental Noise (England) Regulations 2006	Take into account Noise Action Plans.
NPSE NPPF PPGN NPSNN	Within the context of Government policy on sustainable development: <ul style="list-style-type: none"> i. Avoid significant adverse effects as a result of the scheme. ii. Mitigate and minimise adverse effects as a result of the scheme. iii. Contribute to the enhancement of the acoustic environment.
Land Compensation Act 1973	Part I Compensation for depreciation caused by use of public works.
Noise Insulation Regulations 1975 (as amended)	Regulation 3 imposes a duty on authorities to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings. This is subject to meeting certain criteria given in the Regulation. Regulation 4 provides authorities with discretionary powers to undertake or make a grant in respect of the cost of undertaking noise insulation work in or to eligible buildings, subject to meeting certain criteria given in the Regulation.
The Highways Noise Payments and Movable Homes (England) Regulations 2000	Provide highway authorities with a discretionary power to provide a noise payment where new roads are to be constructed or existing ones altered. The relevant Regulations set out the criteria which should be applied in assessing eligibility for making such payments.

10.6 Design mitigation and enhancement measures

A construction programme detailing the specific activities that will take place, the phasing and duration of each of the activities, and a detailed plant list, is not yet available for the proposed scheme options.

The need for temporary noise mitigation during the construction phase will be determined at a future design stage by undertaking a BS5228-1:2009+A1:2014⁶⁰ assessment that takes into account the following factors:

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

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

A Construction Environmental Management Plan (CEMP) should be created and implemented by, or on behalf of, the contractor and be approved by the Local Authorities prior to the commencement of construction works. The CEMP should outline the following:

⁶⁰ BRITISH STANDARDS INSTITUTION (2014) BS5228:2009 + A1:2014 CODE OF PRACTICE FOR NOISE AND VIBRATION CONTROL ON CONSTRUCTION AND OPEN SITES, PART 1: NOISE. LONDON BSI.

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

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

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

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

In addition, the contractor should use the following good working practices:

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

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

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

10.6.1 Operation

Due to the new infrastructure, all of the proposed scheme options have the potential to increase noise levels at noise sensitive receptors and therefore noise mitigation may be required to reduce noise levels or improve noise levels generally, noting the presence of several Important Areas and residential communities close to Junction 25. The assessment of impacts in Section 10.7 has indicated that Option 1 is likely to require the least noise mitigation and Option 3 is likely to require the most, due to the increasing scale of the proposed scheme.

Noise mitigation can consist of noise barriers, earth bunds, or low noise road surfacing, and may include any existing noise mitigation in situ that will be retained by the proposed scheme options. Further assessments of mitigation options will be undertaken at a future design phase.

10.7 Potential significant effects

10.7.1 Construction

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

Options 2 and 3 propose the demolition of a retaining wall adjacent to the westbound diverge, due to the widening of lanes beyond the existing retaining wall. It is understood the wall is to be rebuilt over the full length of the lane with a height of 4m reducing to 1m over the 150m leading to Junction 25. These works will be closest to noise sensitive receptors on Bullsmoor Way, Bullsmoor Gardens and Bullsmoor Ride, which are 80-200m away from the proposed works. This is likely to have an additional noise impact on these receptors during the time of demolition and construction.

10.7.2 Operation

The main factors that can cause a short term or long-term change in noise level at nearby noise-sensitive receptors are:

- Changes to the traffic flow, speed or composition. Any alleviation to congestion caused by the proposed scheme options is likely to increase the average traffic speeds on the M25, the A10, and connecting roads, leading to an increase in noise levels.
- Changes to the road alignment and layout. This includes changes to the horizontal or vertical alignment of existing carriageways and adding new sections of road. Realignment or rerouting traffic can also cause decreases in areas where it was rerouted from and noise increases in areas it will be rerouted to.
- Changes to the road surfacing. The installation of low-noise road surfacing can reduce road traffic noise level by 2.5dB or more compared with Hot Rolled Asphalt surfaces, due to differences in the composition of the road surface.
- Changes to the existing retaining walls. This can affect the level of screening provided to residents located south of the M25, and the paths of the soundwaves reflected from the retaining wall to noise sensitive receptors north of the M25.

At present only Basic Noise Level calculations have been undertaken on the available traffic data available for the proposed scheme. Assessment of the change in noise levels at individual properties will be deferred to a later design stage.

10.7.3 Option 1

Figure 10-4 and Figure 10-5 illustrate the change in Basic Noise Level on each road due to changes in traffic in the Opening and Design Years of the scheme for Option 1, relative to

the Do Minimum scenario. Also shown are the 'Important Areas' (in purple) as identified from the strategic noise maps.

A decrease in Basic Noise Level of minor impact significance was predicted at the eastbound M25 off-slip at Junction 25 as a result of changes to the traffic volume, average speed, or fleet composition. Negligible changes in Basic Noise Level were elsewhere in the short-term (Opening Year). Negligible changes were predicted throughout the study area in the long-term (Design Year).

The proposed road widening at Junction 25 will take place on the inside of the roundabout, so it is thought that the roundabout itself will be no closer to any nearby residential receptors.

The widening of the southbound entry (to the north east of the roundabout) will position the widened road slightly closer to the nearby residential receptors in Waltham Cross, although these buildings will still be over 300m away.

10.7.4 Option 2

Figure 10-6 and Figure 10-7 illustrate the change in Basic Noise Level on each road due to changes in traffic in the Opening and Design Years of the scheme with Option 2. Also shown are the 'Important Areas' (in purple) as identified from the strategic noise maps.

An increase in Basic Noise Level of minor impact magnitude was predicted at the eastbound carriageway of the M25 prior to Junction 25. This is due to traffic speeds improving as congestion is relieved at Junction 25. This section of road passes through Important Area 5716 at Bulls Cross Ride. The long-term changes to Basic Noise Level, relative to the Do Minimum scenario, were predicted to be negligible.

The proposed road widening at Junction 25 will take place on the inside of the roundabout, so it is thought that the roundabout itself will be no closer to any nearby residential receptors.

The widening of the southbound entry (to the north east of the roundabout) will position the widened road slightly closer to the nearby residential receptors in Waltham Cross, although these buildings will still be over 300m away.

It is likely that approximately 150 residential buildings at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens will experience an increase in noise levels due to the proposed additional lane on the westbound diverge. This lane will align the edge of the westbound diverge closer to the residential properties directly south east of the roundabout. A short-term noise increase of minor impact magnitude was predicted at the westbound diverge, and a negligible change in noise levels in the long-term. The westbound diverge is located within Important Area 1186 and is approximately 390m from Important Area 13660.

The increase in noise levels at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens may be affected by the height reduction of the retaining wall adjacent to the M25 westbound carriageway, stretching over the 150m length up to the roundabout. This would provide less screening from road traffic noise, causing further noise increases.

The segregated left turn lane from the eastbound M25 to northbound A10 will align the footprint of Junction 25 closer to noise sensitive receptors to the northwest of the roundabout. Increases in Basic Noise Level of major impact magnitude were predicted in the short-term (increase of 5dB $L_{A10,18h}$ or more) and the long-term (increase of 10dB $L_{A10,18h}$ or more). However, the nearest noise sensitive receptors to this road link are over 200m at Bullsmoor Way and Important Area 13660, located at the opposite quadrant of the Junction 25 roundabout.

Short-term noise increases of minor impact magnitude were predicted at Bullsmoor Lane due to changes in traffic in the Opening Year compared with the Do Minimum scenario. The long-term changes to Basic Noise Level at Bullsmoor Lane were predicted to be negligible.

10.7.5 Option 3

Figure 10-8 and Figure 10-9 illustrate the change in Basic Noise Level on each road due to changes in traffic in the Opening and Design Years of the scheme with Option 3. Also shown are the 'Important Areas' (in purple) as identified from the strategic noise maps.

An increase in Basic Noise Level of minor impact magnitude was predicted at the eastbound carriageway of the M25 prior to Junction 25. This is due to traffic speeds improving as congestion is relieved at Junction 25. This section of road passes through Important Area 5716 at Bulls Cross Ride. The long-term changes to Basic Noise Level, relative to the Do Minimum scenario, were predicted to be negligible.

The proposed road widening at Junction 25 will take place on the inside of the roundabout, so it is thought that the roundabout itself will be no closer to any nearby residential receptors.

The widening of the southbound entry (to the north east of the roundabout) will position the widened road slightly closer to the nearby residential receptors in Waltham Cross, although these buildings will still be over 300m away.

It is likely that approximately 150 residential buildings at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens will experience an increase in noise levels due to the proposed additional lane on the westbound diverge. This lane will align the edge of the westbound diverge closer to the residential properties directly south east of the roundabout. A short-term noise increase of minor impact magnitude was predicted at the westbound diverge, and a negligible change in noise levels in the long-term. The westbound diverge is located within Important Area 1186 and is approximately 390m from Important Area 13660.

The increase in noise levels at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens may be affected by the height reduction of the retaining wall adjacent to the M25 westbound carriageway, stretching over the 150m length up to the roundabout. This would provide less screening from road traffic noise, causing further noise increases.

The segregated left turn lane from the eastbound M25 to northbound A10 will align the footprint of Junction 25 closer to noise sensitive receptors to the northwest of the roundabout. Increases in Basic Noise Level of major impact magnitude were predicted in the short-term (increase of 5dB $L_{A10,18h}$ or more) and the long-term (increase of 10dB $L_{A10,18h}$ or more). However, the nearest noise sensitive receptors to this road link are over 200m at Bullsmoor Way and Important Area 13660, located at the opposite quadrant of the Junction 25 roundabout.

Additionally, the northbound A10 located north of Junction 25 was predicted a short-term noise increase of minor impact magnitude due to changes in traffic volume, average speed, and or fleet composition. In the long-term, the impact of Option 3 on this road was predicted to be negligible.

Short-term noise increases of minor impact magnitude were predicted at Bullsmoor Lane due to changes in traffic in the Opening Year compared with the Do Minimum scenario. The long-term changes to Basic Noise Level at Bullsmoor Lane were predicted to be negligible.

The segregated left turn lane from A10 northbound to M25 westbound merge was predicted to increase noise levels to the south west of the roundabout due to the realignment of the road closer to noise sensitive receptors. The impact magnitude of the noise increases was major in the short-term and the long-term.

Widening the southbound A10 to accommodate an extra lane was predicted to result in a minor increase to Basic Noise Levels in the short-term, concentrated at the merge onto the A10 from the M25. The long-term change to Basic Noise Levels at the same road link was predicted to be negligible.

Figure 10-4 Option 1 Opening Year Change in Basic Noise Level (dB LA10,18h) (not to scale)

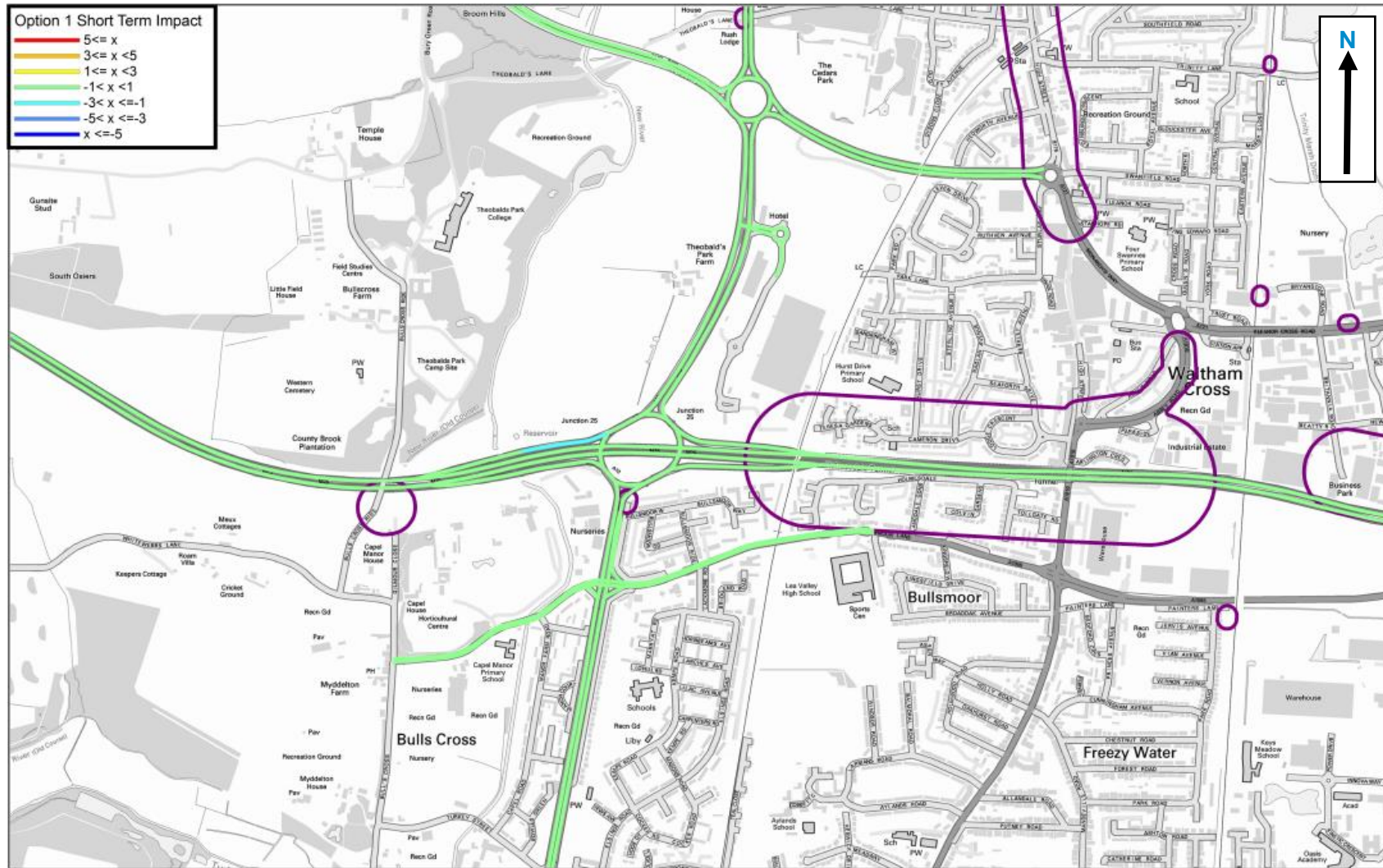


Figure 10-5 Option 1 Design Year Change in Basic Noise Level (dB LA10,18h) (not to scale)

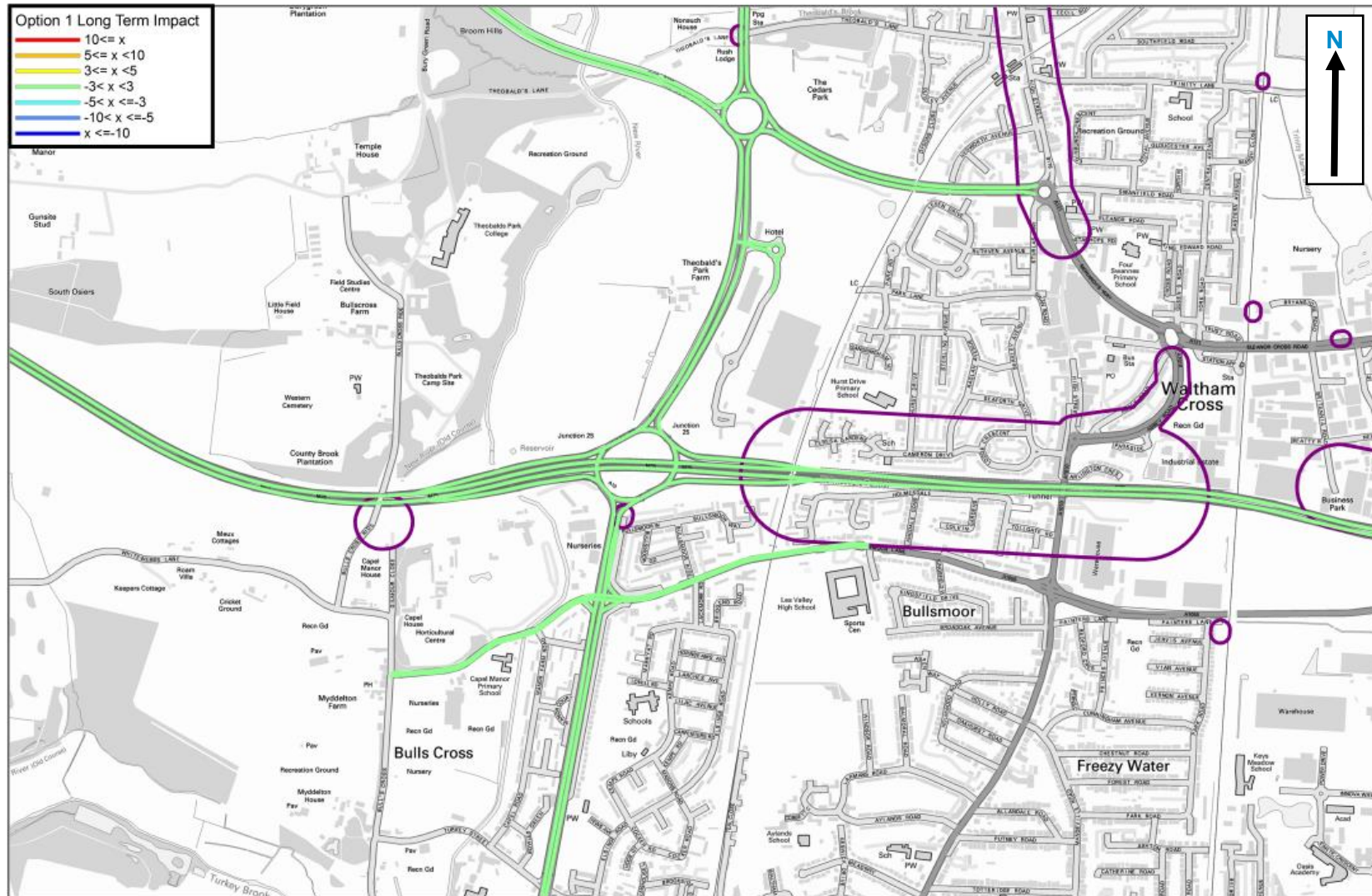


Figure 10-6 Option 2 Opening Year Change in Basic Noise Level (dB LA10,18h) (not to scale)

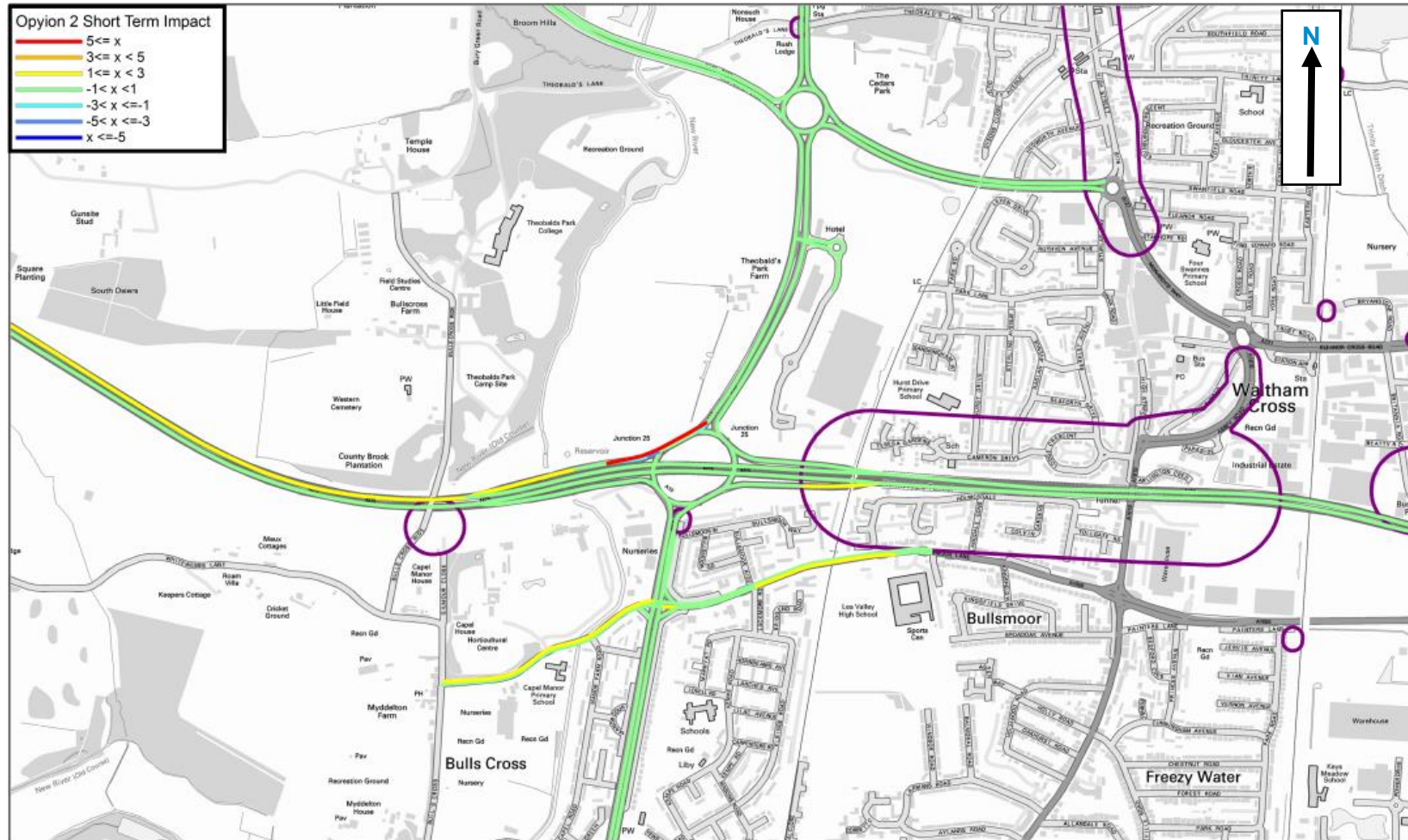


Figure 10-7 Option 2 Design Year Change in Basic Noise Level (dB LA10,18h) (not to scale)

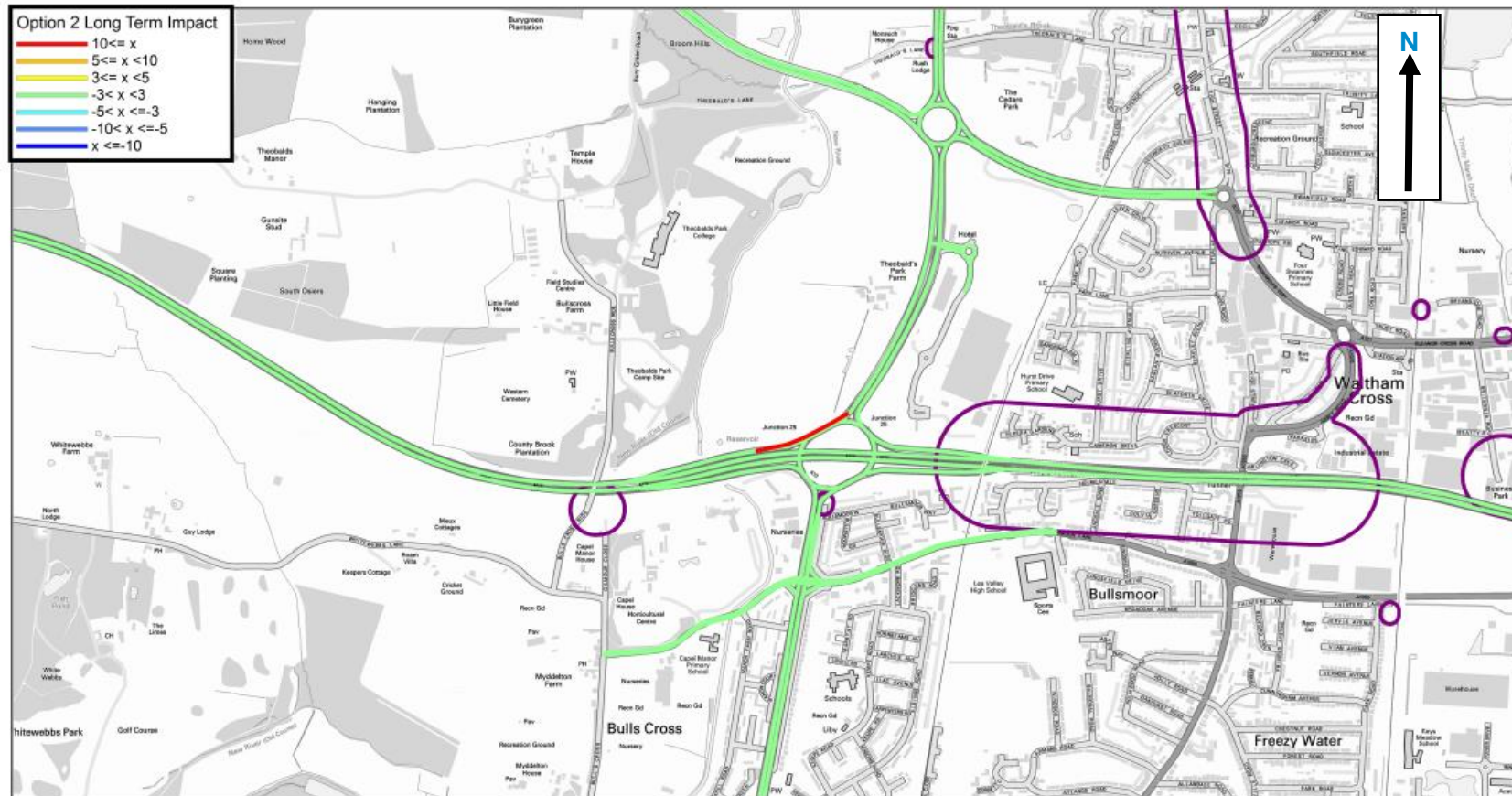


Figure 10-8 Option 3 Opening Year Changes in Basic Noise Level (dB LA10,18h) (not to scale)

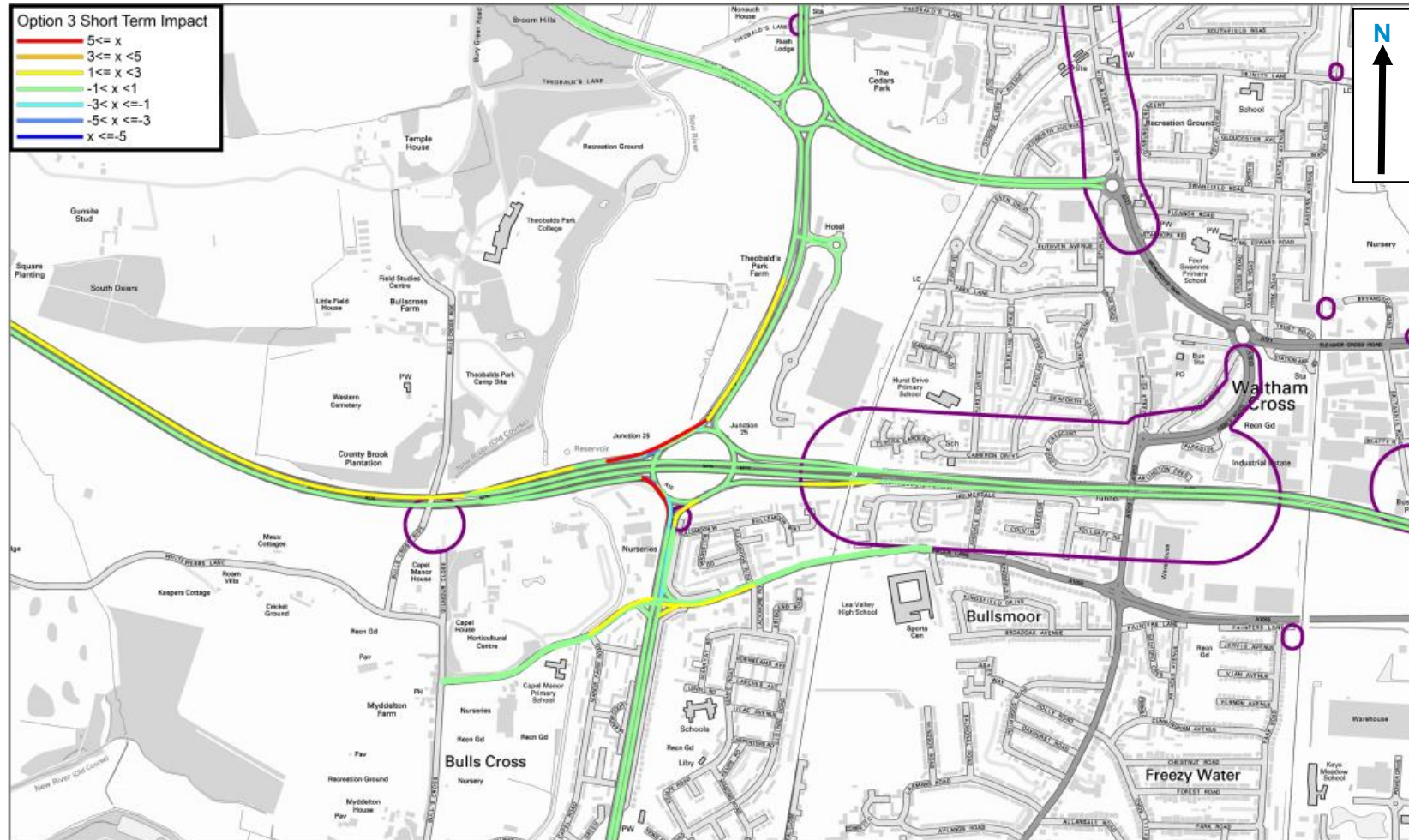
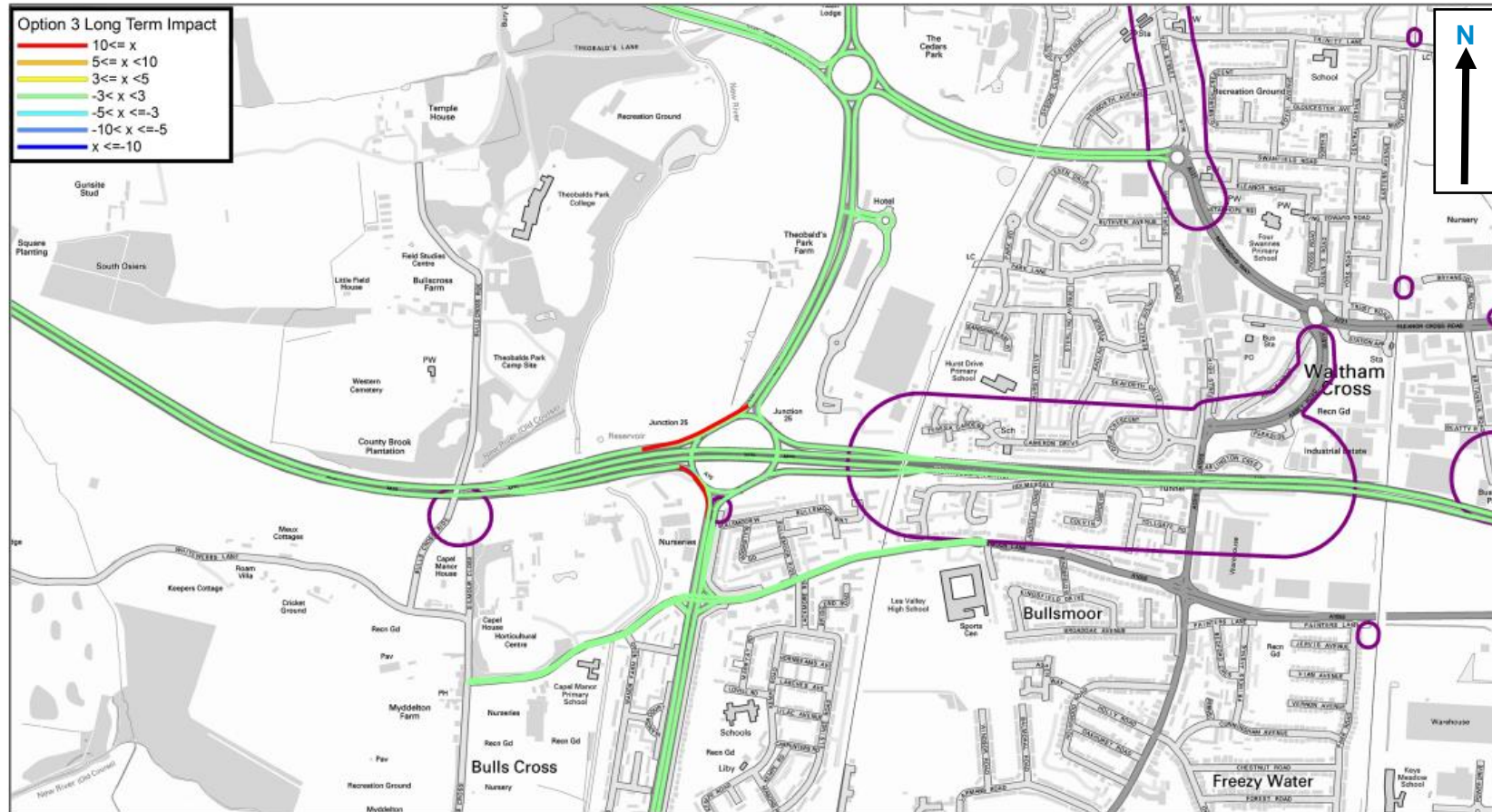


Figure 10-9 Option 3 Design Year Changes in Basic Noise Level (dB LA10,18h) (not to scale)



10.8 Limitations to assessment

At this stage no detailed information about construction methods or timing are available and hence a very high level overview of potential construction impacts has been provided.

Baseline noise monitoring will be undertaken at a later design stage (PCF Stage 3), and will be used to inform a construction noise impact assessment at this stage.

No address data identifying the usages of individual properties is currently available and therefore it is not possible to identify where noise level changes are likely to impact upon noise sensitive receptors, or to include property counts at this stage.

A 3 dimensional noise model has not been constructed at present and therefore no account has been taken of ground topography or road gradients in undertaking the basic noise level calculations.

Road surfacing types are not currently available and therefore these details have not been taken into account in the basic noise level calculations.

Basic noise level calculations may show an impact on a road link which would in fact be masked by higher noise levels from adjacent links (e.g. where a slip road is adjacent to the main carriageway, it is unlikely that a change in noise on the slip road would have an effect on the overall noise level).

All potential impacts have been identified in the absence of any mitigation. Details of any existing mitigation should be included when undertaking a detailed assessment of noise levels at receptors. This will inform the requirements for any new mitigation that should be included in the design.

11 Road drainage and the water environment

11.1 Introduction

This section sets out a review of the water environment relevant to the M25 Junction 25 Improvements. The assessment has used publicly available data and is based on the proposed scheme options at the time of reporting. Should any of the options change, baseline conditions may be subject to change.

An overview of the baseline conditions is included, together with descriptions of proposed methods and a scope of the work likely to be required to undertake a detailed assessment of the impact of road drainage on the water environment as part of the Environmental Impact Assessment (EIA).

11.2 Assessment methodology

Scoping of the environmental assessment for the M25 Junction 25 Improvements was undertaken in April 2016 (Highways England, May 2016)⁶¹, based on a broad understanding of the proposed scheme options. The scoping exercise was undertaken to identify the water topics requiring consideration in the environmental assessment (and the appropriate level of assessment for these).

The results are presented in the Environmental Scoping Report (Highways England, May 2016) and will not be repeated here. In summary, the following water topics were scoped into further assessment:

- Surface watercourses
- Groundwater
- Abstractions and discharges
- Flood risk

Water topics scoped out included the following:

- WFD designated lakes as none were identified the study area
- Designated sites as none were identified the study area

The assessment is based on guidance contained in the DMRB Volume 11, Section 3, Part 10 HD 45/09 - Road Drainage and the Water Environment (November 2009) and further notes from the IAN 161/15 - Smart Motorways (November 2015).

The method of assessing the importance, magnitude and significance of effects is stated within tables in the DMRB, HD45/09 (Annex IV, Tables A4.1 to A4.6) and has not been reproduced in this section.

At this stage, a high level desk-based assessment has been undertaken using publicly available data.

11.3 Study area

The spatial scope of the assessment includes as a minimum, features of the water environment within 1km of the improvement work. This is in line with the DMRB guidance for the assessment of impacts associated with road schemes, where studies indicate beyond 1km it is thought any impact to the water environment in terms of soluble pollutants, is likely to be sufficiently diluted. This study area may extend as necessary as the programme progresses, in order to gather relevant data from upstream or downstream of the proposed scheme options.

⁶¹ Highways England. May 2016. Road Investment Strategy. M25 Junction 25 Improvements. Environmental Study Scoping Report. HE551518-ATK-EGN-1-RP-EN-0002

11.4 Baseline conditions

This section sets out the baseline conditions of the water environment. Baseline conditions echo that reported in the Scoping Report, which was based on desk-top, publically available data. Water environment constraints are shown on Figure 11.1 in Appendix H.

11.4.1 Surface watercourses

Waterbodies within the study area fall within the Thames River Basin District (RBD). The revised Thames River Basin Management Plan (RBMP) was published in February 2016.

Two Water Framework Directive (WFD, 2000/60/EC) classified reaches are within 1km of the proposed scheme options. These are listed in Table 11.1. The New River (GB806100111) a man-made waterway which passes over the existing M25 on an aqueduct immediately to the west of the junction, flowing in a southerly direction. The New River is a man-made waterway and is designated as an Artificial Waterbody (AWB) as it is a strategic water transfer system. For an AWB, objectives are set for ecological potential and chemical status and are still required to aim to achieve good status. A Source Protection Zone (SPZ) is centred on the aqueduct where the New River crosses the M25, and extends to the south broadly centred on New River.

The Turkey Brook and Cuffley Brook (GB106038033180) waterbody is to the south of the junction, flowing in an easterly direction broadly parallel to the M25. New River is culverted where it crosses over the Turkey Brook, just in excess of 1km from the junction. Turkey Brook and Cuffley Brook waterbody is not designated as an AWB or Heavily Modified (HMWB).

Table 11.1 shows the current and predicted status of the water bodies and provides the status for each element that makes up the overall status. This shows the element that drives the overall status as it is based on the lowest classification. For example, the predicted overall status for Turkey Brook and Cuffley Brook is for good, which is supported by a predicted good status for both physico-chemical and biological quality elements. Both waterbodies are designated as Protected Areas under the Nitrates Directive (91/676/EEC). No assessment of 'Specific Pollutants' is made for these waterbodies, suggesting that water quality is unlikely to be affected by these pollutants.

The other watercourse within 1km of the works, Theobalds Brook, is outside of the classified WFD stretches but is part of the Small River Lee (and tributaries) (GB106038033200) waterbody. This is located approximately 1km north of the junction 10. The Theobalds Brook contributes to the overall quality and status of the waterbody, consequently, these 'other' watercourses are all considered to have an objective of good status.

At the time of reporting, the exact alignments of watercourses is unclear due to inconsistencies between OS base mapping and digital river mapping. However, due to their status as important receptors surface watercourses' are scoped in for further assessment.

Table 11-1 WFD watercourses⁶²

Classification Item	Element	Classification (2015)	Predicted Outcome (2027)
New River (GB806100111)			
Morphological designation		Artificial	
Protected area		Nitrates Directive	
Overall waterbody		Moderate	Good
Ecological		Moderate	Good
	Supporting Elements (Surface Water)	Moderate	Good

⁶² Environment Agency. 2016. Catchment Planning <http://environment.data.gov.uk/catchment-planning>

Classification Item	Element	Classification (2015)	Predicted Outcome (2027)
Hydromorphological Supporting Elements		Not Assessed	
Chemical		Good	Good
Turkey Brook and Cuffley Brook (GB106038033180)			
Morphological designation		Not designated	
Protected area		Nitrates Directive	
Overall waterbody		Moderate	Good
Ecological overall		Moderate	Good
	Physico-chemical	Moderate	Good
	Biological quality	Moderate	Good
Hydromorphological Supporting Elements		Supports Good	Supports Good
Chemical overall		Good	Good
Small River Lee (and tributaries) (GB106038033200)			
Morphological designation		Not designated	
Protected area		Nitrates Directive	
Overall waterbody		Moderate	Good
Ecological overall		Moderate	Good
	Physico-chemical	Moderate	Good
	Biological quality	Moderate	Good
Hydromorphological Supporting Elements		Not assessed	Not assessed
Chemical overall		Good	Good

11.4.2 Lakes and other water features

There are other water features within 1km of the existing alignment, including a reservoir. The exact number and status are unknown at the time of reporting, as is their dependence on groundwater. These details should be confirmed at the next stage and therefore 'lakes and other water features' are scoped in for further assessment.

Ponds are to be considered in an ecological context in the Nature Conservation section.

11.4.3 Groundwater

Environment Agency interactive mapping indicates that there are no bedrock aquifers in the study area, however there is a small Secondary A superficial aquifer. Secondary A aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. Generally, these were formerly classified as minor aquifers⁶³. The alignment of the secondary aquifer reflects the surface hydrology, following the current or historical course of the surface watercourses and is likely to be associated with the presence of river terrace gravels. It is considered to be of low importance.

The existing alignment is not underlain by any WFD Groundwater body. Whilst there are SPZ in the study area, they appear to be centred on the New River and do not reflect the distribution of areas defined as Secondary Aquifer. Further work is required to understand the nature of the SPZ with respect to groundwater and the potential vulnerability to potential effects from any scheme.

The potential inclusion of cuttings and earthworks in the proposed improvements means that groundwater should be considered at the next stage of the assessment

11.4.4 Abstractions and discharges

The Environment Agency website⁶¹ indicates that there is one groundwater abstraction within 1km. At the time of reporting, no data were available for this license. Confirmation of

⁶³ Environment Agency 2016. Whats In Your Backyard. <http://apps.environment-agency.gov.uk/wiyby/default.aspx>

this is recommended at the next stage of the assessment and therefore abstractions should be considered at the next stage of the assessment.

At the time of reporting, no data were available for discharges. Confirmation of numbers and locations is recommended at the next stage of the assessment and therefore discharges are scoped in as further assessment is required.

Based on the Highways Agency Drainage Data Management System (HADDMS) there are two outfalls around Junction 25. HADDMS is showing a field study has been complete and with the status of one as 'very high risk', and the other as 'risk addressed'. For the former, this means action to address this risk is required.

11.4.5 Flood risk

Environment Agency Flooding from Rivers interactive mapping⁶¹ shows that pockets of Flood Zone 2 are adjacent to the proposed works, and an area at risk from surface water flooding immediately to the south of the Holmesdale Tunnel. Areas of Flood Zone 3 are also within 1km. Sources of flooding risk include Theobalds Brook and Turkey Brook, however these do not fully explain the distribution of flood risk in the study area.

The scale of the proposed scheme options and their proximity to areas identified as being at risk from flooding means that further flood risk assessment is required.

11.4.6 Designated sites

There are no statutory designated sites within the study area, however the New River (GB806100111) is a non-statutory designated Site of Metropolitan Importance (SMI). This supports a range of aquatic plants, fish, birds and amphibians. From a water perspective, designated sites will not be considered further in the context of water resources. Further details of these are described in the Nature Conservation section.

11.5 Regulatory / Policy framework

With regard to the protection of specific water resources, water quality standards and related policy relevant to the proposed improvements these are set out in Table 11.2.

Table 11-2 Water resources legislation

Legislation	Description
European legislation	
Water Framework Directive (2000/60/EC)	The Water Framework Directive (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.
Groundwater Directive (2006/118/EC)	The Groundwater Directive 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.
The Floods Directive (2007/60/EC)	The aim of this Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity.
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.

Legislation	Description
Environmental Damage (Prevention and Remediation) Regulations (2009)	The emphasis of these Regulations is proactively putting in place appropriate pollution prevention measures to reduce risks to the environment.
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 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. Lead Local Flood Authorities 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 : <ul style="list-style-type: none"> • roles and responsibilities for flood and coastal erosion risk management • improving reservoir safety • encouraging sustainable urban drainage systems • designation of third party flood management assets • special administration regime for water companies • powers for water companies to control non-essential uses of water • various provisions relating to charging
Highways Act 1980	Where flooding on a highway is caused by another person (e.g. an adjoining landowner), the Highway Authority can take action against the person responsible.
Groundwater (England and Wales) Regulations (2009)	These Regulations implement the Groundwater Directive by preventing entry into groundwater of “hazardous substances” and the pollution of groundwater by non-hazardous pollutants. Both direct and indirect (percolation) inputs of pollutants are covered by the Regulations although a discharge which leads to a direct input of such matter is already an offence under Water Resources Act 1991.
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.
Water Act 2003	The Act requires that dewatering operations are subject to an abstraction licence except for short term situations where pumping is carried out for emergency purposes.
Water Industry Act (1991) (Amendment) (England and Wales) Regulations (2009)	Section 118 of the Act makes it an offence to discharge trade effluent to public sewers without consent. Companies can discharge their effluents into the public sewer on condition of a trade effluent discharge consent. These consents are granted by the relevant local water and sewage undertaker. The Regulations extend controls on activities to include those which cause harm to controlled waters in addition to activities which risk or cause pollution.
Water Resources Act 1991	Consolidated existing water legislation. Regulated water quality and prevention of water pollution. Created water pollution offences based on the polluter pays principle. Much of this is now covered by the Environmental Permitting Regulations
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2003	Gives effect to the European WFD and introduces a system of river basin management planning with the general aim of achieving good status of surface and ground waters by 2015.
The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015	The new Directions set out the environmental standards to be used for the second cycle of river basin plans. Along with the updated Water Environment (WFD) (England and Wales) Regulations 2003, they transpose Directive 2013/39/EC on environmental quality standards for priority substances.

11.6 Design mitigation and enhancement measures

The risk of pollution during construction can be reduced by the adoption of good working practices. Environment Agency Pollution Prevention Guidelines⁶⁴ detail good practice advice for undertaking works which may have the potential to result in water pollution. In general terms, by following these guidelines, there should be no significant impacts to the water environment.

The design provisions set out in the Managed Motorway guidance IAN 161/15 (November 2015) should also be considered to mitigate the potential risks to the water environment.

As a general rule, the proposed works should avoid encroaching within 8m⁶⁵ of a water feature if possible to avoid potential effects. Where this is not possible, further assessment will be required and there would be a need for permitting⁶⁶.

Accounting for the New River's importance as a strategic water resources asset, liaison will be required with the Environment Agency to develop specific controls necessary to ensure its protection during construction.

11.6.1 Water quality

The proposed construction works have the potential to impact water quality in any of the receiving surface or groundwater receptors. This may be due to:

- The excavation, and the subsequent deposition of soils, sediment, or other construction materials
- Spillage of fuels or other contaminating liquids
- The mobilisation of contamination following disturbance of contaminated ground or groundwater, or through uncontrolled site runoff

Providing adherence to best practice mitigation outlined above, during the construction period, there should be no significant effects to the water environment.

There is potential opportunity to improve the status of existing outfalls by incorporating additional mitigation measures where appropriate.

11.6.2 Flood risk

Providing adherence to best practice mitigation outlined above during the construction period, there should be no significant effects to the flood risk.

Under operation, the increase in impermeable area would need to be mitigated so as not to increase the risk of surface water flooding. At the time of reporting, the exact mitigation is to be confirmed. However, design should take into consideration the design principals outlined in the Managed Motorway guidance IAN 161/15 (November 2015).

11.6.3 Groundwater

All options being considered will cross a SPZ and areas defined as Secondary Aquifer. Potential effects of the proposed scheme options may be associated with cuttings and will most likely require piling.

No controlled discharges are to be made to ground or groundwater during construction without consent and the permission to ensure the scheme compliance with the Environmental Permitting Regulations 2010 and the protection of groundwater resources.

⁶⁴ Pollution Prevention Guidelines (PPGs) with particular reference to PPG1 (general guide to the prevention of water pollution), PPG3 (use and design of oil separators in surface water drainage systems), PPG5 (works near or liable to affect watercourses) and PPG6 (working at construction and demolition sites). The PPGs contain a mix of regulatory requirements and good practice advice. They have been withdrawn by the Environment Agency but are still considered good practice advice to avoid pollution of watercourses. All of the PPGs are available from <http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.environment-agency.gov.uk/business/topics/pollution/39083.aspx>

⁶⁵ <https://www.gov.uk/guidance/flood-risk-activities-environmental-permits>

⁶⁶ <https://www.gov.uk/guidance/changes-to-your-flood-defence-consent-after-6-april-2016>

Where any excavation is to be undertaken below the water table, consultation with the Environment Agency will determine if an abstraction licence for dewatering would be required.

Providing adherence to best practice mitigation outlined above during the construction period, there should be no significant effects to the ground water environment.

11.7 Potential effects

Table 11.3 sets out a summary of the proposed scheme options which have the potential to impact the water environment associated with each option.

Table 11-3 Potential effects associated with each option

Option	Environmental concerns
1	<ul style="list-style-type: none"> • Increase in impermeable areas to accommodate carriageway widening has the potential to increase flood risk and associated pollutant discharge from the area could impact water quality • The inclusion of cuttings and earthworks in the proposed improvements presents a potential mechanism for impacts on groundwater level and quality • Option will cross a SPZ and areas defined as Secondary Aquifer, potential effects may be associated with cuttings and will most likely require piling. • Earthworks, cutting and piling may affect the flow of groundwater in the Secondary Aquifer, indirectly affecting surface water features and abstractions which are dependent upon groundwater inputs • Works may introduce new pollutant pathways to the underlying Aquifer. The inherent risks of contamination during construction presents a further risk to the underlying aquifer
2	<ul style="list-style-type: none"> • As per option 1, however the increase in area potentially affected is marginally larger due to more widening works and cuttings proposed
3	<ul style="list-style-type: none"> • As per option 1, however the increase in area potentially affected is larger than both option 1 and 2, due to more widening works and cuttings proposed • Potential impacts on the New River as options involve modifying the aqueduct – a strategic water resources asset.

11.8 Limitations to assessment

Data quality – desk study, using mainly web-based data has only been reported at this stage and therefore the level of detail for certain topics, such as abstractions and discharges is limited/unknown. Of note, spatial data for abstractions and discharges presented on the Environment Agency website can be inaccurate. Therefore, the data reviewed to date should be treated with caution and does not remove the need for a formal data request to be made.

Data quantity – as per quality, only open, freely licensed data has only been reported at this stage and therefore the amount of detail on certain topics is limited. No consultation with stakeholders has been undertaken to date. The assessment therefore does not account for site specific concerns that stakeholders may have (e.g. environmental regulators).

The assessment considers the most recent option alignment designs. Should any of the option alignments change, the water environment baseline conditions may be subject to change.

The assessment is based on existing data sources and has not been verified through a site walkover survey. This will aim to validate and, where necessary, refine the definition of baseline conditions.

It is assumed that the provision of mitigation or compensation for any effects will be equally effective for each option. To date, no investigations have been made of potential opportunities to mitigate scheme effects which may only be associated with particular route alignments.

The feasibility of adapting drainage infrastructure to derive benefits to the water environment has not been investigated. Such adaptations may reduce the significance of effects to the water environment or may even avoid effects entirely.

The vulnerability of the Secondary Aquifer is assumed to be consistent between the proposed scheme options.

It is assumed that cumulative effects will be comparable for each route option.

11.9 Recommendations

One of the key recommendations for all water topics is a data request to the Environment Agency to refine the data collated at scoping stage in conjunction with a site visit. As the programme progresses in combination effects and cumulative impacts from other proposed schemes should be considered to ensure risks are captured and the aims of these disciplines and schemes are not undermined.

11.10 Summary

All proposed scheme options could potentially, without appropriate mitigation, result in a deterioration of the water environment with potentially significant effects through construction.

Based on the data at the time of reporting, this qualitative assessment has identified water features within the study of very high importance. All options proposed could potentially result in some measurable changes in the water features, however until more qualitative assessments, in the form a WEBTAG assessment, have been undertaken, it is difficult to quantify this at this time of reporting. WEBTAG assessments are out of the scope of this ESR and should be taken at the next stage of the EIA process.

Option 3 is potentially the most environmentally damaging for the water environment, based on the larger scale, the nature of works proposed and need to modify a strategic water resources asset, although the difference is small.

Option 1 is the least environmentally damaging for the water environment.

12 Geology and soils

12.1 Introduction

This section presents a summary of the indicated ground conditions relevant to the proposed scheme. It includes a high level preliminary geotechnical assessment, a review of the historical land use and potential land contamination, and outlines the preliminary geotechnical and geo-environmental considerations/risks. Where applicable, relevant geological designated sites, landfills/historic landfills and the quality of soils/agricultural land classification within and adjacent to the route have also been identified.

12.2 Assessment methodology

The assessment has been carried out in accordance with:

- The technical framework for structured decision-making about land contamination set out in Model Procedures for the Management of Land Contamination, Environment Agency Contaminated Land Report (CLR) 11 (September 2004)
- Guidance in DMRB Volume 11, Section 3, Part 11 - Geology and Soils (June 1993) in conjunction with supplementary guidance in IAN 125/15 – Environmental Assessment Update (Highways England, October 2015)
- Guidance in DMRB Volume 4, Section 1, Part 2 – Managing Geotechnical Risk (HD 22/08) (August 2008)

12.3 Study area

'The site' refers to the area which covers the extent of any proposed construction works associated with all the currently proposed scheme options for the M25 Junction 25 improvement scheme. The assessment of geology and soils has been carried out on a radial zone of 500m surrounding the footprint of the site.

12.4 Baseline conditions

12.4.1 Sources of information

Baseline information was gathered from the readily available sources listed below. As such, it should be noted that this high level desk based assessment is indicative only at this stage and is pending the findings of a future geotechnical desk study and investigation:

- Banks VJ, Bricker SH, Royse KR and Collins PEF, Anomalous buried hollows in London: development of a hazard susceptibility map, Quarterly Journal of Engineering Geology and Hydrology Vol. 48, pp. 55-170, 2015
- British Geological Survey Borehole Scans (<http://mapapps.bgs.ac.uk/boreholescans/boreholescans.html>), accessed 01/07/2016
- British Geological Survey, Coal Authority interactive Map (<http://mapapps2.bgs.ac.uk/coalauthority/home.html>), accessed 01/07/2016
- British Geological Survey, England and Wales Sheet 239 Solid and Drift Geology, 1:50,000, BGS, 1976
- British Geological Survey 'Geology of Britain Viewer', 1:50,000 (<http://mapapps.bgs.ac.uk/geologyofbritain/home.html>), accessed 01/07/2016
- British Geological Survey, GS Mining Access Portal (<http://mapapps2.bgs.ac.uk/mineplans/home.html>), accessed 01/07/2016
- British Geological Survey Lexicon (<http://www.bgs.ac.uk/lexicon>), accessed 01/07/2016
- Environment Agency What's In Your Backyard website (<http://apps.environment-agency.gov.uk/wiyby/default.aspx>), accessed 04/07/2016
- HE, n.d. Highways Agency Geotechnical Data Management System (HAGDMS) v5.6.0 (<http://www.hagdms.co.uk/>), accessed 29/06/2016

- Multi-Agency Geographic Information for the Countryside, (<http://magic.defra.gov.uk>) accessed 04/07/2016
- Natural England Agricultural Land Classification map- London and the South East: <http://publications.naturalengland.org.uk/publication/141047?category=5954148537204736>
- Natural England Designated Sites View (<https://designatedsites.naturalengland.org.uk>), accessed 04/07/2016
- Natural England Agricultural Land Classification Map of England and Wales (<http://publications.naturalengland.org.uk/publication/141047?category=5954148537204736>), accessed 15/06/2016

As well as an Envirocheck Report purchased from Landmark Information Group on 22/06/2016, held by Atkins and presented in Appendix I.

This preliminary high level desk study assessment excludes the following at this stage of assessment:

- Information from flood assessment data
- A literature review of the local area
- A full review of historical borehole records
- Mining reports
- UXO reports

Due to the high level nature of this desk study, encompassing all three proposed scheme options proposed at this stage, some of the information presented in the above sources may identify additional effects on the proposed scheme. It is therefore recommended that, in accordance with HD 22/08, a full Preliminary Sources Study Report be carried out prior to preliminary design stage.

12.4.2 Current site setting

The site comprises the M25 Junction 25 roundabout, encompassing a 760m stretch of the M25 approximately orientated east to west, and a 650m stretch of the A10 (also referred to as Great Cambridge Road) which is approximately orientated south to south-west to north to north-east.

The junction is set within the urban fringe of north London and has a variety of surrounding land uses including open space, agricultural land, roads and residential/light commercial/institutional properties. New River runs in a north-south direction and is culverted beneath the far western extent of the site.

Nurseries are present 50m to the south, 280m to the north-east and 500m to the south-west of the site. Theobald's Park Farm is 300m to the north of the site.

Capel Manor Gardens are located immediately south-west of the western extent of the site and Theobalds Park is 145m to the north of the western section extent. There are a significant number of recreational grounds present within the vicinity of the site.

Residential properties are present within the south-east quadrant of Junction 25, notably alongside the A1055 and cul-de-sacs extending from this road (including Bullsmoor Ride, Bullsmoor Way, Bullsmoor Gardens and Great Cambridge Road).

Commercial activities within the study area include:

- an aquarium and pond suppliers located alongside the A10, 30m south-west
- dry cleaners 59m to the south-east
- builders merchants 88m to the south-east
- vehicle services 108m to the east
- a glass fibre manufacturers 150m to the south

- petrol stations 122m south-east, 147m to south-east and 300m to the south-east
- vehicle cleaning services 122m and 147m to the south-east
- warehouses and a news printers (Broxbourne Limited) 250m to the north-east
- a veterinary clinic 250m to the south-west
- a fireworks supplier also 250m to the south-west

A north to south orientated railway line is present within the study area, intersecting the M25 approximately 400m east from the centre of Junction 25.

12.4.3 Site history

The earliest available historical map dates from 1864 and latest available dates from 1996. Historical development at the site has been summarised in Table 12.1.

Table 12-1 Historical development of the site and surrounding area

Date	Summary of development at the site	Summary of development in the surrounding area
1864 - 1881	<p>The site is mapped as open fields; the only noticeable development at the site is situated alongside Bullsmoor Lane which runs approximately east to west along the southern extent of the site.</p> <p>A river is shown running approximately north to south across the western part of the site.</p> <p>A pond is present in the north-west quadrant of the site with what appears to be a stream or drainage ditch running approximately east to west and which connects the pond to the river.</p>	<p>Maps from this time do not show the northern section of the site nor any land within 500m of the northern site boundary.</p> <p>The village of Bull's Cross is mapped south-west of the site, generally comprising Manor Farm, Barn Cottages, Manor House, Chapel House and a series of orchards. New River, Turkey Brook and Bullsmoor Lane are mapped in their current alignment (however the rivers are unnamed).</p> <p>An area of marshland is mapped to the south-east of Junction 25. An unnamed river runs across the eastern section of the site and through the marsh in a north – south direction and then flows eastwards along the northern boundary of Bullsmoor Lane.</p>
1872 - 1884	<p>No significant change.</p>	<p>Maps from this time do not show the southern section of the site nor any land within 500m of the southern site boundary.</p> <p>A footbridge is present in the north-west part of the site allowing a footpath to cross the New River.</p> <p>A possible pit is mapped approximately 50m north-west from the centre of the site.</p> <p>A gravel pit is labelled approximately 100m to the north of the western extent of the site.</p> <p>Theobald's Park Farm is mapped approximately 150m north of the centre of the site and Theobald's Park is present approximately 650m to the north-west of the centre of the site.</p> <p>Bullscross Farm and a pond are mapped approximately 350m north-west of the centre of the site and a gasometer and Gas Works are present in the north western part of Bullscross Farm.</p>
1896	<p>The pond is no longer mapped. New River has been named.</p>	<p>The gasometer and Gas Works are no longer shown.</p> <p>The present day railway line is mapped in its current configuration. Bullsmoor Lane is embanked across the new line.</p> <p>Nurseries have been constructed to the north-east of the site, alongside the railway line.</p> <p>The gravel pit to the west of the site now covers a larger extent.</p> <p>A cemetery is located 370m to the north-west.</p> <p>A moat is mapped approximately 50m north-west of the site, where a possible pit was previously identified.</p>
1898	<p>No significant change.</p>	<p>No significant change, although it should be noted that mapping south of Junction 25 is absent.</p>

Date	Summary of development at the site	Summary of development in the surrounding area
1913	No significant change.	No significant change, although it should be noted that mapping north and southeast of Junction 25 is absent.
1914	No significant change.	<p>It should be noted that some mapping south-west of Junction 25 is absent.</p> <p>The railway is now labelled as “G.E.R” and “Edmonton & Cheshunt”.</p> <p>Additional nurseries occupy land approximately 200m to the south of the far-eastern extent of the site and immediately south-east of the location at which Bullsmoor Lane crosses the railway.</p> <p>Additional nurseries have been developed alongside that already present to the north-east and south-east of the site.</p> <p>A branch of the river north of the western extent of the site is now labelled as “New River (old course)”.</p>
1935	Great Cambridge Road has been constructed in a configuration similar to the present day.	<p>The gravel pit to the north-west appears disused. A pond is now present 100m to the south-west from the centre of the site.</p> <p>Land between 50m and 150m to the south of the eastern extend of the site is now occupied by nurseries.</p> <p>Additional nurseries have been built along the railway line to the north-east and a number of tanks are present amongst the development.</p>
1967	<p>Development has occurred on the southern section of the site, including nurseries (mostly to the south-west) and residential properties (mostly to the south-east).</p> <p>Electricity pylons cross the south of the site approximately east to west.</p>	<p>It should be noted that mapping west and north-west of Junction 25 is absent.</p> <p>Significant residential development is apparent to the south-east.</p> <p>A drain running in a west – east direction is shown to run alongside a lane 130m to the north from the most northern extent of the site.</p> <p>Some of the nurseries to the east and north-east of the site have been demolished.</p> <p>Nurseries immediately south of the railway line/ Bullsmoor Lane crossing have been demolished and replaced with a playing field, paddling pool and playground.</p>
1969 - 1975	Some new residential developments are shown in the southern portion of the site, adjacent to Great Cambridge Road.	<p>Land C. 160m to the north of the western extent of the site is in use as a campsite.</p> <p>Some of the nurseries to the north-east are no longer present.</p> <p>Tanks and filter beds occupy land 480m to the north of the eastern extent of the site.</p>
1983 - 1987	The M25 has been constructed and the site reflects its current configuration. Significant construction works have occurred in the central part of the site, associated with the structures across the M25.	<p>It should be noted that mapping south-east of Junction 25 is absent.</p> <p>A small reservoir is shown immediately north of the site and east of New River.</p>
1989 - 1992	No significant change.	<p>Some additional residential development.</p> <p>A school and sports field are shown to the south-east of the site, east of the railway line.</p>
1994 - 1996	<p>Mapping only available for the north western part of the site.</p> <p>No significant change.</p>	<p>Mapping is only available for the area north-west of the site.</p> <p>The old gravel pit is shown as a marsh and another marsh is shown to the east of the old gravel pit.</p> <p>A small reservoir is shown immediately north of the M25, adjacent to the New River.</p>

Environmental datasheets, taken from the site specific Envirocheck Report (Appendix I), identified the following historical features and land uses within 500m of the site boundary which historical maps did not reveal. These are detailed below (distances are provided from the centre of the site):

- potentially infilled ponds (other than those identified on historical maps) 141m to the north-west and 408m to the north
- historical landfill sites 350m to the north-east (ceased operation in 1971) and 385m to the south-east (end date not known)
- registered landfill site 766m to the north-east (first received waste in 1982)
- brewers 72m to the south-east
- vehicle servicing and repairs 108m to the east
- petrol filling stations 178m to the east, 122m to the south-east, 134m to the south-east, 147m to the south-east
- wheelie bin cleaning service 204m to the east
- cleaning services 228m to the east, 297m to the south
- catering equipment services 299m to the east
- joinery manufacturers 450m to the south-west
- historical and active tanks located 124m, 136m, 150m, 161m, 163m and 174m to the east; 122m to the south-west; 191m to the north-east and 254m to the north-east

12.4.4 Geology

12.4.4.1 Structural geology

The study area is located on the northern limb of the north-east to south-west trending London Basin Syncline. The available geological information does not indicate that any faults are present within the vicinity of the study area.

12.4.4.2 Artificial deposits

Although not indicated on the geological maps, Made Ground associated with infrastructure construction, is anticipated to be present at the site. Within the junction, Made Ground is expected at embankment and structure locations and associated with road and railway line construction. Elsewhere Made Ground is anticipated at the locations of commercial, industrial and residential developments and their associated infrastructure, including roads and railway lines.

12.4.4.3 Superficial deposits

Geological mapping indicates that Junction 25 is underlain by superficial deposits of Enfield Silt Member (formerly known as Brickearth). Kempton Park Gravel Member (formerly known as Kempton Park Gravel Formation) is present immediately east of Junction 25, River Terrace Deposits are present immediately to the north-west and Taplow Gravel Member (formerly known as Taplow Gravel Formation) is present immediately to the south-west, as shown on Figure 12-1 below.

Kempton Park Gravel Member, Taplow Gravel Member and River Terrace Deposits generally comprise sand and gravel, containing localised lenses of silt, clay and/or peat. Enfield Silt Member is typically cohesive, comprising silt and clay.

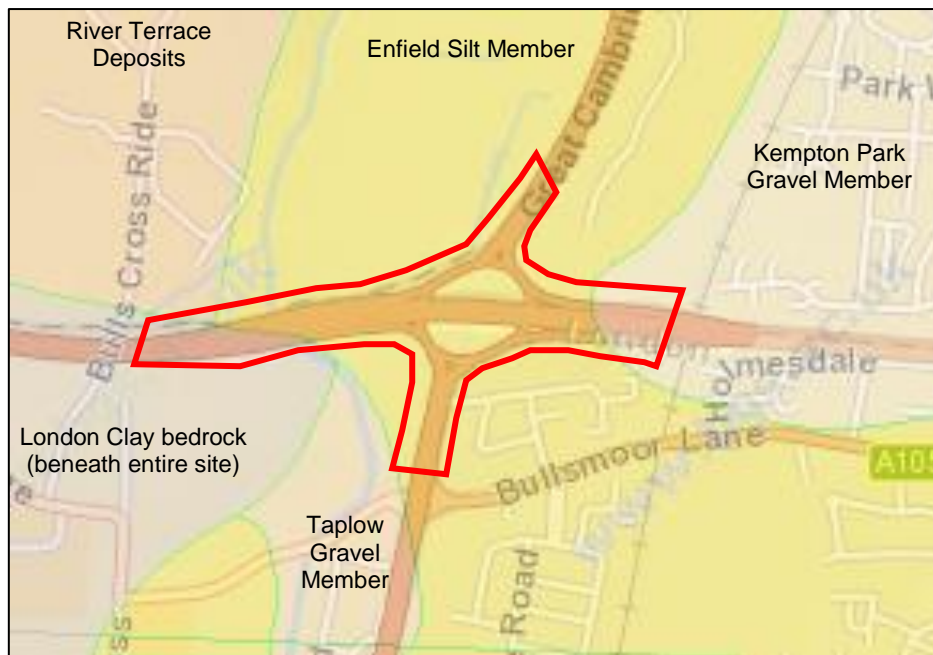
12.4.4.4 Bedrock geology

The solid geology at the study area is anticipated to comprise London Clay Formation of the Thames Group over Woolwich and Reading Formations of the Lambeth Group. White Chalk Subgroup of the Chalk Group is anticipated beneath strata of the Lambeth Group.

London Clay Formation is generally described as a bioturbated or poorly laminated, fissured, blue-grey or grey-brown (when weathered) silty to very silty clay. Woolwich Formation generally comprises glauconitic sands and red mottled clays and sands. Reading Formation generally comprises grey clays and sands with brackish fauna. White Chalk Subgroup

generally comprises chalk with flints and discrete marl seams. The upper section of the chalk will likely be weathered, structureless chalk with less weathered, structured chalk at depth.

Figure 12-1 BGS Geology mapping of the area surrounding M25 Junction 25 (Modified from BGS 'Geology of Britain Viewer'. Labels based on BGS Lexicon.)



12.4.4.5 Historical boreholes

The BGS holds a wealth of available boreholes relevant to the study area. Figure 12.2 in Appendix J presents a geological map of the site with the locations of the BGS historical boreholes included. Whilst a review of the more pertinent available records has been carried out to further inform anticipated ground conditions at the site, not all of the available borehole records available or presented within Figure 12.2 have been reviewed as part of this high level assessment. Boreholes will be further reviewed as part of the ongoing desk study for the preferred option.

Contrary to information provided on the available geological maps for the area, London Clay Formation and in some cases Lambeth Group are absent within the borehole records around the area of the eastern overbridge carrying the existing Junction 25 roundabout over the M25. Here, particularly thick deposits of medium dense gravel with occasional layers of silt, sand and clay are recorded. These deposits were recorded to be of a maximum thickness of 28.6m in TL30SE136, where they are indicated to lie directly on top of White Chalk Subgroup. This feature is consistent throughout the borehole records in a discrete, localised portion in the eastern side of the site, as indicated in Figure 12.3 in Appendix J. Figure 12.2 includes a section line; an indicative geological long section, based on ten of the available BGS exploratory hole records along the M25 in the eastern portion of the site, has been produced and is presented as Figure 12.3.

The borehole log descriptions provided for gravel materials encountered in the eastern portion of the site, are interpreted to be superficial deposits, rather than granular deposits of the Lambeth Group. Lambeth Group is identified in other boreholes, outside the extent of this localised feature, as comprising sand and silt. Given the variability of the Lambeth Group and the poor strata descriptions, it is possible that some of the material that has been interpreted as superficial deposits are instead gravel layers within the Lambeth Group, and therefore the extent of the geological anomaly may not be as deep as that depicted in Figure 12.3.

Whilst the data available is limited, it is considered most likely that the geological anomaly corresponds to either a deep, buried river channel, or a buried hollow (also known as a rock-head depression or drift-filled hollow). The presence of London Clay Formation in the boreholes around the feature suggest that a buried hollow is more likely, however it should be noted that limited BGS borehole records are available immediately north and south of the feature and those that are available lack the descriptive quality that would be required to make interpretations with confidence.

Banks *et al* (2015) produced a map that assessed the susceptibility of an area to buried hollows, whereby the following three factors were used as classification criteria:

- the presence of Kempton Park Gravel Member
- the presence of London Clay Formation in less than 35m thicknesses, or if absent large portions of clay material within the Lambeth Group
- the presence of artesian groundwater

Given that Kempton Park Gravel Member is present, and London Clay Formation is present in thicknesses under 35m, Banks *et al* (2015) would classify the study area as having a moderate susceptibility to buried hollows.

Although assumptions can be made as to the origins of this feature, detailed assessment, including a targeted ground investigation, should be carried out to ascertain certainty in its size, location, composition, depth and the geotechnical properties of infill material.

Elsewhere across the site, borehole records suggest a stratigraphic profile consistent with geological mapping, further details of anticipated ground conditions are provided in Table 12-2.

12.4.4.6 Summary

Table 12-2 summarises the anticipated geology at M25 Junction 25.

Table 12-2 Summary of anticipated geology

Group	Formation		Thicknesses (m)	Top depth encountered in BGS boreholes (m bgl)	Location and description (BGS Lexicon)
Made Ground			0 – 11.	Ground level	Anticipated to likely comprise reworked Enfield Silt Member and Kempton Park Gravel. Expected to be localised to and associated with construction of the M25.
Thames Catchments Subgroup	Maidenhead Formation	Enfield Silt Member	0 – 6.	Ground level	Varies from silt to clay, commonly yellow-brown and massive.
		Taplow Gravel Member	0 – 3.	Ground level	Sand and gravel, locally with lenses of silt, clay or peat. Fluvial deposit.
		Kempton Park Gravel Member	Generally 0 – 8, up to 20 at location of buried hollow.	Ground level	Sand and gravel, locally with lenses of silt, clay or peat.
Fluvial Deposits	River Terrace Deposits		0 – 5.	Ground level	Sand and gravel, locally with lenses of silt, clay or peat.
Thames Group	London Clay Formation		Generally 12 – 15; Absent within assumed buried hollow.	4.0 (borehole TQ39NW405)	Mainly comprises bioturbated or poorly laminated, blue-grey or grey-brown, slightly calcareous, silty to very silty clay, clayey silt and

Group	Formation	Thicknesses (m)	Top depth encountered in BGS boreholes (m bgl)	Location and description (BGS Lexicon)
				sometimes silt, with some layers of sandy clay. Commonly contains thin courses of carbonate concretions ('cementstone nodules') and disseminated pyrite. It also includes a few thin beds of shells and fine sand partings or pockets of sand, which commonly increase towards the base and towards the top of the formation. At the base, and at some other levels, thin beds of black rounded flint gravel occurs in places. Glauconite is present in some of the sands and in some clay beds, and white mica occurs at some levels.
Lambeth Group	Woolwich Formation and Reading Formation	Generally 15 – 21; Absent within assumed buried hollow.	16 (boreholes TQ39NW405 and TL30SW63)	Vertically and laterally variable sequences mainly of clay, some silty or sandy, with some sands and gravels, minor limestones and lignites and occasional sandstone and conglomerate. Glauconitic sands at base (Upnor Formation), overlain by grey clays and sands with brackish fauna (Woolwich Formation), and interleaved red and variegated clays and sands (Reading Formation).
Chalk Group	White Chalk Subgroup	Base not proven, greater than 63m in borehole TQ39NW405.	26 (borehole TL30SE387)	Chalk with flints. With discrete marl seams, nodular chalk, sponge-rich and flint seams throughout.

12.4.5 Hydrogeology

The Enfield Silt Member and London Clay Formation are considered to be unproductive strata. Granular superficial deposits of Kempton Park Gravel Member, Taplow Gravel Member and River Terrace Deposits are classified as superficial Secondary 'A' Aquifers⁶⁷ collectively termed the Upper Aquifer. The Lambeth Group is classified as a bedrock Secondary 'A' Aquifer by the Environment Agency, while the Chalk Group, anticipated at depth, is classified as a Principal Aquifer⁶⁸. The Lambeth Group and the Chalk are known to be hydraulically connected, albeit limited via clay units within the Lambeth Group. Therefore the two units are collectively termed the Lower Aquifer.

The deep thickness of superficial gravels and sand identified beneath the eastern M25/Junction 25 overbridge has the potential to provide some connectivity between the Upper and Lower Aquifers (please refer to Figure 12.3).

The majority of the site is located in a Zone 1 Groundwater Source Protection Zone (SPZ), with the northern, eastern and southern parts of the study area being located within a Zone 2

⁶⁷ A Secondary A aquifer is defined as an aquifer with, 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers'.

⁶⁸ A 'Principal Aquifer' is defined by the Environment Agency as layers of rock or drift deposits that have high intergranular and/or fracture permeability – meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifers.

SPZ. Parts of the potential deep infilled channel or buried hollow are located within the SPZ1 and SPZ2. The far eastern extent of the site is not located within an SPZ.

The Envirocheck report (Appendix I) indicates that five groundwater abstraction licences are active within the study area or within 500m of the study area. These are; immediately south-west of the study area; 207m to the north-east and 250m to the south-west of the centre of the Junction 25 roundabout. An abstraction for horticultural water supply is indicated approximately 400m to the north-east of the centre of the Junction 25 roundabout.

The Envirocheck report (Appendix I) indicates four discharge licences recorded within the study area. The nearest of which is reportedly for 'Trade Discharge – Process Water' and located approximately 50m to the south-west. There are three others located between 180m and 250m to the west of the site, of which are licences for the discharge of final effluent sewage.

The site is not subject to tidal influence.

BGS borehole logs suggest that perched groundwater may be encountered within the superficial deposits anticipated to be encountered at the study area.

The BGS groundwater flooding susceptibility mapping shows the potential for groundwater flooding to occur at the surface at the eastern extent of the site in the area around the Holmesdale Tunnel.

12.4.6 Hydrology

As previously noted in Section 11.4, a number of surface waterbodies are present within the study area. These include two watercourses classified under the WFD (2000/60/EC), namely 'Unknown' which relates to an aqueduct also known as New River that passes beneath the existing M25 immediately to the west of the junction and the 'Turkey Brook and Cuffley Brook' waterbody is to the south of the junction, flowing in an easterly direction, broadly parallel to the M25. New River is culverted where it passes under the Turkey Brook.

The EA flood map for planning identifies a Flood Zone 2⁶⁹ is located adjacent to the eastern extent of the study area however the map detailing risk of flooding from rivers and seas does not identify this zone.

The EA flood maps also indicates that the site is prone to surface water flooding. The Envirocheck report (Appendix I) indicates that a surface water abstraction is present 350m to the west of the centre of the Junction 25 roundabout for 'Spray Irrigation'. A discharge of final/treated sewage effluent into a freshwater stream/river is indicated 550m to the west of the centre of the Junction 25 roundabout.

12.4.7 Mining activity and quarrying

The site is not located in an area affected by mining or quarrying based upon a review of the Coal Authority interactive map viewer and BGS non-coal mining plans.

Data provided within the Envirocheck report (Appendix I) indicates that a gravel pit shown in the historical maps up to 1935 aligns with a BGS recorded mineral site located adjacent to the north western extent of the study area. Records indicate it operated as an opencast quarry for the abstraction of sand and gravel. Two records of potentially infilled land (both with and without water) are indicated in the vicinity of the historical gravel pit.

A linear feature approximately 300m long and marked as potentially infilled land (water) is shown along the northern edge of the M25 extending from the Junction 25 roundabout westwards within the Envirocheck report.

12.4.8 Geological SSSI

No SSSIs or Local Geological Sites have been identified within the 500m radial study area.

⁶⁹ Flood Zone 2 - a flood zone with up to a 0.1 per cent (1 in 1000) chance of occurring each year

In summary, no further consideration of special geological features is required for any of the proposed scheme options.

12.4.9 Ground stability

1:50,000 scale ground stability mapping, provided in the Envirocheck report (Appendix I), identifies that most of the site is located in an area of low potential for collapsible ground stability hazards. At the western and eastern extents of the site, the potential for collapsible ground stability hazards is shown to be very low.

The potential for landslide ground stability hazards within the site extent is generally very low, although some areas in the western and eastern parts of the site are shown as having low potential.

The potential for shrinking or swelling clay ground stability hazards is shown to be very low across most of the site, but is moderate at the western, southern, and eastern extents of the site. An area of high potential for shrinking or swelling of clay is indicated in the western part of the site.

The motion map data provided within the Envirocheck report provides an indication into long-term stability across the UK, based on analysis of satellite radar data. It shows that the site is mainly stable (<1.5mm movement per year), but upward movement of 1.5mm to 3.5mm per year and downward movement of -1.5mm to -3.5mm per year has been recorded on the A10 in the southern part of the site. No movements of >3.5mm per year are shown within 100m of the site.

12.4.10 Contaminated land

The Environment Agency website records two historical landfill sites in the north eastern and south eastern quadrants of the study area, known as Park Lane and Aylands Open Space, respectively. These are positioned adjacent to the railway line. Park Lane historical landfill is situated approximately 400m north-east of Junction 25 and operated between 1963 and 1971. This landfill is known to have held inert, commercial, household and special waste (waste that has hazardous properties). Aylands Open Space historical landfill is situated approximately 400m south-east of Junction 25; details regarding this landfill are not known.

Infill/Made Ground is likely to be present at the site, associated with the construction of the A10, M25 and railway line, alterations to surface water courses and the historical infilling of a pond and gravel pit. The source of Made Ground is unknown and it is therefore considered that contamination may be encountered within and close to these areas. Historically the area was extensively occupied by nurseries and so glass may be a significant component of Made Ground.

Potentially contaminative activities/land uses have occurred within the vicinity of the site which include a news printing plant, warehousing, nurseries, fibre glass manufacturers, petrol filling stations, builder's merchants, a cemetery and a brewers. There is one recorded pollution incident which occurred within the vicinity of Junction 25. This occurred on the M25 anticlockwise off-ramp in 1997 and resulted in a minor impact to controlled waters.

The potential presence of contamination may pose a risk to the identified receptors during the construction works for the proposed scheme options. Contamination may be present within the materials and any associated leachate or groundwater. Such materials could also result in the generation of vapours, ground gas generation or the presence of aggressive chemicals which may potentially migrate off-site along service ducts. In terms of the proposed site works, risk to site workers should be mitigated by the use of appropriate PPE and application of safe working practices.

Other potential receptors identified include:

- workers employed locally at commercial premises namely to the south-west of the junction

- workers and children attending local schools and colleges (including Lea Valley High School (190m to the south), Hurst Drive Primary School (196m to the north), Capel Manor College (280m to the south-west), Capel Manor Primary School (390m to the south) and Honilands Primary School (440m to the south))
- workers at Western and West End Great Synagogue (417m to the north-west)

Characterisation of the soils and groundwater will be required and it is recommended that a full geo-environmental desk study is carried out prior to detailed design. A ground investigation is also required in order to reduce geo-environmental risk and to facilitate detailed design. A risk assessment will then be required to assign reuse and testing criteria to inform a Materials Management Plan (MMP) and Site Waste Management Plan (SWMP) to satisfy waste management regulations and guidance (see section 13). Subject to the findings of the ground investigation, risk assessment may also be necessary to determine the requirement for remedial measures to address any risks identified to any receptors. Piling Risk Assessments may also be required for the protection of controlled waters, subject to the findings of the risk assessment, and with approval sought from the Environment Agency. These will have implications on both cost and programme and should be considered at the early stages of the project.

12.4.11 Quality of soils / Agricultural soils classification

According to Natural England Regional Agricultural Land Classification Maps, the western section of the site falls within an area classified as a Grade 3 (good to moderate quality land). The south western section of the site falls within an area classified as land predominantly in urban use.

The study area is located within a surface water nitrate vulnerable zone.

12.4.12 Existing earthwork condition

A review of the Highways England Geotechnical Database Management System (HA GDMS) has identified that all earthworks located adjacent to the M25 within the study site are classified as being in either 'A – As New' or 'C – Satisfactory' condition in accordance with Schedule 14 of the M25 Design, Build, Finance and Operate contract (Connect Plus Services, Geotechnical Asset Condition Methodology, June 2011).

Four minor geotechnical defects are recorded on HA GDMS and are identified in Table 12.3. It should be noted that observation records for the A10 are not included within the HA GDMS.

Earthworks are inspected and geotechnical observations are recorded in accordance with Highways England guidance in the DMRB Volume 4, Section 1, Part 3 – Maintenance of Highway Geotechnical Assets (HD 41/15). Observation classification is determined based on the quality of the feature and its location observed during walkover inspections.

Table 12-3 Summary of observed earthwork features

Feature ID	Feature Class	Description
5_M25_4663_503139	1D – Minor defect	1m by 1.5m by 0.3m deep erosion feature in French drain filled with assorted debris and silt.
5_M25_4663_503137	1D – Minor defect	Seepage induced erosion next to bridge
5_M25_4672_503142	1D – Minor defect	Soil slip, 9.5m wide. 0.5m backscar in top third of slope. Slip is below concrete plinth of aqueduct on which there is evidence of seepage. Lower slope bulge.
5_M25_4673_461604	1D – Minor defect	Small soil slip and discontinuous tension cracks located in midslope.

12.5 Regulatory / Policy framework

This assessment has been prepared in line with the National Planning Policy Framework 2012 which states that the site should be suitable for its new use. The suitability for use designation takes account of ground conditions and land instability, including issues arising from natural hazards or former activities, and pollution arising from former land uses.

This section highlights the regulations and policy directly concerning geology and soils for the M25 Junction 25 proposed scheme options. The applicable regulations, policy and guidance documents are outlined below:

- Mines and Quarries Act 1954
- Control of Pollution Act 1974
- Wildlife and Countryside Act 1981 (amended 1985) (for Geological SSSIs)
- Environmental Protection Act 1990 (c. 43), as amended by the Environment Act 1995
- Town and Country Planning Act 1990
- Anti-Pollution Works Regulations 1999
- Pollution Prevention and Control Act 1999
- Water Framework Directive 2000 (2000/60/EC)
- Contaminated Land (England) Regulations 2000
- Control of Pollution (Oil Storage) (England) Regulations 2001
- Control of Substances Hazardous to Health (COSHH) Regulations 2002
- Water Resources Act 2003
- Borough of Broxbourne Local Plan Second Review (Broxbourne Borough Council, 2005) alongside Sustainability Appraisal of the Broxbourne Emerging Local Plan (July 2016)
- The Dangerous Substances Directive (78/44/EEC) (replaced by the CLP Regulation, 2008)
- Safeguarding our Soils – A Strategy for England 2009
- Waste Management Regulations 2011
- National Planning Policy Framework 2012
- National Networks National Policy Statement 2014
- DMRB Volume 11, Section 3, Part 11 (as amended), 1993
- Interim Advice Note 125/15 (2015)
- DMRB Volume 4, Section 1, Part 2 (HD 22/08) (2008)
- DMRB Volume 4, Section 1, Part 3 (HD 41/15) (2015)
- MCHW Volume 1, Series 600 (2016)
- MCHW Volume 2, Series 600 (2016)
- MCHW Volume 1, Series 1600 (1998)
- MCHW Volume 2, Series 1600 (1998)
- MCHW Volume 1, Series 1700 (2014)
- MCHW Volume 2, Series 1700 (2014)
- Interim Advice Note 124/11 (2011)
- Interim Advice Note 161/15 (2015)
- Eurocode 0: Basis of Structural Design
- Eurocode 7: Geotechnical Design

Good practice guidance is also provided by the Environment Agency and Defra in Contaminated Land Report (CLR) 11 – Model Procedures for the Management of Land Contamination. CLR11 provides a technical framework for the application of a risk management process for dealing with land affected by contamination. The assessment framework and guidance given within these documents have been considered in this assessment.

12.6 Preliminary engineering assessment

An assessment of the anticipated ground conditions at the site has been carried out for each of the currently proposed scheme options, with consideration also given to the differing engineering requirements of each option. Figure 12.2 presents the currently proposed scheme options alongside the geological map of the area. Figure 12.2 also includes a section line, the indicative cross section discussed in section: baseline conditions; geology is presented at Figure 12.3.

12.6.1 Option 1

In order to accommodate widening of the Junction 25 roundabout for new lane construction, the following will be required:

- reinforcement of two existing bridges crossing over the M25 so that the carriageway can be extended into the existing hard verge and cycle lane
- construction and extension of new and existing embankments

Realignment of the existing footway and strengthening of existing embankment slopes is proposed for widening of the A10 southbound off-slip, to minimise the land take required outside the existing highway boundary,.

To accommodate the construction of a new cycle path and footbridge, the following has been proposed:

- construction of new paving approximately parallel to the A10 on-slip and off-slip roads
- refurbishment and lengthening of existing subways
- construction of new strengthened embankments
- construction of a new over bridge over the M25 within the centre of the Junction 25 roundabout

Ground conditions are anticipated to comprise superficial deposits of Enfield Silt Member and Kempton Park Gravel Member which are classified as Secondary 'A' Aquifers over solid geology of London Clay Formation for the majority of this option. Made Ground associated with construction of the M25 and A10 roads, existing embankments and existing structures will be encountered. Strengthening of the eastern M25 overbridge and widening of its approach roads, as well as construction of the new cycle bridge and paths are proposed where the buried hollow is anticipated. London Clay Formation and Lambeth Group are not anticipated at the suspected location of the buried hollow; instead superficial deposits of sands and gravels with beds of silt and clay are expected (up to 20m thickness), likely overlying White Chalk Subgroup. The suspected buried hollow is also located within an SPZ1 and an SPZ2.

12.6.2 Option 2

The works proposed in Option 1 are also included in the current proposal for Option 2.

In order to accommodate construction of a dedicated left hand turn from the M25 clockwise carriageway to the A10 northbound carriageway while remaining within the existing Highways England land boundary, steepening and strengthening of existing earthworks (embankments and cuttings) is proposed. Ground conditions are anticipated to comprise superficial deposits of River Terrace Deposits, Enfield Silt Member and Kempton Park Gravel Member over solid geology of London Clay Formation. The River Terrace Deposits and Kempton Park Gravel Member are both classified as Secondary 'A' Aquifers. Made Ground associated with existing embankments of the A10 and M25 may be encountered.

In order to accommodate widening of the existing M25 anticlockwise off-slip, construction of a new retaining structure is proposed, most of which is within the anticipated extent of the buried hollow, where ground conditions are anticipated to comprise superficial deposits of sands and gravels with beds of silt and clay (up to 20m thickness), directly overlying White

Chalk Subgroup. Outside of the extent of the buried hollow, ground conditions are anticipated to comprise superficial deposits of Enfield Silt Member and Kempton Park Gravel Member over solid geology of London Clay Formation. Made Ground associated with construction of the M25 and A10 roads, existing embankments and existing structures will be encountered.

12.6.3 Option 3

The works proposed in Option 1 and Option 2 are also included in the currently proposed Option 3.

In order to accommodate the construction of a dedicated left hand turn from the A10 northbound carriageway to the M25 anticlockwise carriageway, the following have been proposed:

- widening of the existing M25 anticlockwise within an existing cutting
- modification of the existing aqueduct
- steepening and reinforcement of existing earthworks to minimise new land requirements
- widening of the existing A10 northbound carriageway
- realignment of the existing aqueduct access track, whereby construction of new or redevelopment of existing earthworks may be required

In order to accommodate the construction of a dedicated left hand turn to Bullsmoor Lane, widening and realignment of the existing A10 carriageways is proposed.

The ground conditions for the majority of the works proposed within *Option 3* only are anticipated to comprise superficial deposits of Enfield Silt Member and Kempton Park Gravel Member over solid geology of London Clay Formation. Made Ground associated with construction of the M25 and A10 roads, existing embankments and existing structures will be encountered.

Superficial deposits are not anticipated at the western extent of the site, where strengthening of the existing M25 anticlockwise on-slip cutting is proposed. Superficial deposits of Taplow Gravel Member may be encountered at the southern extent of the proposed option, where widening of the existing A10 northbound carriageway and realignment of the existing aqueduct access track is proposed.

12.7 Potential effects

Published geological data and available environmental datasheets, as taken from the site specific Envirocheck Report (Appendix I), have been used to produce the high level preliminary geotechnical risk register presented as Table 12.4 below. Potential hazards associated with the geology and soils of the study area have been identified, and plausible mitigation strategies have been outlined. This is for indicative purposes only, and further site-specific investigations should be carried out to gain a better understanding of the risks present for each option and to aid more detailed design of mitigation measures. An initial assessment of the risk presented by each identified hazard is presented for each of the proposed scheme options.

12.7.1 Summary of high level risk identification

Where ground conditions associated with an identified hazard are not anticipated at this stage, the risk associated with that hazard is considered Low (L). Where the ground conditions associated with an identified hazard are present, but it is considered that the hazard will have minimal impact on the project, the risk is considered Moderate (M). Where anticipated ground conditions are such that an identified hazard may have a major impact on the project, the risk is considered High (H).

From a review of the historical maps and other publically available sources of information, several potential sources of contamination have been identified within or in proximity to the

scheme. On-site sources of potential contamination include infill/Made Ground associated with the construction of the A10, M25 and their associated infrastructure, alterations to surface watercourses and the historical infilling of a pond and gravel pit on the western section of the site. Off-site potential sources include the nearby Aylands Open Space historical landfill site, nearby railway lines, a news printing plant, warehousing, fibre glass manufacturers, petrol filling stations, builder's merchants, a cemetery and a brewery. Historically the area was extensively occupied by nurseries and so glass may be a significant component of Made Ground.

Potential human receptors include local residents, workers at nearby commercial premises, visitors to the Capel Manor College Gardens and future site workers.

Potential controlled waters receptors comprise groundwater receptors which include SPZ 1 and SPZ 2, the nearby superficial Secondary A Aquifer to the east and west and potentially the Lower Aquifer (Secondary A and Principal Aquifer) in the vicinity of the deep, buried river channel, or a buried hollow, as well as potential surface water receptors which include the New River.

Potential sources of contamination and receptors associated with the proposed scheme options are shown on Figure 12.4 in Appendix J.

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

- inhalation, ingestion and dermal contact with contaminants in soil and soil-derived dust/fibres
- inhalation, ingestion and dermal contact with contaminants within perched water and shallow groundwater (if present)
- migration and accumulation of ground gases followed by inhalation or ignition causing asphyxiation and/or explosion
- inhalation of vapours

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

- surface water run-off
- leaching/migration of contaminants in soils to underlying groundwater in the Upper Aquifer
- lateral migration of contamination in groundwater in the Upper Aquifer
- lateral migration of contamination in groundwater in the Upper Aquifer to surface waters
- vertical migration of contamination in groundwater within the Upper Aquifer down to the Lower Aquifer
- lateral migration of groundwater within the Lower Aquifer within the SPZ 1 and SPZ 2 and related groundwater abstraction points.

Table 12-4 High level risk register




Hazard	Description	Mitigation	Problematic materials or conditions	Risk rating in		
				Option 1	Option 2	Option 3
Unexpected ground conditions, presence of a buried hollow	Ground conditions encountered are different to those anticipated, leading to time and cost implications during the ground investigation and construction phases.	Carry out a PSSR and Annex A to determine the likely ground conditions, and perform a site specific ground investigation, including targeting the presence of the suspected buried hollow, to assess ground conditions and site specific geotechnical characteristic values, including an assessment of contamination and groundwater.	Generic risk	H	H	H
Buried & overhead services	Buried services associated with the roads and other nearby infrastructure are likely abundant throughout the study area. Overhead services are likely present which may interfere with construction or drilling equipment.	Contractor to ensure they are satisfied that all present services have been located prior to intrusive works. Service surveys may be required, and some services may need to be diverted.	Generic risk	H	H	H
Variable ground conditions, presence of a buried hollow	Inconsistency in material properties may occur due to variable materials and/or weathering profiles. This can lead to complications during the ground investigation phase, and when considering geotechnical parameters during the detailed design phase. Local changes in permeability can give rise to localised changes in the groundwater conditions, such as perched water or groundwater ingress.	Carry out a PSSR and Annex A to determine the likely ground conditions, and perform a site specific ground investigation, including targeting the presence of the suspected buried hollow, to assess ground conditions and site specific geotechnical characteristic values, including an assessment of contamination and groundwater. Contractors Method Statement should identify ways to deal with variable ground that may be encountered.	Generic risk; particularly likely in the area of the buried hollow.	H	H	H
High groundwater table, perched and water ingress.	High groundwater levels or groundwater within more permeable layers above the groundwater table may present a geotechnical risk or cause complications during the construction and ground investigation phases. Groundwater ingress can lead to instability or collapse of excavations.	Groundwater levels should be monitored during the ground investigation phase, accounting for seasonal variation. Appropriate water control and excavation support should be considered during ground investigation and construction.	Superficial Deposits	M	M	M
Clay shrink-swell	High plasticity clay minerals are susceptible to shrinkage and swelling as	Consideration should be given to the foundations during detailed design stage.	Bedrock Geology	M	M	M

Hazard	Description	Mitigation	Problematic materials or conditions	Risk rating in		
				Option 1	Option 2	Option 3
	the weather and groundwater conditions change. This can cause differential settlement, and thus structural damage, to overlying structures.	Foundations must be designed deep enough so that clay shrink / swell has minimal impact on the structure. Ground investigation should establish the depth and composition of superficial cover.				
Soft, compressible and/or low strength ground	Soft, compressible and/or low strength ground may cause excessive settlement or bearing capacity failure to any structures founded onto or above the associated materials.	Consideration should be given to the foundations during detailed design stage. Piled foundations or replacement of the bearing strata with a stronger or less compressible material (such as compacted granular fill) may be required, depending on material properties and loading conditions.	Made Ground	M	M	M
			Superficial Deposits, particularly the Enfield Silt Member	H	H	H
Ground conditions aggressive towards concrete	Presence of sulphate and/or sulphide bearing materials (such as natural materials containing pyrite or high amounts of organic matter) within the ground may induce sulphate attack on buried concrete structures, causing major deterioration to the strength of the concrete.	Chemical testing should be carried out on soil and groundwater samples during the Ground Investigation phase to determine the aggressiveness of the ground towards concrete. Any buried concrete structures should be designed in accordance with the Building Research Establishment Special Digest 1 during detailed design stage.	Made Ground	H	H	H
			Bedrock Geology	H	H	H
Hard layers encountered during drilling / excavation	Hard layers, such as ferruginous concretions and septarian nodules, may cause delays or damage to drilling equipment during the construction and ground investigation phases, potentially resulting in programme delays and/or cost implications.	Carry out a PSSR and Annex A to determine the likely ground conditions, and perform a site specific ground investigation, including targeting the presence of the suspected buried hollow, to assess ground conditions and site specific geotechnical characteristic values, including an assessment of contamination and groundwater. Contractors Method Statement should identify ways to deal with hard layers that may be encountered.	Bedrock Geology	M	M	M
Weathered bedrock	The surface of the bedrock will likely have an irregular weathering profile, giving rise to differing geotechnical properties compared to the underlying unweathered material. The weathered surface material will likely be weaker, and fissures may be more abundant	Carry out a PSSR and Annex A to determine the likely ground conditions, and perform a site specific ground investigation, including targeting the presence of the suspected buried hollow, to assess ground conditions and site specific geotechnical characteristic values, including an assessment of contamination and groundwater. The ground investigation should	Bedrock geology	H	H	H

Hazard	Description	Mitigation	Problematic materials or conditions	Risk rating in		
				Option 1	Option 2	Option 3
	causing uncharacteristic behaviour and altering the groundwater regime.	permit assessment of the bedrock weathering profile, to aid determination of site specific geotechnical characteristic values and the difference in characteristics between the weathered and unweathered bedrock.				
Existing earthwork defects (unidentified or developing)	Defects to the existing earthworks are areas of weakness, and may present a risk of landslip during ground investigation and construction. Whilst some defects have already been identified, there may be existing defects beyond those identified	Continued inspections of nearby earthworks to be undertaken, and identified defects near to the proposed works to be repaired. Remediation of significant defects may be required.	Work on or near existing cuttings and embankments.	H	H	H
Destabilisation of excavation side walls	Collapse of excavation side walls due to removal of supporting material. Particularly likely where groundwater is present.	Consideration should be given to the size of excavations. Excavations of sufficient depth may require stabilization.	Superficial Deposits, particularly the Enfield Silt Member	M	M	M
Destabilisation of slopes	Loading or regrading of existing slopes may make them become unstable. Foundation capacity will be reduced near to sloping ground.	Structures should be constructed at the toe or away from the crest of slopes. Retaining structures may be necessary for structures cutting into existing slopes. Slope analyses may be required to establish the baseline stability, and account for differing loading conditions, and particularly where existing earthworks are being altered in any way. Stability surveys and continued monitoring may be required to ensure slopes are and remain in a stable condition.	Work on or near slopes	H	H	H
Encountering contaminated materials and opening of	Historical infilling of wastes may not have been capped and confined within an impermeable membrane.	Physical and/or chemical hazard to human receptors: Appropriate PPE to be worn on site. Removal and correct disposal of such wastes.	Possible contamination; Landfill material, engineered fill or Made Ground	M	H	H
		Release of contaminants into groundwater or surface water sources from surcharge: Minimising impact of construction work which could lead to the release of contaminants into the environment.		M	M	M

Hazard	Description	Mitigation	Problematic materials or conditions	Risk rating in		
				Option 1	Option 2	Option 3
source-receptor pathways	Organic and inorganic contaminant residue may have laterally migrated within Made Ground and superficial deposits or within groundwater (if present) beneath the site and may have accumulated.	Physical and/or chemical hazard to human receptors: Appropriate PPE to be worn on site. Removal and correct disposal of such wastes.	Unknown, possible contamination; Residue contamination from historical and current land uses including news printing plant, warehousing, nurseries, fibre glass manufacturers, builder's merchants, cemetery and a brewers	L	L	L
		Release of contaminants into groundwater or surface water sources from surcharge: Minimising impact of construction work which could lead to the release of contaminants into the environment.		M	M	M
	Due to the absence of London Clay (aquitar) there is potential for contaminants to migrate down to the Lower Aquifer, and into Source Protection Zones as a result of construction works.	Release of contaminants into groundwater or surface water sources from surcharge: Minimising impact of construction work which could lead to the release of contaminants into the environment.		M	M	M
Piling activities creating preferential pathway facilitating the moment of contamination.	Piling has the potential to affect the flow of groundwater and creating preferential pathways for the migration of contaminants. Due to the absence of London Clay (aquitar) there is potential for piling to facilitate the migration of contaminants towards the Lower Aquifer, and into Source Protection Zones as a result of construction works.	Release of contaminants into groundwater or surface water sources from surcharge: Minimising impact of construction work which could lead to the release of contaminants into the environment.		M	M	M

Key

-  High risk
-  Moderate risk
-  Low risk

12.8 Design mitigation and enhancement measures

The proposed scheme options will be designed to ensure that construction works will not pose a risk to human health or the environment.

A more detailed assessment of the indicated geology and ground conditions local to the preferred option should be carried out prior to detailed design stage once the locations of proposed structures have been confirmed.

Potential risks have been identified as part of this high level data review. Appropriate mitigation measures will be identified as part of the assessment once the chosen development option has been finalised. Mitigation and enhancement measures are likely to include:

- production of a Preliminary Sources Study Report in accordance with HD 22/08 to review existing data (geological, hydrological, hydrogeological, geotechnical, past and current land use and the potential for contaminated land), to provide recommendations for further investigation and to confirm the findings of this initial high level study. Existing contamination and geotechnical information will be reviewed, including BGS boreholes, BGS mapping and historical ground investigation reports relating to the construction of the M25
- production of a preliminary risk assessment to understand risk to groundwater and surface water environment from proposed works
- a walkover of the chosen option site to clarify the baseline condition of earthworks and highlight any earthworks that require remediation to facilitate build of the scheme
- an intrusive ground investigation, including the collection and laboratory analysis of soil samples and subsequent monitoring/sampling/laboratory analysis of groundwater, vapour and ground gas, to:
 - target areas of instability/bridge design/junction reconfiguration
 - confirm the geological succession and provide an assessment of ground conditions
 - identify the extent of the suspected buried hollow
 - provide an assessment of the groundwater and gas regime at the site
 - determine the presence and nature of any sub-surface obstructions
 - determine the level of contamination at the site
 - classify waste for disposal off site
 - identify geotechnical and geo-environmental risk
 - provide geotechnical parameters for design (including pavement, bridge and earthwork design)
 - identify materials for re-use in construction
 - identify import materials for use in earthwork construction
- production of a risk assessment to better determine areas of contaminated ground / groundwater and any necessary mitigation and/or design measures once ground investigation data has been obtained and analysed
- classification of waste to inform reuse or disposal of material. This will be undertaken in accordance with current UK and European legislation regarding management of wastes. The potential effects will be reduced by adoption of mitigation measures including the development of an MMP and a SWMP
- geotechnical interpretation of ground investigation data, to include the production of a ground model for the site, the provision of geotechnical characteristic parameters and identification of geotechnical risk
- design of geotechnical engineering features to ensure that contamination migration pathways are not created
- production of a piling risk assessment to determine risk of introducing contamination pathways
- on site geotechnical monitoring to analyse stability and settlement during construction

- geotechnical supervision during construction to ensure the suitability of materials and construction technique

Geotechnical reporting and the management of geotechnical risk shall be in accordance with the Design Manual for Roads and Bridges (HD22/08).

Environmental interpretation, reporting and risk assessment will be undertaken in accordance with CLR11 and will include the development of a Conceptual Site Model (CSM) and, subject to the findings of the risk assessment, provide recommendations for further assessment and/or remediation where necessary.

In subsequent stages, sufficient assessment will be undertaken to further refine the choice of route option, identifying significant impacts on geology and soils and, where appropriate, any contaminated land issues. The study will confirm baseline information, report consultations with relevant statutory bodies and report the findings of site investigations. Any significant effects on geological sites will be recorded along with possible methods of treating contaminated land where present.

Good site practices should also be adhered to during construction. Measures are likely to include (but are not be limited to):

- management of potential risks to ground investigation/construction workers through health and safety legislation, such as the Control of Substances Hazardous to Health (COSHH) Regulations. COSHH requires the employer to carry out an assessment of the risks associated with exposure to hazardous substances and then to prevent and if this is not reasonably practicable, to adequately control such exposures
- working methods during construction to ensure that surface water cannot run from the works and any stockpiles into adjacent surface watercourses
- implementation of appropriate dust control measures
- storage of fuel away from surface watercourses in accordance with Environment Agency Pollution Prevention Guidance (PPG) notes PPG2 and PPG6
- development of a methodology to address what remedial actions will be undertaken and how such actions will be validated and recorded if unsuspected contamination is encountered during the works

The measures listed above are a small selection of those adopted as standard on all development sites. Further details will be provided in a site specific CEMP.

Assuming appropriate mitigation measures are implemented during the design and construction stages of the projects, it is considered that there should be no significant adverse effects to the identified receptors caused by the implementation of any of the proposed scheme options. On this basis, the overall impact is considered likely to be neutral for all options.

12.9 Limitations to assessment

The current assessment has been based on the collation and evaluation of readily available documentation provided by the Environment Agency, BGS, Envirocheck report (Appendix I) and other data sources made available to Atkins, as detailed above in baseline conditions; sources of information. Some of the opinions may be based on unconfirmed data or information from third parties which cannot be fully verified and, as such, no responsibility can be taken for its accuracy. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. The accuracy of maps cannot be guaranteed and it should be recognised that different conditions within the area may have existed between and subsequent to the various map surveys.

Atkins has not undertaken direct consultation with relevant regulatory bodies in association with this work as consultation is not considered to be appropriate at this stage.

Any borehole data from British Geological Survey (BGS) sources are included on the basis that: 'The British Geological Survey accept no responsibility for omissions or misinterpretation of the data from their Data Bank as this may be old or obtained from non-BGS sources and may not represent current interpretation'.

This section should be read in light of the legislation, statutory requirements and/or industry good practice applicable at the time of the works being undertaken. Any subsequent changes in this legislation, guidance or design may necessitate the findings to be reassessed in the light of these circumstances.

13 Materials and waste

13.1 Introduction

This section assesses, at a high level, the potential impacts of materials and waste arisings from the proposed M25 Junction 25 scheme options. Proposed mitigation and enhancement measures are detailed towards the end of the section.

The section is broadly based on the guidance and methodologies outlined in the DMRB Volume 11, Section 1, 2, 3 and 11 and the Department for Transport's Interim Advice Note 153/11 titled 'Guidance on the Environmental Assessment of Material Resources'.

13.2 Assessment methodology

Interim Advice Note 153 / 11 is intended for the "identification of impacts associated with materials resource use waste arisings" for construction, improvement and maintenance projects and as such is applicable to the M25 Junction 25 proposed scheme options.

The Interim Advice Note 153 / 11 states that a 'Simple Assessment' should be undertaken before detailed design. The simple assessment collates information and data that is readily available to address the potential effects during the options identification stage (PCF1). This level of assessment would usually be undertaken at the DMRB Scoping Stage, however as the proposed scheme options being assessed within this ESR are preliminary, the assessment undertaken below broadly follows this approach, and is limited in scope due to the lack of relevant information at this options identification stage.

No specific significance criteria is defined in the DMRB for materials and waste. Therefore, the assessment follows the methodology set out in Section 5 of this EAR. The sensitivity of the receptor is dependent on the capacity of the local environment to provide materials and to dispose / treat of waste arisings (i.e. the capacity of available waste management infrastructure in Hertfordshire and in the north London area). Once a preferred option has been selected, construction, demolition, and excavation waste arisings estimates will be produced and used to identify the magnitude for change. The magnitude of change will only be assessed for waste arisings as no baseline is available for material use and this is generally not reported for such schemes.

13.3 Sensitivity

The sensitivity of the materials cannot be determined as some impacts may occur offsite, or possibly outside of the UK. This includes the depletion of non-renewable resources, the extraction of minerals or during the manufacturing process and transport. This level of information is unlikely to be available until the contractor(s) have been appointed and a detailed Bill of Quantities (BoQs) is available.

With regards to waste, the sensitivity will be dependent upon on the baseline waste arisings and the treatment / disposal capacity, which will be qualitatively assessed during the options selection stage. Both the quantities of waste generated and the composition of the waste will vary with the M25 Junction 25 scheme options.

13.4 Study area

M25 Junction 25 lies to the north of the M25 London Orbital motorway on the border between Hertfordshire County to the north and the London Borough of Enfield to the south. The study area therefore includes the waste disposal and treatment networks within Hertfordshire and the North London area (Barnet, Camden, Enfield, Hackney, Haringey, Islington and Waltham Forest, collectively the North London Waste Authority).

13.5 Baseline conditions

Materials used and wastes generated have the potential to generate environmental impacts through:

- Use of large quantities of materials (e.g. from non-renewable resources)
- Generation of large quantities of waste
- Generation of hazardous waste.

As defined in the Interim Advice Note 153 / 11 surplus materials and waste are likely to arise from two sources:

- 'Existing site materials'
- 'Materials brought onto site but not used for the original purpose'

It should be noted that materials generated from the works will also include excavation materials as a principle source.

Baseline information was gathered from the sources listed below. It should be noted that the desk based assessment is indicative only and is limited in scope due to the lack of relevant information at the options identification stage.

- Environment Agency 'What's In Your Backyard?' website (available at: <http://apps.environment-agency.gov.uk/wiyby/default.aspx>)
- Multi-Agency Geographic Information for the Countryside ('MAGIC') website (available at: <http://magic.defra.gov.uk/>)
- Hertfordshire Waste Development Framework, Waste Core Strategy and Development Management Policies, Development Plan Document 2011 – 2026 (2012)
- Hertfordshire Waste Development Framework, Waste Site Allocations, Development Plan Document 2011 – 2026 (2014)
- The North London Waste Prevention Plan 1 April 2016 to 31 March 2018 (2016)⁷⁰;
- The North London Joint Waste Strategy (2009)
- Envirocheck Report purchased from Landmark Information Group on 22/06/2016, held by Atkins (Order Number: 89325066_1 and 89325066_2)

Baseline information on the ground conditions relevant to the proposed scheme options is provided in the 'Geology and Soils' section.

With regards to materials, no baseline is available for material use and this is generally not reported for such schemes.

With regards to operational waste, it is anticipated that the waste arisings associated with the M25 Junction 25 at present consists only of litter and ad hoc maintenance waste. Within the surrounding area the waste arisings are likely to be minimal, and will primarily consist of:

- Agricultural waste from Theobald's Park Farm and the nearby nurseries / areas of open space
- Municipal waste from Theobald's Park Farm, the nearby nurseries, Capel Manor College Gardens and residential and commercial properties in the vicinity

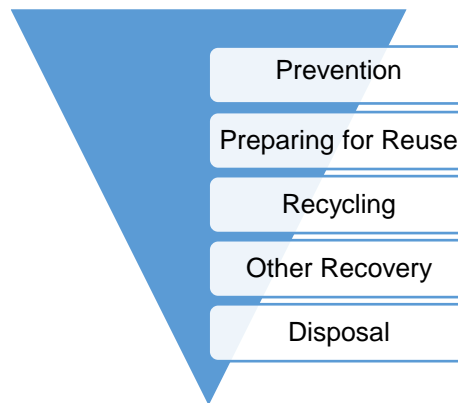
As noted above, the baseline for waste arisings has been extended to include the waste management networks within Hertfordshire and the North London area as waste is regularly treated / disposed of within these areas.

⁷⁰ North London Waste Plan is currently under review, <http://www.nlwp.net>.

13.6 Regulatory / Policy framework

This section highlights the regulations and policy which will directly affect materials and waste management for the M25 Junction 25 proposed scheme options. The regulations and policy documents primarily emphasise the waste hierarchy to ensure that waste is managed within the priority order, as shown in Figure 13-1 below.

Figure 13-1 Waste Hierarchy



The regulations and policy documents are outlined below:

- EU Waste Framework Directive (2006/12/EC)
- EU Landfill Directive (1993/31/EC), as amended by the EU Directive (2003/33/EC)
- Waste (England and Wales) Regulations 2011 (SI 2011/988), as amended in 2012 (SI 2012/1889) and in 2014 (SI 2014/656)
- The Hazardous Waste (England and Wales) Regulations 2005 (SI 2005/894), as amended in 2009 (SI 2009/507), 2015 (SI 2015/1360) and 2016 (SI 2016/336)
- Waste Electrical and Electronic Equipment (WEEE) Regulations 2006 (SI 2006/3289), as amended in 2007 (SI 2007/3454), 2009 (SI 2009/2957), 2010 (SI 2010/1155) and 2013 (SI 2013/3113)
- Environmental Protection (Disposal of Polychlorinated Biphenyls and other Dangerous Substances) (England and Wales) Regulations 2000 (SI 2000/1043), as amended in 2000 (SI 2000/3359)
- The Environmental Permitting (England and Wales) Regulations 2010 (SI 2010/675), as amended in 2011 (SI 2011/2043), 2012 (SI 2012/630) and 2014 (2014/255);
- European Waste Catalogue (2000/532/EC)
- Environmental Damage (Prevention and Remediation) Regulations 2009 (SI 2009/153), as amended in 2010 (SI 2010/587) and 2015 (SI 2015/810)
- The Control of Asbestos Regulations 2012 (SI 2012/632)
- Environmental Protection Act 1990 (c. 43), as amended in 1996
- Clean Neighbourhoods and Environment Act 2005 (c. 16)
- Environmental Protection (Duty of Care) Regulations 1991 (SI 1991/2839), as amended in 2003 (SI 2003/63)
- Waste Management Plan for England 2013
- National Planning Policy for Waste 2014
- National Networks National Policy Statement 2014
- DMRB Volume 11, Section 1, 2, 3 and 11 (as amended)
- Interim Advice Note 153 / 11 (2011)
- Hertfordshire Waste Development Framework, Waste Core Strategy and Development Management Policies, Development Plan Document 2011 – 2026 (2012)
- Hertfordshire Waste Development Framework, Waste Site Allocations, Development Plan Document 2011 – 2026 (2014)

- The North London Waste Prevention Plan 1 April 2016 to 31 March 2018 (2016)⁷¹
- The North London Joint Waste Strategy (2009)

It should be noted that the European Commission (EC) will soon be revising a number of directives to ensure they align with the Circular Economy Package, which aims to be “closing the loop of product lifecycles through greater recycling and re-use, and bring benefits for both the environment and the economy”. The directives which will be revised, which may have an measures for consideration in this the M25 Junction 25 scheme, include the EU Waste Framework Directive (2008/98/EC), the EU Landfill Directive (1993/31/EC) (as amended), and the Waste Electrical and Electronic Equipment (WEEE) Directive (2012/19/EU) (as amended).

13.7 Design mitigation and enhancement measures

With regards to the type, quantity, and source of materials to be used and the type, quantity and composition of waste that will be generated, there are a number of different environmental mitigation and enhancement measures to be considered. These measures can be utilised during construction, demolition, and excavation as outlined (at a high level) in and detailed below. These options should be implemented to mitigate the potential for significant environmental impact of the materials and waste associated with the proposed M25 Junction 25 scheme, whilst ensuring legal compliance and meeting all applicable targets.

Figure 13-2 Material and Waste Mitigation and Enhancement Measures



13.7.1 Designing out waste

Ideally waste will be designed out throughout all design stages, to ensure materials are either reused (potentially from excavation) or recovered (potentially from demolition). Further to this, Designing out Waste (DoW) will ensure locally sources, recycled and / or recovered materials are used where practicable.

The UK’s Waste Resources Action Programme (WRAP) has produced guidelines for design teams under the following headings:

- Re-use and recovery
- Offsite construction

⁷¹ North London Waste Plan is currently under review, <http://www.nlwp.net>.

- Materials optimisation
- Waste efficient procurement
- Deconstruction and flexibility

All of these factors should be considered and implemented in the design of the development to improve the sustainability of the project including minimising waste to landfill. It should be noted that the reuse of excavated materials (associated with earthworks) for the M25 Junction 25 scheme will be dependent upon the design of the preferred scheme option and further investigations of the potential for contaminated land in the surrounding area. Such investigations are detailed in the 'Geology and Soils' section in Section 12.

A 'Lite' Site Waste Management Plan (SWMP) should be prepared in order to estimate the waste arisings, the waste composition and the potential for re-use and recovery. Once the design process progresses further, a full SWMP should be prepared based on the detailed design drawings and the latest available BoQ. The full SWMP will set out the further detail related to waste arisings, procedures, and responsibilities for the management of waste. If applicable, the potential for reuse of the excavated materials should be detailed in a Materials Management Plan (MMP) which should follow the guidance and framework set out in the 'CL:AIRE Definition of Waste: Development Industry Code of Practice' (DoW CoP).

13.7.2 On site management

The contractor on site should work to maximise reuse and recycling, and minimise waste to landfill. The full SWMP should continually be updated and managed, by the contractor, to facilitate such measures. The full SWMP will provide an auditable trail of the actual reuse / recycling figures and document the final destination of waste materials during construction, demolition and excavation.

In addition, the M25 Junction 25 site should be managed so as to avoid unnecessary waste such as excess material brought to site. Best practice waste management on such schemes is inclusive of but not limited to:

- Designing out waste at the initial stage of the project through utilising standardised sizes and materials where possible and engaging with the design team on the importance of this
- Having a clear understanding of the nature of the excavated material
- Undertaking robust sampling and characterisation of waste
- Setting targets for waste recovery and recycling to enable those working on the scheme to have a clear understanding of what is expected
- Including a full SWMP so that waste generation and management can be logged and audited
- Using precast concrete and other materials that can be prepared off site to minimise waste generation on site
- Avoiding ordering excess materials and using materials brought to site as efficiently as possible
- Organising deliveries so materials arrive on site as they are needed to reduce the possibility of damage and wastage occurring
- Having clearly defined and separated skips on site as well as a clearly marked waste area
- Having a good understanding of the waste market (e.g. waste segregation and sale prices)
- Utilisation, where practicable, of on or offsite treatment to re-introduce waste in to the market as a resource
- Training staff to understand how they should sort any waste and having regular reminders and updates

In addition to the reduction of environmental impacts, best practice measures for waste management also contribute to financial benefits for the M25 Junction 25 scheme, through the avoidance of costs associated with landfilling.

13.7.3 Treatment and disposal

In order to reduce the environmental impacts of the M25 Junction 25 scheme, commitments to achieving a high recycling and recovery rate for all waste generated should be made. This can be achieved through source segregation of recyclable materials and the provision of appropriate recycling facilities. Achieving a high recycling rate will minimise the environmental burden (such as pollution and energy impacts) associated with the production of products from virgin material.

Across Hertfordshire County and the North London area, there are number of contractors, waste collection and waste disposal companies. Highways England should select a waste contractor who is local (where available) and is registered with the Environment Agency as a waste carrier for all the appropriate classes of waste to be transported (to be determined during the next design stage). The contractor should be able to undertake daily collections which will be required during peak construction, demolition and excavation activities. The contractor, on behalf of Highways England, should always ensure to complete Waste Transfer Notes or Hazardous Waste Consignments Notes. These should be kept for a minimum of 2 and 3 years respectively.

13.8 Potential effects

At this stage of the design process no information on the use of materials or generation of waste associated with the proposed scheme options is currently available. However, it is assumed that proposed options which cover the greatest area (physical extent) will require the greatest amount of demolition works, have the greatest volume of earthworks (excavation works), and will require the greatest volume of construction materials, thus have the potential to produce more waste. On this basis, and without more detailed knowledge of the management of materials, Option 3 would have the greatest adverse effect.

A summary of the potential effects on each of the proposed scheme options is provided in Table 13-1 below.

Table 13-1 Materials and Waste Potential Effects

Potential Effect	Option 1	Option 2	Option 3
Potential excess material use / waste generation if wastes are not reused / recycled where practicable.	x	x	x
Potential for the disposal of large quantities of excavated materials, if the materials are found to be hazardous and thus not suitable for reuse (for further details see the 'Geology and Soils' section in Section 12).	x	x	x
Increased waste arisings associated with widening existing carriageways and bridges.	x	x	x
Increased waste arisings associated with the construction of the pedestrian / cycle footbridge.	x	x	x
Increased waste arisings associated with the construction of maintenance access track.			x
Increased waste arisings associated with the refurbishment of subways.	x	x	x
Increased demolition waste arisings associated with the narrowing of the existing hardened verge.	x	x	x

Potential Effect	Option 1	Option 2	Option 3
Increased excavation waste arisings due to the creation of embankments.	x	x	x

13.9 Limitations to assessment

No detailed information regarding material types or potential waste generation is available at this stage of design (PCF1). This assessment should be updated once more information is available on these topics and assessed for the preferred option only, as aforementioned in the 'Assessment Methodology' section. Once further information is available, the magnitude of change will only be assessed for waste arisings as no baseline is available for material use, and this is not typically reported for such schemes. It is anticipated that waste arisings, once the scheme is operational, will be negligible as it these will continue to arise from litter and ad hoc maintenance, and as such will not be assessed.

Additionally, as outlined above, some impacts of materials and waste may occur offsite or potentially outside the UK, including the depletion of non-renewable resources, the production of waste at the point of extraction, and transportation of this materials or waste. These stages of the process are likely to have had their own environmental assessments and, as such, will not be included in the scope of this assessment.

14 People and communities

14.1 Introduction

The assessment will consider the impacts of the proposed scheme options on People and Communities. This will include impacts on Motorised Travellers (MT: drivers and passengers of both public and private vehicles), Non-Motorised Users (NMU: pedestrians, cyclists and equestrians), Community Severance, Land Use, and Community Effects. This assessment follows the updated DMRB interim guidance contained within IAN 125/15, combining published guidance in DMRB Volume 11, Section 3, Parts 6 (Land Use), 8 (Pedestrians, Cyclists, Equestrians and Community Effects) and 9 (Vehicle Travellers) into one assessment of People and Communities.

The assessment considers any impacts that the proposed scheme options may have on:

- Effects on All Travellers: Motorised Travellers (MT) (drivers and passengers of both public and private vehicles) and Non-Motorised Users (NMU) (pedestrians, cyclists and equestrians), including amenity and journey length
- Effects on Communities, including development land, agricultural land, private and community land, community severance

The ESR provides a high level assessment of the potential for the proposed scheme options to effect existing travel patterns, journey lengths and community effects within the study area. Road safety has also been considered, together with effects on severance at the local level.

14.2 Assessment methodology

14.2.1 Motorised travellers: views from the road

Using the category description in the DMRB views from the road will be assessed according to travellers' ability to see the surrounding landscape on a four point scale: no view, restricted view, intermittent view, open view as described in Table 14.1.

Table 14-1 DMRB Criteria for Views from the Road

View Categories	Description
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
Open view	View extending over many miles, or only restricted by exiting landscape features

There are no specific assessment 'significance criteria' or 'magnitude of impact' assessment frameworks associated with 'view from the road' set out in DMRB therefore a qualitative assessment using professional judgment and based on the above criteria, is considered appropriate. The assessment will take into account findings from the landscape and visual impact assessment, including the landscape character, quality of the view experience and route type.

14.2.2 Motorised travellers: driver stress

Driver Stress is defined in DMRB as the adverse mental and psychological effects experienced by a driver traversing a road network. Stress can induce in drivers' feelings of discomfort, annoyance, frustration, or fear culminating in physical or emotional tension that detracts from the value and safety of the journey. DMRB indicates that with increased driver stress, a drop in driving standards occurs, which may be expressed as an increase in aggression towards other road users, or a diminished response to visual and other stimuli.

The level of stress experienced by a driver may be affected by a number of factors including; road layout and geometry, surface riding characteristics, junction frequency and speed and flow per lane. There are three main components of driver stress: frustration; fear of potential accidents; and uncertainty relating to the route being followed:

- Driver frustration – Caused by an inability to drive at a speed consistent with the standard of the road, and increases as speed falls in relation to expectations
- Driver fear – The main factors are the presence of other vehicles, inadequate sight distances and the likelihood of pedestrians, particularly children, stepping into the road. Fear is highest when speeds, flows and the proportion of heavy vehicles are all high, becoming more important in adverse weather conditions
- Driver uncertainty – Caused primarily by signing that is inadequate for the individual's purposes

The measurable aspect of Driver Stress is associated with frustration due to delays. However, no detailed modelling of the performance of the M25 Junction 25 has been undertaken at PCF Stage 1 assessment. As a consequence the level of Driver Stress has been determined through a qualitative assessment of the above factors, under a three point descriptive scale, as recommended under DMRB guidance, as Low, Moderate or High.

14.2.3 Non-motorised users and community severance

The assessment for NMU will be undertaken in accordance with the guidance for a Simple Assessment in the Pedestrians, Cyclists and Equestrians component of DMRB 11.3.8. It will focus on changes in journey lengths and times, the effect on the amenity value of journeys and changes in community severance band will consider:

- The impact of the scheme on the journeys that pedestrians, cyclists and equestrians make in its locality
- The impact on existing usage of the community facilities and routes by pedestrians and others
- Changes in safety and amenity value of routes which may be affected by the proposed options
- The effects of the proposed options on community severance

The assessment will involve a desk study to identify likely Non-Motorised Users (NMU) activity, as well as how local community facilities are likely to be impacted by the construction and operation of the junction proposed scheme options in both adverse and beneficial senses. No surveys or consultation have been undertaken for the PCF Stage 1 assessment.

The level of new severance will be taken into account using criteria set out by DMRB Volume 11, Section 3, Part 8 which categorises the level of severance as Slight, Moderate or Severe.

Table 14.2 sets out how the magnitude of impact is assessed for impacts on NMU using a three point scale. The magnitude can be both positive (beneficial) or negative (adverse) and also takes into account the permanence and reversibility of the impact. Professional judgement will be used to assign the correct level of impact.

Table 14-2 Magnitude of Impact – Non motorised travellers

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 limited amount of time. <ul style="list-style-type: none"> • 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 250m

Medium	Some people, are likely to be dissuaded from making trips. Other trips will be made longer or less attractive. <ul style="list-style-type: none"> • 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 250m – 500m.
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. <ul style="list-style-type: none"> • Pedestrian at-grade crossing of a new road carrying over 16,000 vehicles per day (AADT); or • Journeys will be increased by more than 500m; or • Three or more of the hindrances set out under 'Low' or two or more hindrances set out under 'Medium'

The sensitivity of the NMU and PRoW will be determined by usage as identified in Table 14.3 below.

Table 14-3 Sensitivity value of NMU users

Sensitive Value	Criteria
High	Frequent or continuous use of a resource, no suitable equivalent alternative resources used by the receptor are reasonably available
Medium	Moderate or occasional use of a resource, limited equivalent alternative resources used by the receptor are reasonably available.
Low	Low or infrequent use of a resource, suitable alternative are readily available.
Negligible	Very infrequent use of resource, multiple equivalent or better alternatives are freely and easily available.

The relationship between the sensitivity of the receptor and the magnitude of impact from the proposed scheme is considered to determine the significance of the effect as described in Section 5 and repeated in Table 14.4. Moderate and major effects are considered significant and minor and negligible effects are not considered significant. Effects can be either adverse or beneficial.

Table 14-4 Significance of Impact Magnitude of Receptors

Significance		Impact Magnitude			
		High Impact	Medium Impact	Low Impact	Negligible Impact
Sensitivity of receptor	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Negligible	Negligible

14.2.4 Private property, community land, agricultural land & development land

The assessment for loss of these land uses and receptors will be undertaken in accordance with the guidance for "Land Use" DMRB Volume 11.3.6. The magnitude of impact is assessed as the amount of land to be taken, using a three point scale of high medium or low. It also takes in account if there is other land in the vicinity that could be used for exchanged land. Professional judgement will be used to assign the correct level of impact. The methodology for assessing NMU and PRoW will be used for assessment of effected land.

Private property consists of the property required to accommodate the proposed scheme options. Private Property is land outside the existing highways boundary that does not

accommodate public open space or any other community facility or asset. It can be residential or commercial/ industrial property.

Community land is any area of public open space and other facilities such as schools, hospitals, libraries and recreation facilities relied upon for community health and well-being.

Agricultural land is land devoted the rearing of livestock and production of crops to produce food and products.

Development land is land designated within the development plan for particular development purposes, or for which planning permission has been granted or is pending. The study area for 'development land' consists of the land parcels required to accommodate the proposed scheme options.

14.3 Study area

The study area for road users MT and NMU comprises the roads, connecting roads, Public Rights of Way (PRoW) and footpaths located within 750m of the proposed scheme options.

The study area for 'community severance' will be extended to include communities that may potentially be directly affected by the proposed scheme options, for example, through the severance. These would include communities directly connected by the NMU and MT routes.

The study area for 'private assets' (including Private Assets, Agricultural Land and Community Assets) will consist of the land parcels required to accommodate the proposed scheme options.

14.4 Baseline conditions

14.4.1 Motorised travellers: view from the road

The existing views from the road are described below:

- The view from the M25 is restricted by vegetation, elevated earthworks and retaining walls when looking north and south. When travelling along the M25 the various overhead bridge structures carrying the New River, Junction 25 roundabout, Lea Valley Line railway and portal to the Holmesdale Tunnel are prominent features.
- Views looking towards the roundabout on the northern and southern approaches of the A10 and slip roads from the M25 is of vegetation screening the motorway and junction.
- Views from Great Cambridge Road which runs parallel to the west of the A10 south of the roundabout junction include rows of trees between the road and the A10. The two roads are separated by a fence. Further views are across the A10 towards the garden centre complex which is screened by an intermittent wall and areas of vegetation.
- The A10 south of the Junction 25 roundabout is bordered by housing to the east and a garden centre complex land to the west. A pylon line crosses the road before the roundabout. A small field providing intermittent views to the vegetation beyond is located to the west of the junction with the A10 and roundabout.
- The A10 north of the Junction 25 roundabout is bordered by industrial use to the west and open arable land to the west, providing intermittent views.

In general, the views from the road for Motorised Travellers on the surrounding road network provide a varied experience, ranging from no views to open views east of the A10 north of Junction 25 over the surrounding landscape comprised of a mixture of agricultural, residential and industrial use, planted vegetation and engineering structures.

14.4.2 Motorised travellers: driver stress

The M25 provides a continuous orbital route around Greater London. The M25 carries high volumes of traffic as described in Section 2 of this report, which cause disruption and delays

to the surrounding road network particularly when emergency closures and lane closures of the motorway are imposed.

Junction 25 is the second busiest signalised junction in the South East of England and is a major national and inter-urban regional transport artery and is intrinsically linked to the performance of the surrounding highway network. Issues such as long peak hour queues have been reported on Junction 25 approaches and the circulatory carriageway, with the junction operating at over capacity with long queues and delays in both the AM and PM peaks. The junction is also amongst the top 10 motorway junction collision locations and roundabouts on the A10 north and south of the junction add to driver stress.

14.4.3 Non-motorised users

There are several PRoW which are located adjacent to, or intersect with, sections of the existing road. These will be considered within the assessment.

There are 6 identified Public Rights of Way (PRoW) within 750m radius of Junction 25 which are located within the London Borough of Enfield or the Borough of Broxbourne. All are classified as either footpaths or bridleways and are detailed below:

- Cheshunt 077 - a 400m stretch of bridleway connects the A10 at Park Plaza in the west, crosses the Lea Valley Line railway at grade, connecting to the end of Park Lane in the east. The PRoW provides access from residential areas of Waltham Cross to the Park Plaza employment site.
- Cheshunt 014 - a 1km stretch of footpath traversing the agricultural land east of the A10 between Theobald's Park Farm off the A10 road and Bulls Cross Ride close to the M25. A notable feature of the footpath is where it crosses the New River on a bridge and then follows the course of the Old New River.
- Cheshunt 013 - a 1.3km stretch of footpath which follows the course of the west bank of the New River situated in the agricultural land east of the A10. The footpath starts to the north of the 1km search area close to the B198 Lieutenant Ellis Way and connects a network of PRoWs including 016, 012, 074 and 014.
- Enfield 127 - a 80m stretch of footpath connects the A1055 Bullsmoor Lane close to the junction with A10 Great Cambridge Road and Marryat Road.
- Enfield 156 - a 50m stretch of footpath connects the A1055 Bullsmoor Lane close with Bridgend Road.
- Enfield 158 - a 200m stretch of footpath connects the A1055 Bullsmoor Lane close with Bullsmoor Way.

There are also several footways and cycleways alongside roads within close proximity to the proposed scheme options.

A footpath is located along the western side of the A10 Great Cambridge Road north of Junction 25 and the access road parallel to the A10 Great Cambridge Road south of Junction 25. Another footpath is located along the west carriageway of the A10 from Bullsmoor Lane ending just before the roundabout at Junction 25 and which is used to access the private properties west of the A10. At the junction of Great Cambridge road and Bullsmoor Lane there is an at grade pedestrian crossing. A footpath also follows the course of the New River.

The proposed scheme options have the potential to temporarily or permanently affect the users of the existing M25 Junction 25 shared pedestrian footpath and cycleway which crosses over the M25 via subways under the gyratory and within the inside of the gyratory across the M25. The shared cycle and pedestrian route beneath Junction 25 has lighting, flooding and security issues, inhibiting usage.

There are roads which are considered in this assessment to be suitable for use by cyclists. A cycle route runs along Great Cambridge road following the residential street which follows the A10 in Enfield. The cycle route continues along the Junction 25 roundabout subway and

footbridge to the north of the M25. The shared cycle/ pedestrian route beneath the M25 Junction 25 has lighting, flooding and security issues, inhibiting usage.

The existing M25, A10 and the surrounding road network affect NMU's enjoyment of existing PRoWs. The motorway, dual carriageway and junction reduces the sense of isolation created when travelling in the rural areas in close proximity. In addition, these PRoWs will be affected by traffic noise and the visual intrusion of the road network.

The footpaths, cycleways and PRoW considered in this assessment serve as both recreational routes and for travelling between the surrounding local districts including Bullsmoor and Waltham Cross to access services or facilities.

14.4.4 Community severance

Several of the existing footpaths which traverse the area of land affected by the proposed development provide a pedestrian link between Bullsmoor and Waltham Cross.

There is a cluster of community facilities and services located along Bullsmoor Lane including a convenience stores and service stations. In Bullsmoor there are schools, a library open spaces and play areas. To the north of the M25 in Broxbourne there are schools, places of worship and employment land. Community Land, facilities and services are identified later in this section.

In addition to recreational use of the footpaths, they may be used by residents utilising the services provided by these community facilities.

14.4.5 Agricultural land

The area to the north west of Junction 25 is identified on Defra's Agricultural Land Classification maps as Grade 3. The ALC maps, upon which the assessment is based, were created from surveys undertaken by DEFRA between 1989 and 1999, and have been treated with some caution in the absence of detailed site investigation survey results. It is considered likely that a proportion of this land will be Best and Most Versatile (BMV) Agricultural Land. From an inspection of aerial photography, it appears that this land is largely comprised of arable fields.

14.4.6 Residential properties and private land

The proposed scheme options are surrounded by a mixture of privately owned uses including agricultural land, residential, commercial and industrial land:

- To the south east of Junction 25 are residential dwellings located along Great Cambridge Road access road.
- A residential estate 'Bullsmoor Way' is located south east of Junction 25 and is bound by the M25, A10, railway and Bullsmoor Lane.
- To the south west of Junction 25 are various commercial properties including Red Gates Nursery, Walton Lodge Veterinary Clinic and Waterworld Aquatics Centre along the A10 Great Cambridge Road.
- Residential properties are located behind the commercial properties (above) along the A10 near to the New River.
- A small shopping parade is located along Bullsmoor Lane close to the junction with the A10
- To the north east of Junction 25 are the Park Plaza employment land including the Newsprinters print works and Travelodge located along Great Eastern Road.
- To the east of Junction 25 is a Network Rail owned railway line and bridge over the M25.
- To the west of Junction 25 is a Thames Water owned aqueduct carrying the New River over the M25.

The areas to the south, east and north east are predominately residential containing the suburb of Bullsmoor in Enfield and the settlement of Waltham Cross in Broxbourne.

14.4.7 Community land

There are a number of parks and formal open spaces within the 750m search area (Aylands Open Space and Holmesdale Tunnel Open Space). In Bullsmoor there is a playground is contained within the Aylands Open Space. None of these community facilities are located within the land required for the proposed development. There are no areas designated as Open Access Land under the Countryside and Rights of Way Act (2000).

Community Land in Enfield and Broxbourne, within Bullsmoor there are 4 schools (Lea Valley High School, Honilands Primary School and Capel Manor Primary School and College) and Waltham Cross contains 3 education facilities (Hurst Drive Primary School, Greenfield Nursery School and Rivers Education Support Centre). Bullsmoor has a library and Theobalds Park contains a place of worship and cemetery (Western and West End Great Synagogue and Cemetery).

As identified under community severance there is a cluster of community facilities and services which might be public or private located clustered around the junction of Bullsmoor Lane and Great Cambridge Road. These include a small shopping parade located along Bullsmoor Lane close to the junction with the A10 in Bullsmoor. This district centre also contains two petrol stations and two fast food takeaways.

14.4.8 Development land

A strategic employment site currently exists north east of Junction 25 at Park Plaza between the A10 and the Lea Valley railway line containing the Newsprinters printworks and logistics centre. A hotel is also located on the site. The Park Plaza employment site is site EMP2 in the saved 2005 Broxbourne Local Plan policies map, and in the emerging new Broxbourne Local Plan the exiting Park Plaza site is identified as a 'Loss of Employment Uses' site policy ED2. The new Broxbourne Local Plan identifies expansion of the Park Plaza as sites PP1 Park Plaza West and PP2 Park Plaza North which are proposed to accommodate up to 10,000 new jobs. Site PP3 Park Plaza Plot D which is adjacent to the north east of Junction 25 is allocated for an office development in accordance with the outline planning permission 07/10/0784/F.

There are no site allocations in proximity to Junction 25 within Enfield. There is a full planning application (15/02745/FUL) submitted on the Kingswood Nurseries site to the west of the A10 close to the junction with Bullsmoor Lane for 56 residential units which is currently awaiting decision - a committee report dated 22/3/16 recommended the site for granting of permission subject to a S106 agreement.

The key receptors identified in the baseline study are shown on Figure 14.1 in Appendix K.

14.5 Regulatory / Policy framework

14.5.1 National policy

The National Planning Policy Framework (NPPF) sets out the Government's planning policies and how these are expected to be applied. NPPF identifies a set of 12 core land-use planning principles that it is stated should underpin both plan-making and decision-taking. It states that planning should proactively drive and support sustainable economic development to deliver, amongst other things, infrastructure that the country needs.

A relevant principle in the NPPF to this section, emphasises the need to manage patterns of growth by making the fullest possible use of sustainable transport modes including public transport, walking and cycling. Section 4 of the NPPF sets out how transport should be considered within the context of planning decisions and sustainable development. The policy encourages solutions that seek to reduce congestion, greenhouse gas emissions and serve to facilitate the use of sustainable transport. Furthermore, local planning authorities (LPAs) are required to identify and protect, where there is robust evidence, sites and routes which could be critical in developing infrastructure to widen transport choice.

Chapter 8 'Promoting Healthy Communities' describes how access to high quality open spaces and opportunities for sport and recreation can make an important contribution to the health and wellbeing of communities. Paragraph 75 states policies should protect and enhance public rights of way (PRoW) and access. Local authorities should seek opportunities to provide better facilities for users, for example by adding links to existing rights of way networks including National Trails.

14.5.2 Countryside and rights of way act 2008

The Countryside and Rights of Way Act 2008 (CRoW) regulates all Public Rights of Way (PRoW) and ensures access to them. It requires local highway authorities to publish a Rights of Way Improvement Plan (RoWIP), which should be reviewed every 10 years. The Act also obliges the highway authority to recognise the needs of the mobility impaired when undertaking improvements.

There is guidance within the Hertfordshire Rights of Way Improvement Plan (2011) and the Draft Enfield Rights of Way Improvement Plan (2009) which sets out how PRoW meet the present and likely needs of the public; the opportunities provided by local rights of way for exercise and other forms of recreation and enjoyment; and the accessibility of local rights of way to blind or partially sighted person and others with mobility issues.

14.5.3 Local policy

Local policy which has indirect relevance for people, community use and enjoyment are set within both authorities Broxbourne and Enfield adopted local planning policy.

The Broxbourne Local Plan (2005) saved policies include policy GBC 17 'Protection and Enhancement of Public Rights of Way', policy T9 'Pedestrian Needs' and policy T10 'Cycling Provision' these policies make reference to the PRoW network and the interest of pedestrians and cyclists while policy CLT1 'Community, Open Space and Recreational Facilities' supports these receptors continued use. Broxbourne policy HD22 'Community Safety' and policy HD23 'Access for the Disabled' promotes safe design and accessibility.

In the London Borough of Enfield core policy 11 'Recreation, Leisure, Culture and Arts' promotes and encourage the increased recreation and use of these facilities while core policy 34 Parks, Playing Fields and Other Open Spaces' protects and seeks to enhance existing open spaces in the borough. Enfield core policy 25 'Pedestrians and Cyclists' seeks to provide safe and accessible routes for pedestrians and cyclists.

A new Draft Local Plan for Broxbourne is currently being consulted on and is anticipated for adoption in winter 2017. Enfield is updating its Local Plan and has prepared a consultation document on the new Local Plan, it is anticipated adoption of the New Local Plan will happen in summer 2017.

14.6 Design mitigation and enhancement measures

There are opportunities to introduce mitigation and enhancement measures into the scheme design, and the management of the scheme. The preferred design option should be designed with future development and housing requirements in mind. The use of best practice construction methods will reduce disruption to users of residential and community receptors within the vicinity of the proposed highways scheme. All proposed scheme options include enhancements to the PRoW that crosses the junction which will benefit non-motorised users

The assessment deals with proposed scheme options without associated environmental design measures. Therefore we have identified generic design or mitigation measures that have the potential to be incorporated within the scheme. The assessment takes into consideration the potential for reduction of adverse effects through the introduction of environmental design or mitigation measures.

Potential mitigation measures that could be applied to the considered schemes are below:

- The preferred option should where possible either retain or improve the existing access arrangements. Existing footpaths and PRowWs should be retained and where crossed by the route, provided with proper means of access to prevent severance
- Clear signage should be positioned to show temporary diversion routes for the effected Motorised Travelers, PRowWs, footpaths & cycleways
- Users of the effected PRowWs, footpaths & cycleways which are to be effected would be notified of planned diversion with signs along the sections to be closed during construction at least one month prior to the works
- Construction works will need to be programmed so that affected PRowW, footpaths or cycleways remain open for part or duration of the construction works, and also that other routes can act as a diversion route for those effected
- The View from the Road for Motorised Travelers where possible should not be further obstructed, and open views of the surrounding countryside should be retained
- Where possible landscaping that can provide screening and reduce noise levels of the chosen option, and which will also improve amenity for users for non-motorised, residential and community receptors
- It may be necessary for key stakeholders, including local walking, riding and cycling groups, to be consulted on the effect of the route options on existing NMU routes
- Take on board the environmental design mitigation from the other topics, notably Landscape, Air Quality and Noise and Vibration which are linked to this topic
- Consultation with the public and stakeholders to discuss the proposals and proposed mitigation
- Consultation with the local authorities (Hertfordshire, Broxbourne and Enfield) to agree diversion routes and the proposed mitigation
- Appropriate local media campaign to notify people of the works and update them on construction. This could result in a reduction in Driver Stress associated with delays during construction for Motorised Travellers

14.7 Potential effects

The assessment tables in Appendix K sets out the value of the receptor, the magnitude of impact to derive the significant of effects. The section below provides a summary.

14.7.1 Option 1

14.7.1.1 *Effects on All Travellers – driver stress, views from the road, NMUs*

During construction there is the potential for local journey length to increase as a result of construction work and subsequent traffic and NMU delays, especially users of the Great Cambridge Road shared footpath and cycleway which will be significantly altered and improved. During operation improved and safer access of this route is expected to decrease journey times and make them more reliable for local people through better provision and reduced congestion.

Option 1, is likely to have a negligible negative impact on views from the road due to the proposed option increasing vehicular lanes and a new footbridge across the M25 being created. Any removal of vegetation at the junction required by the option will have the potential to further impact views.

Driver stress is expected to be temporarily adversely impacted by the construction works, however is expected to reduce during operation through increased traffic flows and a more efficient road network reducing driver frustration.

NMU amenity may be temporarily adversely affected by construction works associated with this option through disruptions to the Great Cambridge Road shared footpath and cycleway are likely to be majorly adversely affected however, it is assumed the new subways and footbridges will be majorly beneficial to NMU users due to a safer and improved environment on operation. It is assumed no other footpaths or PRowWs are likely to be impacted under this option. It is expected that during operation NMU users of the Great Cambridge Road shared

footpath and cycleway will be a major beneficial effect due to a new footbridge which will be constructed as part of the proposals, offering a safer and improved environment, removing the current lighting, flooding and security issues

14.7.1.2 Effects on Communities – community severance, community land, agricultural land, development land

As with amenity, it is likely most PRowS & footpaths will not be significantly impacted and there will likely to be no community severance during construction. However, the NMU users of the Great Cambridge Road shared footpath and cycleway are likely to experience major impacts during construction but the improvements to the footbridges and subways will be a major benefit for users. It is assumed this route serves users from the predominately residential Bullsmoor area of Enfield to access the employment site at Park Plaza. These impacts will be investigated further in subsequent design stages.

The option is likely to have an adverse effect during construction and operation on the residential receptors identified especially along the access road of the Great Cambridge Road. It is also likely some land take will be required for this option from employment land at Park Plaza Plot D (Granted permission for office development in accordance with the outline planning permission 07/10/0784/F) and agricultural land at Theobalds Park Farm.

14.7.2 Option 2

14.7.2.1 Effects on All Travellers – driver stress, views from the road, NMUs

During construction there is the potential for local journey length to increase as a result of construction work and subsequent traffic and NMU delays. Especially users of the Great Cambridge Road shared footpath and cycleway which are indicated to be significantly altered and improved. During operation improved and safer access of this route is expected to decrease journey time and make them more reliable for local people through better provision and reduced congestion.

Option 2, is likely to have a negligible negative impact on views from the road, increasing in impact from Option 1, due to the proposed option increasing vehicular lanes and a new footbridge across the M25 being created. Any removal of vegetation at the junction required by the option will have the potential to further impact views.

Driver stress is expected to be temporarily adversely impacted by the construction works, increasing in impact from Option 1 due to the greater magnitude of the proposals in Option 2. However, it is expected to reduce during operation through increased traffic flows and a more efficient road network, reducing driver frustration.

NMU amenity may be temporarily adversely affected by construction works associated with this option through disruptions to the Great Cambridge Road. Users of the shared footpath and cycleway are likely to experience major adverse effects but it is assumed the new subways and footbridges will be a major benefit to NMU users due to a safer and improved environment in operation. It is assumed no other footpaths or PRowS are likely to be affected under this option. It is expected that during operation NMU users of the Great Cambridge Road shared footpath and cycleway will experience a major beneficial effect due to a new footbridge which will be constructed as part of the proposals, offering a safer and improved environment, removing the current lighting, flooding and security issues.

14.7.2.2 Effects on Communities – community severance, community land, agricultural land, development land

As with amenity, it is likely most PRowS & footpaths will not be significantly affected and there will likely to be no community severance during construction. However, the NMU users of the Great Cambridge Road shared footpath and cycleway are likely to experience major adverse effects although the improvements to the footbridges and subways will be a major benefit for users. It is assumed this route serves users from the predominately residential Bullsmoor area of Enfield to access the employment site at Park Plaza. These impacts will be investigated further in subsequent design stages.

The option is likely to have an adverse effect during construction and operation on residential receptors identified especially along the access road of Great Cambridge Road and Bullsmoor Way. It is also likely that some land take is required for this option, employment land at Park Plaza Plot D (Granted permission for office development in accordance with the outline planning permission 07/10/0784/F) and agricultural land at Theobalds Park Farm.

14.7.3 Option 3

14.7.3.1 *Effects on All Travellers – driver stress, views from the road, NMUs*

During construction there is the potential for local journey length to increase as a result of construction work and subsequent traffic and NMU delays especially for users of the Great Cambridge Road shared footpath and cycleway which are indicated to be significantly altered and improved. During operation the improved and safer access of this route is expected to decrease journey times and make them more reliable for local people through better provision and reduced congestion. The maintenance access track to the New River Aqueduct will be altered and accessed instead from Bullsmoor Lane.

Option 3, is likely to have a negligible negative impact on views from the road, having the greatest impact of the three options, due to the proposed option increasing vehicular lanes, a new footbridge across the M25 being created and the addition of widening of the A10 Great Cambridge Road south of Junction 25. Any removal of vegetation at the junction required by the option will have the potential to further affect views.

Driver stress is expected to be temporarily adversely impacted by the construction works, assumed to have the greatest impact of the three options due to Option 3 having the largest amount of proposed works which would affect MT. However, these effects are expected to reduce during operation, and assumed to have the greatest benefit of the three options, through increased traffic flows and a more efficient road network leading to a reduction in driver frustration.

NMU amenity may be temporarily adversely affected by construction works associated with this option through disruption to the Great Cambridge Road shared footpath and cycleway. However, it is assumed the new subways and footbridges will be a major benefit to NMU users due to a safer and improved environment on operation. The footpath on the western side of Great Cambridge Road is assumed to be lost as part of Option 3 however, there will be no NMU access required as the private properties which uses this footpath will also be lost. This option requires widening of the anticlockwise carriageway beneath the New River aqueduct which flows in a bridge over the motorway. The effect on NMU users of the New River footpath is not known however, the works are not anticipated to require alterations to the bridge structure and therefore would not impact on the New River footpath.

It is expected that during operation NMU users of the Great Cambridge Road shared footpath and cycleway will experience a major beneficial effect due to a new footbridge which will be constructed as part of the proposals, offering a safer and improved environment, removing the current lighting, flooding and security issues.

14.7.3.2 *Effects on Communities – community severance, community land, agricultural land, development land*

As with amenity, it is likely most PRow's & footpaths will not be significantly impacted and there is likely to be no community severance during construction. NMU users of the Great Cambridge Road shared footpath and cycleway are likely to experience major adverse effects during construction but the improvements to the footbridges and subways will be of major benefit for users in operation. It is assumed this route serves users from the predominately residential Bullsmoor area of Enfield to access the employment site at Park Plaza. These impacts will be investigated further in subsequent design stages.

The option is likely to have an adverse effect during construction and operation on the residential receptors identified, especially along the access road of Great Cambridge Road,

Bullsmoor Way and those along the New River west of the Great Cambridge Road in Enfield. It is also likely that some land take would be required for this option, employment land at Park Plaza Plot D (Granted permission for office development in accordance with the outline planning permission 07/10/0784/F) and agricultural land at Theobalds Park Farm would be required. A further, much larger land take, would be required south of Junction 25 to the west of Great Cambridge Road at Waterworld Aquatics Centre and Red Gates Nursery, resulting in permanent loss of these commercial assets. A planning application (15/02745/FUL) for 56 residential at this location (also known as Kingswood Nurseries) has been submitted. These impacts will be investigated further in subsequent design stages.

Appendix K provides assessment tables on the effects on all travellers and effects on communities and their sub topics during construction and operation.

14.7.4 Motorised users views from the road

The effects of Views from the Road on Motorised Users for the proposed scheme options based on the methodology set in section 14.2 during construction and operation are detailed in Table 14-5 & Table 14-6.

Table 14-5 Construction Phase Motorised Users Views from the Road

Option	<i>Motorised Travellers: View from the Road</i>
1	<ul style="list-style-type: none"> • M25 (No View & Restricted View): Visual horizontal intrusion of construction works to construct footbridge at Junction 25. • Junction 25 (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • A10 north (No view & Open view): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • A10 south Great Cambridge Road (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • Bullsmoor Lane (No View & Restricted View): Visual intrusion of construction works.
2	<ul style="list-style-type: none"> • M25 (No View & Restricted View): Visual horizontal intrusion of construction works to construct footbridge at Junction 25. • Junction 25 (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • A10 north (No view & Open view): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • A10 south Great Cambridge Road (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • Bullsmoor Lane (No View & Restricted View): Visual intrusion of construction works.
3	<ul style="list-style-type: none"> • M25 (No View & Restricted View): Visual horizontal intrusion of construction works to construct footbridge at Junction 25. • Junction 25 (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25. • A10 north (No view & Open view): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25.

<ul style="list-style-type: none"> • A10 south Great Cambridge Road (No View & Restricted View): Potential loss of vegetation screening at Junction 25 and visual intrusion of construction works to construct footbridge at Junction 25 and demolition of commercial properties. • Bullsmoor Lane (No View & Restricted View): Visual intrusion of construction works and demolition of commercial properties.

Table 14-6 Operational Phase Motorised Users Views from the Road

Option	<i>Motorised Travellers: View from the Road</i>
1	<ul style="list-style-type: none"> • M25: No view & Restricted view new horizontal visual intrusion of footbridge at Junction 25. • Junction 25: No view & Restricted view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 north: No view & Open view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 south Great Cambridge Road: No view & Restricted view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • Bullsmoor Lane: No view & Restricted view limited change to distant views towards Junction 25.
2	<ul style="list-style-type: none"> • M25: No view & Restricted view new horizontal visual intrusion of footbridge at Junction 25. • Junction 25: No view & Restricted view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 north: No view & Open view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 south Great Cambridge Road: No view & Restricted view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • Bullsmoor Lane: No view & Restricted view limited change to distant views towards Junction 25.
3	<ul style="list-style-type: none"> • M25: No view & Restricted view new horizontal visual intrusion of footbridge at Junction 25. • Junction 25: No view & Restricted view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 north: No view & Open view potential loss of vegetation screening at Junction 25 and potential view of new footbridge at Junction 25. • A10 south Great Cambridge Road: No view & Restricted view potential loss of vegetation screening at Junction 25, potential view of new footbridge at Junction 25, alteration to views to the east when heading north to Junction 25 will increase openness. • Bullsmoor Lane: No view & restricted view alteration to views towards Junction 25 will increase openness.

14.8 Limitations to assessment

The assessment is based on professional judgement and takes into account both the adverse and beneficial contribution that proposed development can have upon the existing and surrounding receptors. The report provides broad, high level indication of effects,

reporting on the potential effects to people and community based on a simple assessment. No site visit has been undertaken and the findings are based upon a desk based study of the area and consultant's knowledge based on previous similar schemes. Information where relevant has been used from other specialist topic inputs in helping assess the magnitude of the proposed scheme on receptors. At this stage, where options are explored there is no detailed information available on the construction and therefore the assessment is based on assumptions and previous experience.

15 Cumulative effects

15.1 Introduction

In accordance with legislation the DMRB Volume 11, Section 2 Part 5: Assessment and Management of Environmental Effects (HA205/08) requires that Cumulative Effects are assessed as part of the assessment process.

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 Assessment methodology

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’ including (but not necessarily limited to):

- Trunk Road projects which have been confirmed (i.e. gone through the statutory processes) close to the M25 Junction 25 Interchange.
- Development projects with valid planning permissions as granted by the Local Planning Authority, and for which statutory EIA is a requirement or a non-statutory EIA has been undertaken.

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.

15.3 Potential effects

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 25 Improvements) or intra-project effects.
- Cumulative effects from different schemes (assessed in combination with the scheme in question) or inter-project effects.

The main source of data for the cumulative effects assessment is the outcomes and information obtained from the individual environmental topic assessments. The assessment of cumulative effects arising from the proposed scheme options in combination with other schemes primarily constitutes a desk-top study of planning documents broadly covering the location of schemes (if any are identified) considered relevant to the assessment.

The planned infrastructure schemes which are considered to have the potential for cumulative effects together with this scheme are outlined in Table 15.1 and are taken from Broxbourne and Enfield Local Plans.

Table 15-1 Planned infrastructure schemes for consideration of cumulative effects

Scheme	Local Authority	Description
Park Plaza	Broxbourne	The Park Plaza employment site containing the printworks and hotel, is site EMP2 in the saved 2005 Broxbourne Local Plan policies map, and in the emerging new Broxbourne Local Plan the exiting Park Plaza site is identified as a 'Loss of Employment Uses' site policy ED2
PP1 Park Plaza West	Broxbourne	Site to the west of the A10 is allocated for the development of a business campus of up to 100,000 m2 housing up to 10,000 jobs set within a generous and well landscaped setting
PP2 Park Plaza North	Broxbourne	Allocated site is north of the Park Plaza site and is proposed to be developed for a variety of small and medium sized enterprises, use classes B1, B2 or relocated businesses as a result of regeneration developments in the borough
PP3 Park Plaza Plot D (07/10/0784/F)	Broxbourne	Adjacent to the north east of Junction 25 the site is allocated for an office development in accordance with the outline planning permission 07/10/0784/F within the existing Park Plaza employment site
Kingswood Nurseries, Great Cambridge Road (15/02745/FUL)	Enfield	Full application for 56 residential units west of Great Cambridge Road, close to the junction with Bullsmoor Lane. Awaiting decision (committee report 22/3/16 recommended granting of permission subject to S106 agreement.)

Cumulative effects associated with noise, air quality and traffic are likely to increase due to the Borough of Broxbourne and the London Borough of Enfield planned housing schemes. The growing District's housing requirements are likely to result in more cars using the local transport network and increased pressure on the local transport infrastructure. These traffic increases will have been factored into the traffic model for the each of the options.

15.4 Indication of any difficulties encountered

This assessment does not feature a full assessment of the cumulative impacts from different projects together with the scheme being assessed, as described in DMRB 11.2.5 (HD 205/08) and Part 6 (HD 48/08). However, the main expected cumulative impacts from different projects with the M25 Junction 25 improvements are considered likely to be from changes to the flows of traffic, and the associated environmental impacts on noise and air quality. The traffic modelling which would enable such an assessment is not available at this stage, and therefore the assessment of these effects will be undertaken at a later stage and will be supported by the Transport Assessment.

16 Outline environmental management plan

16.1 Introduction

The use of Environmental Management Plans (EMPs) to manage the environmental effects of development is widely considered as best practice for major infrastructure projects by statutory, non-statutory and major companies alike. Use of EMPs conform to best practice guidance from BS EN ISO 14001 (BSI, 1996, as amended) and is guided for Highways England schemes by the Interim Advice Note (IAN) 'Environmental Management Plans' (183/14).

Preparation and implementation of EMPs permits the demonstration of compliance with environmental legislation. They also provide a mechanism by which designers can integrate best practice and sustainability elements into scheme concept and design, whilst contractors can show effective management of good working practices.

The need for environmental management planning extends throughout the whole project cycle, commencing at the early design stage. Obviously there needs to be a certain degree of information available before main design decisions can be made. This restriction is recognised in IAN 183/14, which indicates that initially, during PCF Stages 0-2, there is only need for high level consideration of Client Scheme Requirements, as the level of detail available is insufficient for effective EMP development.

An Outline EMP is required for PCF Stages 3 and 4, leading on to a Construction Environmental Management Plan (CEMP) for PCF Stage 5, ultimately evolving into a Handover EMP (HEMP) which is the main mechanism for passing essential environmental information to the client and, crucially, to the body responsible for the future maintenance and operation of the asset.

16.2 Client Scheme Requirements (environment)

For the purpose of the scheme, the primary Client Scheme Requirement for environmental issues is 'minimise the detrimental environmental effects of the scheme and offset with mitigation measures where technically feasible and economic to do so, taking into account of costs, availability of funding and statutory obligations'.

With this requirement in mind, measures have already been considered to mitigate and minimise the potential environmental implications of the options. This includes minimisation of land and property take, integration of embankment design to address noise and landscaping mitigation measures and use of possible drainage management to facilitate biodiversity mitigation.

As the scheme is still in the stage of option identification, it is too early to provide anything more than these preliminary references to environmental management measures. Nevertheless, all environmental factors are being fully evaluated during this assessment and as such, an outline is provided of the way in which it is envisaged that the environmental management plan should be developed for the scheme.

16.3 Outline of EMP requirements

One of the prime purposes of an EMP is to help identify potential environmental risks and to provide a mechanism for recording such possibilities and identifying ways in which to manage, control and/or obviate those risks. The EMP must then provide the framework to demonstrate delivery of the environmental responsibilities for implementing the management of potential adverse effects. Typically a listing of environmental aspects and impact is used to note potential impacts, feeding into the main EMP structure. This is identified in IAN 183/14 as a Register of Environmental Actions and Commitments (REAC), which is critical to the success of the EMP and subsequently, the environmental performance of the project.

The EMP must also demonstrate compliance with relevant environmental legislation, government objectives and scheme specific environmental objectives. It is also important that all relevant consents from regulatory authorities such as Sefton Council, Natural England and the Environment Agency are implemented, managed and updated, where necessary.

In order to demonstrate that all such measures are being taken and followed, the EMP needs to provide a mechanism for monitoring, reviewing, updating and auditing environmental performance and compliance.

The IAN (183/14) acknowledges that it would be too onerous to prepare the EMP at this early stage of option identification, as there are still several options under consideration and insufficient information to be able to develop a clear, robust listing of scheme specific issues to be considered. Therefore a detailed outline of the structure of the EMP will be required at PCF Stage 3, during the preparation of the preferred option.

The indicative elements of the outline EMP are given below:

Introduction and background: giving a brief summary of the project, any relevant strategy or programme context and the purpose of the EMP;

Environmental risk assessments: detailing the environmental risks associated with all activities on the project, the mitigation measures to remove or reduce the risks and assigned responsibilities for the risks;

Description of proposed design and proposed management of that design identifying individuals responsible;

Environmental Actions and Commitments Register (REAC): to provide a record of the project specific environmental actions and commitment to be implemented and managed thorough all stages of the project.

The Highways England IAN 183/14 provides more detail of the indicative contents of the Construction Environmental Management Plan, which is not required until PCF Stage 5, but which should be borne in mind during the preparation of the Outline EMP at PCF Stages 3 and 4.

Table 16.1 provides a summary of the environmental mitigation and management measures that will be required, based on the current level of understanding of the impacts of the overall scheme. At this stage generic measures are provided that are likely to be required for all of the design options currently being proposed. The specific detail of mitigation required will need to be revisited once an option has been selected and the impacts can be better understood.

Table 16-1 Outline Environmental Management Plan

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
Air Quality	Local residents Ecological receptors AQMA near	Nuisance caused by dust deposition during construction Impact on human health from NOx and PM10 emissions due to construction traffic causing congestion	Best Practice Measures in a CEMP Traffic Management Plan	Prior to Construction
Cultural Heritage	Unknown buried remains	Physical disturbance caused during the excavation of new roads, service trenches, topsoil stripping, landscaping features and drainage ponds	Archaeological Investigations to establish nature, extent and survival of any previously unrecorded buried archaeological remains	Prior to commencement of scheme construction As part of an update to the ESR if recommended
	Heritage Assets including Listed Buildings, non-designated historical landscapes and APAs.	Impact on historic setting	High quality design Undertake Setting Assessment of designated assets affected	As part of an update to the ESR if recommended
Landscape	Sensitive landscape receptors include: existing mature trees, belts of trees and hedgerows.	Landscape: potential loss of vegetation, and transformation of landscape pattern and land use;	Preparation of a Landscape and Environment masterplan. At design stage a tree survey should be carried out to inform arboriculture constraints accompanied by tree constraints plans. As design is more defined an Arboriculture Method Statement accompanied by tree retention plans should be produced to inform tree protection measures.	Design stage
	Sensitive visual receptors: users of PRow along New River to the north west of the M25 Junction 25, residential receptors within Theobald's Farm and from residential receptors at the junction of Bullsmoor Lane and the A10 and along the A10.	Deterioration of visual amenity due to alteration of the view both through introduction new elements of the scheme and loss of existing landscape elements in the view.	During construction all existing tree, scrub, shrub and hedgerow planting within the highway estate would be retained wherever possible and protected in accordance with BS5837:2012. Loss of tree, scrub and shrub cover should be substituted elsewhere within the highway boundary in the vicinity of the scheme. Construction working methods around tree roots should take account of arboricultural advice for the protection of all retained trees.	Construction stage

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
Ecology and Nature Conservation	Designated Sites (SPA, Ramsar, SSSI, SIN, LWS)	Potential pollution of watercourses	Assessment of Impacts on European Sites. Pollution prevention mitigation following EA guidelines.	As part of an update to the ESR in PCF 2
	Notable habitats	Temporary disturbance or permanent loss of these habitats	Avoidance during option selection, design of structures, layouts, management plan and aftercare plan. Protection of habitats outside the working area from accidental incursion. Protection of retained trees following standard practice.	As part of an update to the ESR in PCF 2
	Notable and protected species	Loss of habitat, disturbance and direct harm	Undertake species surveys to determine presence and species status. 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) would be damaged during the works. Use of precautionary method of working during construction to minimise risk to individual animals of protected species where licences would not be required.	As part of an update to the ESR at later stage in design process to reduce likelihood of surveys going out-of-date
Geology and Soils	Geology and soils, construction workers and water resources	Contamination, accidental spillage, unforeseen ground conditions and groundwater regime; redesign, programme and cost implications	Best Practice measures in accordance with CEMP, Eurocode, HD22/08 and HD41/15, to include desk study, ground investigation and geotechnical reporting	Prior to Construction
	Buildings (buried concrete structures)	Damage to the structure due to chemical attack and degradation; redesign, programme and cost implications	Best Practice measures in accordance with, Eurocode, BRE Special Digest 1 HD22/08 and HD41/15, to include desk study, ground investigation and geotechnical reporting	Prior to Construction
Materials and Waste	Material resources.	Use of finite resources.	Designing out Waste (DoW) to ensure locally sourced, recycled and / or recovered materials are used where practicable.	During the development of the design
	Waste treatment and disposal infrastructure.	Increased pressures placed on regional waste treatment and disposal infrastructure.	Implementation of best practice waste management measures e.g. development of an SWMP ('lite' and detailed) and if applicable an MMP, designing out waste, setting recovery and reuse targets,	Prior to and during construction

TOPIC	SENSITIVE RECEPTORS	POTENTIAL IMPACT	MANAGEMENT MEASURES	TIME FRAME
			promoting offsite construction, materials optimisation, waste efficient procurement, having clearly defined onsite segregation facilities and disposal plans.	
Noise and Vibration	Residential receptors (including NIAs), sensitive land uses (e.g. schools, places of worship, hospitals) recreational users of footpaths and outdoor space, sensitive habitat and species.	Disturbance from construction phase, aligning roads closer to sensitive receptors, increases to traffic volume, average speed or increased HGV representation in traffic fleet composition.	BPM to minimise construction noise	Residential receptors (including NIAs), sensitive land uses (e.g. schools, places of worship, hospitals) recreational users of footpaths and outdoor space, sensitive habitat and species.
People and Communities	Motorised users of the road NMU of road and off-road routes Users of community facilities Residential Receptors Owners and users of private property Agricultural Land classified as BMV Development Land	Change in levels of driver stress Reduction in NMU amenity and journey length	Consideration of landscape screening of the road wherever possible and If required noise mitigation for the operation phase. Use of Best Practice construction methods to reduce disruption to users of facilities within vicinity Agricultural Land Assessment to determine in detail the quality of the agricultural land. Liaison will be required with land owners and LPAs to discuss and mitigate against loss of development land	As part of an update to the ESR in PCF 2 Prior to submitting for approval
		Community severance Loss of private assets Loss of BMV Agricultural Land Loss of Development Land		
Road Drainage and the Water Environment	New River and associated SPZ	Potential impact to water quality during aqueduct construction works	Best Practice Measures in a CEMP Liaison will be required with the Environment Agency to develop specific controls necessary to ensure its protection during construction Areas which may generate contaminated water would be bunded and have water discharged to self contained units with treatment facilities. There would be no discharge to groundwater	As part of an update to the ESR in PCF 2
	Secondary A Aquifer and associated SPZ	Cuttings, and piling works may affect the flow of groundwater, indirectly affecting surface water features and abstractions which are dependent upon groundwater inputs. The works may introduce new pollutant pathways to the underlying aquifer		
	Holmesdale Tunnel	Potential for increased surface water flooding owing to increased impermeable area	Best Practice Measures in a CEMP <ul style="list-style-type: none"> An adequate surface water drainage system, potentially incorporating SuDS. 	As part of an update to the ESR in PCF 2

17 Summary of effects

17.1 Introduction

As this is only the option identification PCF Stage1 of the project process, there is no attempt to make any form of comparative assessment of the options. Therefore, in this conclusion section, we present the initial findings of the optioneering process for each of the disciplines. Dependent upon the nature of the assessment undertaken, i.e. Simple or Detailed, not all the options within the overall Online and Offline schemes have been assessed individually.

17.2 Option 1

17.2.1 Air quality

The traffic model for the opening year has shown that there are likely to be a number of roads affected with Option 1 including an increase in traffic, indicating a potential increase in pollutant concentrations at nearby receptors: M25 west of J25; A10 south and north of J25; A1055 Bullsmoor Lane west of the A10 south; Bulls Cross south of Bullsmoor Lane.

17.2.2 Cultural heritage

The construction and operation of Option 1 will not give rise to any significant effects on the cultural heritage resource. The construction of the option would impact on the setting of the Grade II listed buildings at Theobalds Park Farm, which would result in temporary slight adverse effects which are not significant. Impacts on the setting of the Grade II* listed Capel House would also result in a temporary, not significant, slight adverse effect.

17.2.3 Landscape

No significant landscape effects were identified both in the construction and operational stage due to the small scale of the proposed scheme. Only a slight alteration to the landscape character is expected in the construction and operational stage. No significant visual effects were identified during construction and operational stage due to the minor alteration of inconspicuous characteristics of the views.

17.2.4 Nature conservation

No potential significant effects on nature conservation features have been identified. The proposed scheme options may potentially impact on legally protected species during construction, and therefore the presence of protected species must be taken into account throughout the design and construction process, so that mitigation measures can be identified that will reduce or avoid impacts on these species.

17.2.5 Geology and soils

There is potential for impacts associated with varying ground conditions that may be encountered; and to human and/or controlled waters receptors associated with potential sources of contamination within or in close proximity to the proposed route, such as localised deposits of Made Ground and other potentially contaminative land uses, including an infilled pond on the north-west quadrant of the site, nearby petrol filling stations and nearby industries such as historical nurseries and brewers. Unless mitigated, piling works during construction has the potential to release contaminants into the surrounding environment via surface water runoff/ groundwater penetration.

17.2.6 Materials and waste

Key effects associated with Option 1 include:

- Potential excess material use / waste generation if wastes are not reused / recycled where practicable
- Potential for the disposal of large quantities of excavated materials, if the materials are found to be hazardous and thus not suitable for reuse
- Increased waste arisings associated with widening existing carriageways and bridges

- Increased waste arisings associated with the construction of the pedestrian / cycle footbridge
- Increased waste arisings associated with the refurbishment of subways
- Increased demolition waste arisings associated with the narrowing of the existing hardened verge
- Increased excavation waste arisings due to the creation of embankments

Option 1 is likely to have the least effect of all of the options.

17.2.7 Noise and vibration

All construction activities have the potential to cause some disturbance at nearby noise and/or vibration sensitive receptors, with demolition works and piling works (for new viaducts and retaining walls) giving rise to some of the highest noise levels dependent on the methods chosen. In the Opening Year of the scheme, a short-term noise decrease of minor impact magnitude was predicted at the eastbound M25 off-slip at Junction 25 as a result of changes to the traffic volume, average speed, or fleet composition. Negligible changes in Basic Noise Level were predicted elsewhere in the short-term. Negligible changes were predicted throughout the study area in the long-term (Design Year). The widening of the southbound entry (to the north east of the roundabout) will position the widened road slightly closer to the nearby residential receptors in Waltham Cross, although these buildings will still be over 300m away.

17.2.8 People and communities

The construction and operation of Option 1 is likely to have the least significant effect on all the identified receptors under this option and would result in temporary and permanent adverse effects ranging from negligible to major adverse during construction. However, effects on identified NMU are only likely to be negligible adverse in operation while the Great Cambridge shared footpath and cycleway is likely to be a major benefit due to the improvements in amenity of users of that NMU route. It is assumed residential receptors will be affected by this option the least of the three options. The impact on motorised traveller's views from the road will depend on the design and landscaping mitigation of the option but it is assumed a loss of current vegetation screening will be required under this option for the proposed improvements. Driver stress is expected to be temporarily adversely impacted by the construction works, however is expected to reduce during operation through increased traffic flows and a more efficient road network reducing driver frustration.

17.2.9 Road drainage and the water environment

Based on the modest scale of option 1 and the modified nature of the water environment, it is considered there should be no significant effects to the water environment.

Option 1 is the least environmentally damaging for the water environment during both construction and operation.

17.3 Option 2

17.3.1 Air quality

The traffic model for the opening year has shown that there are likely to be a number of roads affected with Option 2 including an increase in traffic, indicating a potential increase in pollutant concentrations at nearby receptors: M25 west of J25; A10 south and north of J25; A1055 Bullsmoor Lane west of the A10 south; Bulls Cross south of Bullsmoor Lane. In addition with option 2 the M25 east of J25, A1055 Bullsmoor Close east of the A10, and the B198 Lieutenant Ellis Way between St Mary's High School roundabout and the B198 / A121 / A10 roundabout are expected to have an increase in traffic. With Option 2 the A10 northbound off-slip is expected to have a decrease in traffic, with a potential decrease in pollutant concentrations at any nearby receptors.

17.3.2 Cultural heritage

The construction and operation of Option 2 will not give rise to any significant effects on the cultural heritage resource. The construction of the option would impact on the setting of the Grade II listed buildings at Theobalds Park Farm, which would result in temporary slight adverse effects. The operation of the Option would potentially result in a permanent slight beneficial effect on the setting of the same buildings, due to improved traffic flow. Impacts on the setting of the Grade II* listed Capel House would also result in a temporary slight adverse effect.

17.3.3 Landscape

No significant landscape effects were identified either in the construction or operational stage due to the small scale of the proposed scheme and only a slight alteration to the landscape character is expected. Few visual receptors have been identified as potentially significantly affected during the operational stage mainly due to the close proximity of the receptors to the proposed scheme and open views towards the M25 Junction 25 from Theobald's Park Farm and from PRowS along the New River.

17.3.4 Nature conservation

No potential significant effects on nature conservation features have been identified. The proposed scheme options may potentially impact on legally protected species during construction, and therefore the presence of protected species must be taken into account throughout the design and construction process, so that mitigation measures that will reduce or avoid impacts on these species can be identified.

17.3.5 Geology and soils

There is potential for impacts associated with varying ground conditions that may be encountered; and to human and/or controlled waters receptors associated with potential sources of contamination within or in close proximity to the proposed route, such as localised deposits of Made Ground and other potentially contaminative land uses, including an infilled pond on the north-west quadrant of the site, nearby petrol filling stations and nearby industries such as historical nurseries and brewers. Unless mitigated, piling works during construction have the potential to release contaminants into the surrounding environment via surface water runoff/ groundwater penetration. Further details of the currently anticipated risks associated with geology and soils and initial mitigation and enhancement measures for implementation during the design and construction stages of the project can be found within Section 12.

17.3.6 Materials and waste

Key effects associated with Option 2 include:

- Potential excess material use / waste generation if wastes are not reused / recycled where practicable
- Potential for the disposal of large quantities of excavated materials, if the materials are found to be hazardous and thus not suitable for reuse
- Increased waste arisings associated with widening existing carriageways and bridges
- Increased waste arisings associated with the construction of the pedestrian / cycle footbridge
- Increased waste arisings associated with the refurbishment of subways
- Increased demolition waste arisings associated with the narrowing of the existing hardened verge
- Increased excavation waste arisings due to the creation of embankments

17.3.7 Noise and vibration

All construction activities have the potential to cause some disturbance at nearby noise and/or vibration sensitive receptors, with demolition works and piling works (for new viaducts and retaining walls) giving rise to some of the highest noise levels dependent on the methods chosen. The proposed demolition of a retaining wall adjacent to the westbound

diverge is likely to exacerbate impacts at Bullsmoor Way, Bullsmoor Gardens and Bullsmoor Ride, which are 80-200m away from the proposed works. During the operational phase of the scheme, the following impacts were predicted short-term noise increases of minor impact magnitude was predicted at:

- Short-term noise increases of minor impact magnitude at the eastbound carriageway of the M25 prior to Junction 25 (which passes through Important Area 5716 at Bulls Cross Ride).
- Short-term noise increases of minor impact magnitude at the westbound diverge where an additional lane is proposed, affecting approximately 150 residential buildings at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens. The westbound diverge is located within Important Area 1186 and is approximately 390m from Important Area 13660. The noise levels at these buildings could increase further due to the proposed height reduction of the retaining wall.
- Short-term and long-term noise increases of major impact magnitude at the proposed segregated left turn lane from the eastbound M25 to northbound A10. However, the nearest noise sensitive receptors to this road link are over 200m at Bullsmoor Way and Important Area 13660, located at the opposite quadrant of the Junction 25 roundabout.
- Short-term noise increases of minor impact magnitude were predicted at Bullsmoor Lane due to changes in traffic in the Opening Year compared with the Do Minimum scenario.

17.3.8 People and communities

The construction and operation of Option 2 is likely to have a greater effect on all the identified receptors compared to Option 1 however, this increase is unlikely be significant due to the relatively small increase in proposed improvement works. Similar to Option 1, the improvements would result in temporary and permanent adverse effects ranging from negligible to major adverse during construction. NMU are only likely to experience negligible adverse effect during operation while the Great Cambridge shared footpath and cycleway is likely to be a major benefit. It is likely that some small areas of private land will be required which will have potential to effect a development site at Park Plaza Plot D and result in the loss of agricultural land at Theobalds Park Farm. The impact on motorised traveller's views from the road will depend on the design and landscaping mitigation but it is assumed some loss of current vegetation screening will be required but this will not change views significantly. Driver stress is expected to be temporarily adversely impacted by the construction works, however is expected to reduce during operation through increased traffic flows and a more efficient road network reducing driver frustration.

17.3.9 Road drainage and the water environment

As option 1, the modest scale of option 2, the design provisions outlined in IAN161/15 (November 2015) and the modified nature of the water environment, it is considered there should be no significant effects to the water environment. Option 2 would involve cuttings and therefore there is potential for impacts on the Secondary Aquifer.

17.4 Option 3

17.4.1 Air quality

The traffic model for the opening year has shown that there are likely to be a number of roads affected with Option 3 including an increase in traffic, indicating a potential increase in pollutant concentrations at nearby receptors: M25 west of J25; A10 south and north of J25; A1055 Bullsmoor Lane west of the A10 south; Bulls Cross south of Bullsmoor Lane. In addition with option 3 the M25 east of J25, A1055 Bullsmoor Close east of the A10, and the B198 Lieutenant Ellis Way between St Mary's High School roundabout and the B198 / A121 / A10 roundabout are expected to have an increase in traffic. With Option 3 the A10 northbound off-slip is expected to have a decrease in traffic, with a potential decrease in pollutant concentrations at any nearby receptors.

17.4.2 Cultural heritage

The construction and operation of Option 3 will give rise to significant effects on the Grade II* listed Capel House. These are temporary and permanent moderate adverse effects as a result of impacts on the asset's setting. The construction and operation of the option would impact on the setting of the Grade II listed buildings at Theobalds Park Farm and the Grade II listed Bulls Cross Lodge, which would result in temporary slight adverse effects. The operation of the Option would potentially result in a permanent slight beneficial effect on the setting of Theobalds Park Farm, due to improved traffic flow. The option would also impact on the setting of Grade II listed buildings adjacent to Capel House resulting in temporary and permanent slight adverse effect. There is the potential for impacts on unknown buried archaeology as a result of its truncation or removal. Option 3 is the least favoured of the options on Cultural Heritage terms

17.4.3 Landscape

No significant landscape effects were identified either in the construction or operational stage due to the small scale of the proposed scheme. Only a slight effect on the landscape character is expected in the construction and operational stages. Few receptors were identified as significantly affected during construction stage as only a partial deterioration of their views is expected. Only one receptor was identified as significantly affected during operational stage and proposed planting could be implemented that would mature to accommodate most of the proposed scheme within the existing landscape. Option 3 has the most landscape and visual effects of the three options under consideration.

17.4.4 Nature conservation

No potential significant effects on nature conservation features have been identified. The proposed scheme options may potentially impact on legally protected species during construction, and therefore the presence of protected species must be taken into account throughout the design and construction process, so that mitigation measures can be identified that will reduce or avoid impacts on these species.

17.4.5 Geology and soils

There is potential for impacts associated with varying ground conditions that may be encountered; and to human and/or controlled waters receptors associated with potential sources of contamination within or in close proximity to the proposed route, such as localised deposits of Made Ground and other potentially contaminative land uses, including an infilled pond on the north-west quadrant of the site, nearby petrol filling stations and nearby industries such as historical nurseries and brewers. Unless mitigated, piling works during construction have the potential to release contaminants into the surrounding environment via surface water runoff/ groundwater penetration. Further details of the currently anticipated risks associated with geology and soils and initial mitigation and enhancement measures for implementation during the design and construction stages of the project can be found within Section 12.

17.4.6 Materials and waste

A summary of the key effects associated with Option 3 are summarised below:

- Potential excess material use / waste generation if wastes are not reused / recycled where practicable
- Potential for the disposal of large quantities of excavated materials, if the materials are found to be hazardous and thus not suitable for reuse
- Increased waste arisings associated with widening existing carriageways and bridges
- Increased waste arisings associated with the construction of the pedestrian / cycle footbridge
- Increased waste arisings associated with the construction of maintenance access track
- Increased waste arisings associated with the refurbishment of subways

- Increased demolition waste arisings associated with the narrowing of the existing hardened verge
- Increased excavation waste arisings due to the creation of embankments

17.4.7 Noise and vibration

All construction activities have the potential to cause some disturbance at nearby noise and/or vibration sensitive receptors, with demolition works and piling works (for new viaducts and retaining walls) giving rise to some of the highest noise levels dependent on the methods chosen. The proposed demolition of a retaining wall adjacent to the westbound diverge is likely to exacerbate impacts at Bullsmoor Way, Bullsmoor Gardens and Bullsmoor Ride, which are 80-200m away from the proposed works. During the operational phase of the scheme, the following impacts were predicted short-term noise increases of minor impact magnitude was predicted at:

- Short-term noise increases of minor impact magnitude at the eastbound carriageway of the M25 prior to Junction 25 (which passes through Important Area 5716 at Bulls Cross Ride).
- Short-term noise increases of minor impact magnitude at the westbound diverge where an additional lane is proposed, affecting approximately 150 residential buildings at Bullsmoor Way, Bullsmoor Ride and Bullsmoor Gardens. The westbound diverge is located within Important Area 1186 and is approximately 390m from Important Area 13660. The noise levels at these buildings could increase further due to the proposed height reduction of the retaining wall.
- Short-term and long-term noise increases of major impact magnitude at the proposed segregated left turn lane from the eastbound M25 to northbound A10. However, the nearest noise sensitive receptors to this road link are over 200m at Bullsmoor Way and Important Area 13660, located at the opposite quadrant of the Junction 25 roundabout.
- Short-term noise increases of minor impact magnitude were predicted at Bullsmoor Lane due to changes in traffic in the Opening Year compared with the Do Minimum scenario.
- Short-term noise increase of minor impact magnitude at the northbound A10 located north of Junction due to changes in traffic.
- Short-term and long-term noise increase of major impact magnitude at the segregated left turn lane from A10 northbound to M25 westbound merge affecting noise sensitive receptors located south west of the Junction 25 roundabout.
- Short-term noise increase of minor impact magnitude from widening the southbound A10 to accommodate an extra lane, with the impact concentrated at the merge onto the A10 from the M25.

17.4.8 People and communities

The construction and operation of Option 3 is likely to have the greatest effect on all the identified receptors compared to the other options. This increase is likely be significant due to the increased scale of the proposed improvement works and because they are located south of Junction 25, close to receptors. Similarly, the improvements would result in temporary and permanent adverse effects ranging from negligible to major adverse during construction. NMU are only likely to experience negligible adverse effects in operation while the Great Cambridge shared footpath and cycleway is likely to be a major benefit due to the improvements in amenity of users of that NMU route. This option requires the largest land take over and above the previous options and would result in the potential loss of commercial business along Great Cambridge Road (Waterworld Aquatics Centre) while significantly effecting a planning application site at Kingswood Nurseries. It is assumed residential receptors will be affected the most of the three options due to these improvements being south of Junction 25. The impact on motorised traveller's views from the road will depend on the design and landscaping mitigation of the option but it is assumed a loss of current vegetation screening will be required under this option for the proposed improvements and it is likely views will change significantly under this option, especially

along Great Cambridge Road south of Junction 25. Driver stress is expected to be temporarily adversely impacted by the construction works, however is expected to reduce during operation through increased traffic flows and a more efficient road network reducing driver frustration.

17.4.9 Road drainage and the water environment

Option 3 is by a small margin potentially the most environmentally damaging for the water environment, based on the larger scale, the nature of works proposed and need to modify a strategic water resources asset (the New River aqueduct).

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