

THE PLANNING ACT 2008

**M4 (JUNCTIONS 3 TO 12) (SMART MOTORWAY) DEVELOPMENT CONSENT
ORDER APPLICATION**

TR010019

Issue Specific Hearing - Environment

**Appendix A - Environment Additional
Representations**

Deadline IV - 26 November 2015

DEADLINE IV RESPONSES - ENVIRONMENT - APPENDIX A

ADDITIONAL REPRESENTATION

HIGHWAY ENGLAND'S RESPONSE

1. ENVIRONMENTAL HEARING – PRELIMINARY MATTERS

1.1 Provide details of which developments have been considered by the scheme and how they have been included in the traffic model

Highways England Comment

- 1.1.1 Details of developments considered for the traffic model are provided at Appendix B to the written summary of the Issue Specific Hearing relating to the Environment. Developments included or not included have been separately listed and, in addition, each development is shown on an accompanying map, cross-referenced to the list by means of the site ID number.
- 1.1.2 The list of developments covers all the information received from local authorities, either directly or through review of local plans, up to February 2014. It was necessary to freeze the inputs to the traffic model forecasts at that date in order to complete the forecasts within the timescale required to allow completion of the environmental assessments and subsequent preparation of the Environmental Statement in support of the DCO application.
- 1.1.3 The basis for inclusion is detailed in Table A2 of the Department for Transport's, Transport Appraisal Guidance (TAG) Unit M4: Forecasting and Uncertainty, a copy of which is provided below. In line with the TAG guidance, all developments considered to be 'near certain' or 'more than likely' were taken forward for inclusion in the core scenario of the traffic model. Those developments considered to be 'reasonably foreseeable' or 'hypothetical' were excluded from the core scenario.

2. ENVIRONMENTAL HEARING – TRAFFIC FORECASTING

2.1 Provide a summary of traffic model assumptions

Highways England Comment

- 2.1.1 Agenda item 11 of the Traffic section of the Environment Issue Specific Hearing stated as follows:

Effect of traffic growth forecasts on emissions and health

Re Sections 3.54-3.63 of the DfT Road Traffic Forecasts 2015 report, which records DfT's forecasts for emissions, and in particular Section 3.59 which states that CO₂ is forecast to fall by between 3% and 26% from 2010 to 2040, are these figures recognised in the M4 Smart Motorway modelling?

- 2.1.2 In response to that agenda item, Mr Whittle on behalf of Highways England explained that it is understood that these figures are derived from the assumptions input to the National Transport Model on fuel efficiency and traffic growth and the subsequent estimation of the effects on emissions through separate emissions modelling. The effects of the M4 Smart Motorway on CO₂ levels have been separately modelled and assessed. However, these metrics have not been used in the air quality assessment for the Scheme. The carbon calculations have been completed using the emissions factor toolkit, which projects future emissions as far forward as 2030. The carbon emissions assessment therefore assumes no reduction in carbon emissions beyond 2030.
- 2.1.3 The level of carbon emissions (and therefore CO₂) is directly related to the amount of fuel consumed. Assumptions about future levels of fuel efficiency are inputted by the DfT into the National Travel Model which, in turn, lead to the forecasts of future carbon emissions, again at the national level. At the local level, models such as the Scheme traffic model, use vehicle operating costs as an input, an element of which is fuel cost. Future levels of fuel cost over time are based on predictions of oil prices and fuel efficiency, the assumptions for both of which are taken from the national level forecasts. Therefore, the national model directly uses fuel efficiency assumptions to produce the relationships that are subsequently used as inputs at the local model level. The various inter-relationships are explained in the following paragraphs.
- 2.1.4 The basis on which trips in the Scheme traffic model are assigned to a particular route is on the lowest cost route of all those routes and modes available and is in turn based on the “generalised cost” of travel, where generalised cost is a weighted combination of monetised time and fares or vehicle operating costs.
- 2.1.5 Vehicle operating costs are a combination of fuel and non-fuel costs (e.g. oil, tyres, maintenance and depreciation). The basis for the calculation of vehicle operating costs is given in TAG Unit A1.3 User and Provider Impacts, and the accompanying TAG Data Book.
- 2.1.6 In particular, as explained in paragraphs 5.1.2 and 5.1.3 of TAG Unit A1.3, fuel costs for use in appraisal are provided within the Data Book in Table A1.3.7 – fuel

and electricity price forecasts. The fuel price forecasts are based on fuel price forecasts published in HM Treasury Supplementary Green Book guidance on valuation of energy use and greenhouse gas emissions.

- 2.1.7 Fuel consumption is estimated from a function that relates consumption to vehicle speed and a number of parameters specified by vehicle type. The parameters were derived to be consistent with the latest fleet composition and projections and methods used in the National Atmospheric Emissions Inventory ("NAEI"), which can be found at: <http://naei.defra.gov.uk/>. The parameters, by vehicle type, are given in Table A1.3.8 of the Data Book – fuel/energy consumption parameters.
 - 2.1.8 The next step is to determine the proportion of cars and goods vehicles using petrol, diesel or electric fuel. These proportions, and their forecast changes over time, are given in Table A1.3.9 of the Data Book – proportions of vehicle kms by fuel type.
 - 2.1.9 The parameters in the fuel consumption equation (in litres/km) can be multiplied by the cost of fuel (in pence per litre) to give a fuel cost equation (in pence per km). The forecast costs of fuel, changes in the fleet mix and efficiency improvements can then be combined to provide forecasts of the fuel cost equation by vehicle type and journey purpose. These are given in the Data Book Tables A1.3.12 – forecast fuel cost parameters (work) and A1.3.13 – forecast fuel cost parameters (non-work).
 - 2.1.10 As explained in paragraph 5.1.8 of TAG Unit A1.3, fuel efficiency is expected to improve over time. This means that the cost parameters for fuel use are expected to decrease over time. The fuel efficiency improvement assumptions are given in the Data Book Tables A1.3.10 – forecast fuel efficiency improvements, and A1.3.11 – forecast fuel consumption parameters.
 - 2.1.11 All of the above parameters are used as inputs to the national model and combined with national growth forecasts to produce Road Traffic Forecasts 2015.
 - 2.1.12 Only the final step – the forecasts of fuel costs by vehicle type - are directly input to the vehicle operating costs used in the M4 Scheme model. These are combined with local growth forecasts, based on NTEM, to produce the Scheme-specific traffic forecasts for the Scheme. It is these traffic forecasts from the M4 model that are then passed for use within the subsequent air quality and noise assessments undertaken for the Scheme.
- 2.2 *Provide a timetable of future discussions between Highways England and London Borough of Hillingdon, Buckingham County Council and South Bucks District Council regarding proposed additional survey / assessment works*

Highways England Comment

- 2.2.1 In respect of London Borough of Hillingdon ("LBH"), Highways England has provided LBH with additional traffic model data for M4 junctions 3 and 4. LBH has advised Highways England that it has sought a view from Transport for London and is giving the matter further consideration before advising Highways England further on its position.

- 2.2.2 A meeting was held between Highways England and Buckinghamshire County Council ("BCC") on 25 November 2015. BCC has identified 17 junctions on its local road network that it wishes Highways England to assess. BCC has data for three junctions and information is being sought from developer transport assessments for another three of the junctions. There is no traffic count data for the remaining 11 junctions. To meet the requirements of Department for Transport, Transport Appraisal Guidance, traffic surveys should only be conducted in neutral months, the next of which is March 2016 and accordingly it was agreed that the matter is not capable of immediate resolution. Further discussions are proposed which will be reflected in a revision to the Statement of Common Ground and DCO documentation.
- 2.2.3 Highways England understands that BCC as Local Highway Authority act on behalf of South Bucks District Council on traffic matters.

2.3 *Provide a copy of the unpublished "Ricardo" report*

Highways England Comment

- 2.3.1 A copy of the Ricardo-AEA Report "Production of Updated Emission Curves for Use in the National Transport Model is provided in Appendix C to the written summary of the Issue Specific Hearing relating to the Environment.

3. ENVIRONMENTAL HEARING – AIR QUALITY

- 3.1 *Confirm current status between Highways England and South Buck District Council of whether agreement has been reached on the study area.*

Highways England Comment

- 3.1.1 Highways England have confirmed with South Bucks District Council that there are no issues with the air quality study area used by the Scheme for assessment of construction and operation effects.

- 3.2 *Provide a copy of the IQMA guidance*

Highways England Comment

- 3.2.1 A copy of the IQMA guidance is contained in Appendix D to the written summary of the Issue Specific Hearing relating to the Environment.

- 3.3 *Provide a summary of scheme effects on AQMAs*

Highways England Comment

- 3.3.1 This action was directed at Local Authorities to review implications of the Scheme for their AQMAs and submit these at Deadline IV. Highways England has received no comments to date and therefore proposes to respond to any comments at Deadline V.

- 3.4 *Provide an update from DEFRA following the Highways England letter pointing out unusual Sipson Road AURN site results*

Highways England Comment

- 3.4.1 Discussions with Defra regarding the AURN site at Sipson Road are continuing and a further update will be provided at Deadline V.

- 3.5 *Provide details of any long term trend data available in the wider area to compare against the results of the last 15 years from the Sipson Road AURN site*

Highways England Comment

- 3.5.1 A review of air quality monitoring data with data captured over similar durations as the Hillingdon Automatic Urban and Rural Monitoring Network ("AURN") site (10 to 15 years) has been undertaken by Highways England. The review focused upon the same AURN that the Hillingdon AURN site is part of.

- 3.5.2 Highways England has collated monitoring data for all of the AURN sites in the South East of England, which are of a similar type (i.e. urban background) to the Hillingdon AURN site. This regional AURN review considered fifteen air quality monitoring sites:

- 3.5.2.1 Oxford St Ebbes;
- 3.5.2.2 Southampton Centre;
- 3.5.2.3 Portsmouth;
- 3.5.2.4 Reading New Town;
- 3.5.2.5 Brighton Preston Park;
- 3.5.2.6 Eastbourne;
- 3.5.2.7 Canterbury;
- 3.5.2.8 Southend-on-Sea;
- 3.5.2.9 Thurrock;
- 3.5.2.10 London Haringey;
- 3.5.2.11 London N. Kensington;
- 3.5.2.12 London Bloomsbury;
- 3.5.2.13 London Westminster;
- 3.5.2.14 London Hillingdon; and
- 3.5.2.15 London Teddington.

3.5.3 The regional AURN review presented below for NO₂ and NO_x demonstrates that for both NO₂ (Figure 1) and NO_x (Figure 2), the predominant trend is either a downward trend or no clear trend, with the exception of the Hillingdon AURN air quality monitor.

Figure 1: Annual Average NO₂ Trends (1999-2014)

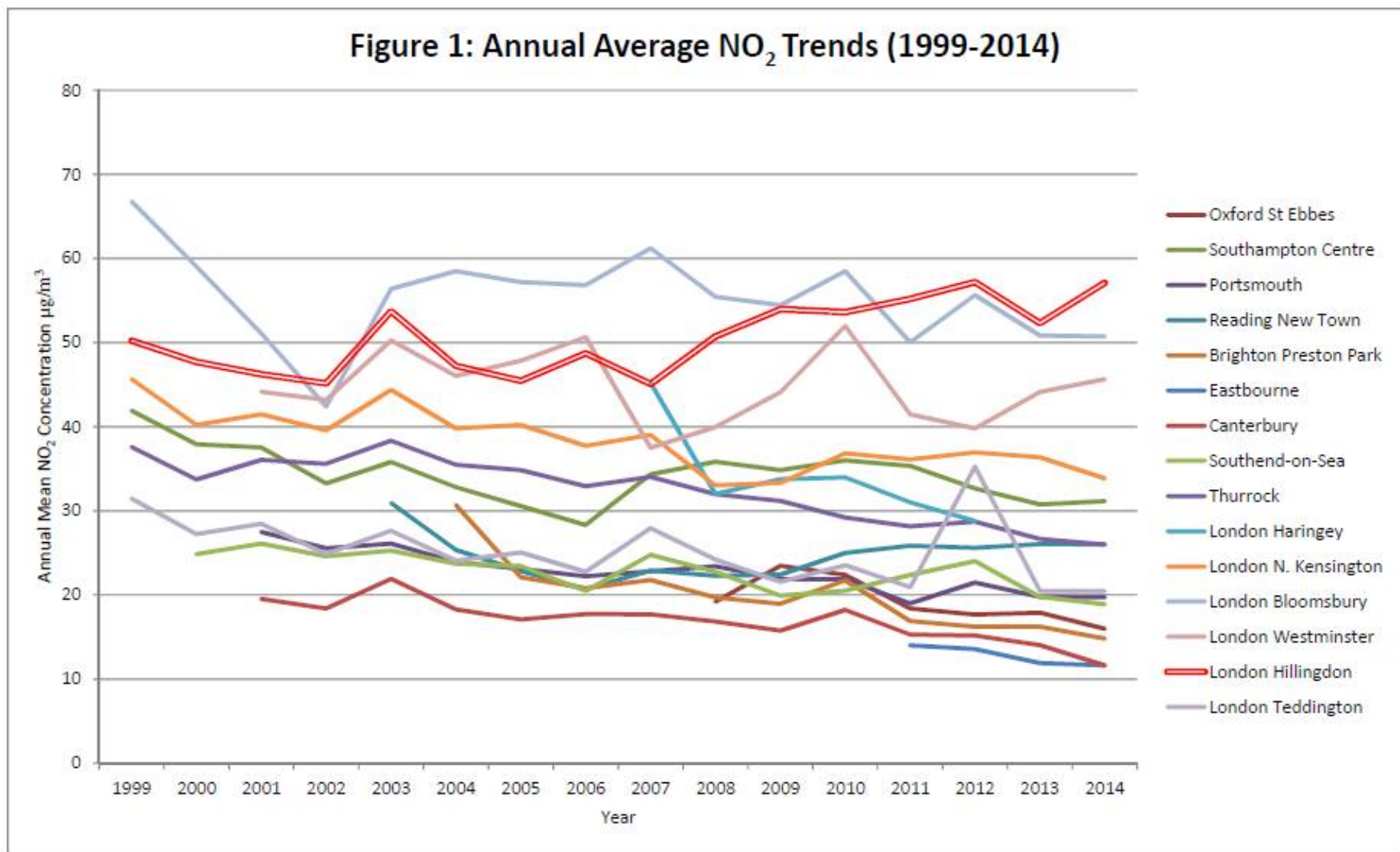
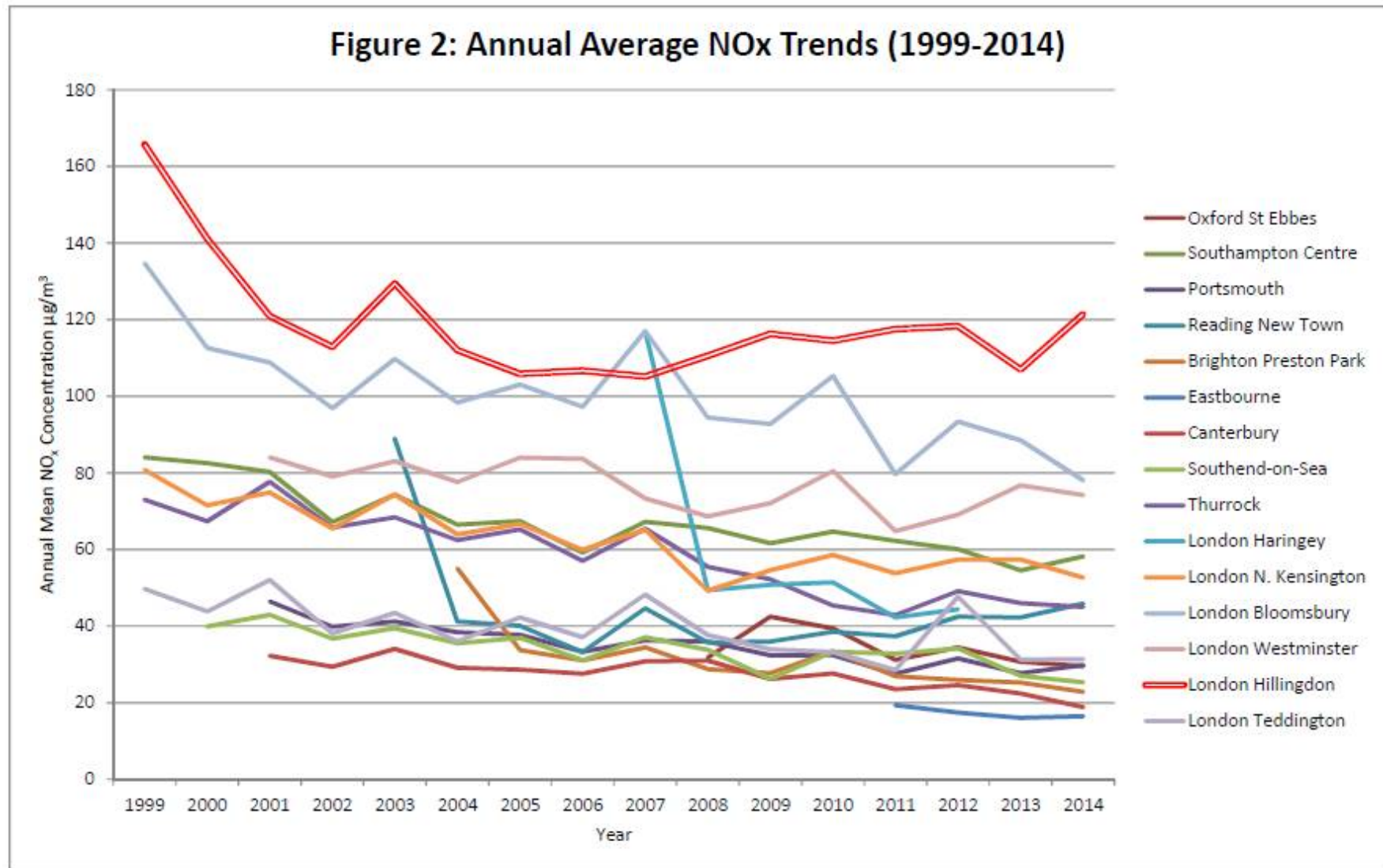


Figure 2: Annual Average NOx Trends (1999-2014)



- 3.5.4 The data indicates that between 1999 and 2007 similar trends were being described at the Hillingdon AURN site as at the other monitoring sites. In particular, the NO_x trends mirror closely those from the London Bloomsbury site. However, from 2008 to 2014, rather than continuing a downwards trend, the London Hillingdon NO₂ concentration appears to increase and the NO_x concentration does not show any clear trend.
- 3.5.5 On that basis, it appears that the London Hillingdon AURN site is recording concentrations of NO₂ that are at variance with the trends against the other urban background sites located within the South East of England.
- 3.6 *Provide a list of other motorway and trunk road schemes which have used the LTT E6 emissions curve.*

Highways England Comment

- 3.6.1 Examples of Highways England schemes that have been subject to air quality assessment using the same long term trends approach ("LTT_{E6}") as the Scheme include:
- 3.6.1.1 A556 Knutsford to Bowdon Improvement;
 - 3.6.1.2 A160/A180 Port of Immingham Improvement;
 - 3.6.1.3 M1 J28-35a Smart Motorway;
 - 3.6.1.4 M6 J16-19 Smart Motorway;
 - 3.6.1.5 M3 J2-4a Smart Motorway;
 - 3.6.1.6 M5 J4a-6 Smart Motorway; and
 - 3.6.1.7 M25 Junction 30/A13 Corridor Relieving Congestion Scheme.
- 3.6.2 The A556 Knutsford to Bowdon Improvement and A160/A180 Port of Immingham Improvement were both applications under the Planning Act 2008 and have been granted development consent by the Secretary of State.
- 3.7 *Provide an update on what stage the Highways England Trial has reached to assess the effects of barriers on air quality*

Highways England Comment

- 3.7.1 Highways England are currently trialling an air quality barrier alongside the M62 to help develop the evidence base on the effectiveness of this potential air quality mitigation measure. At this time, Highways England is not able to say definitively whether air quality barriers are effective, but expects to publish conclusions during the third quarter of 2016. There is currently no data available which can be provided to the Examination.
- 3.8 *Consider the sensitivity testing that can be undertaken in relation to vehicles emission rates*

Highways England Comment

- 3.8.1 To address the uncertainty in future NO_x and NO₂ trends and Euro 6/VI performance, Highways England has developed guidance on uplifting modelled concentrations using the Defra published emission factors as outlined in IAN 170/12v3. This took account of data which showed that concentrations of roadside pollutants are not reducing in line with expectations, and performance of vehicles in the real world was also not in accordance with their emission standard or published emission factors. It should be noted that research to date suggests that, whilst emissions from Euro 6/VI vehicles may not meet the strict Euro standard in real world conditions, they are an improvement over the existing fleet, and would be expected to lead to reductions in overall emissions in the future.
- 3.8.2 Highways England considers that the methodology used in the air quality assessment presented in the Environmental Statement (“ES”) (Application Document Reference 6-1, APP-146) is more conservative than applying the 50% uplift to Euro 6/VI emissions alone (as requested by interested parties at the issue specific hearings), because there is already a precautionary uplift to total NO₂ concentrations applied in the derivation of the LTT_{E6} projection used in the assessment.
- 3.8.3 The derivation of the LTT_{E6} projection used in the ES assessment is shown in Figure 1 in Appendix E to the written summary of the Issue Specific Hearing relating to the Environment. The ‘LTT’ projection is based on measured trends at roadside monitoring sites. However, this ‘LTT’ projection does not include any potential improvement from Euro 6/VI vehicles over existing fleet, because Euro 6/VI vehicles were not on the road network during the analysis period.
- 3.8.4 The ‘E6 Only’ projection takes only the predicted benefits associated with Euro 6/VI vehicle emissions from Defra's published emission factor toolkit ("EFT"), and sets the effects associated with all older fleet back to the measured long term trend. To account for the uncertainty in future Euro 6/VI performance, a precautionary approach was then applied.
- 3.8.5 The ‘LTT_{E6}’ projection was derived by assuming the mid-point between the ‘LTT’ and ‘E6 Only’ projections. This effectively applies an uplift to the improvements associated with Euro 6/VI that are calculated using the EFT. However, this uplift is applied to both the road and background components after conversion of modelled road NO_x to NO₂, rather than simply the road NO_x component as would be the case if Highways England had only applied an uplift to the Euro 6/VI emissions.
- 3.8.6 The assumptions made in Highways England’s IAN170/12v3 advice, as applied in the air quality assessment, will predict greater NO₂ concentrations at receptor locations than those predicted as a result of uplifting the Euro 6/VI vehicle NO_x emissions by 50%. A sensitivity test is therefore not considered necessary for NO₂, and would lead to prediction of lesser impacts than currently reported for the Scheme.
- 3.8.7 Further, Highways England does not consider that a sensitivity test for PM₁₀ would provide useful data. This is because, whilst dieselisation may reduce the rates of improvement in emissions of PM₁₀, the study area for the Scheme does not include locations predicted to be above the objective values. This includes the

current baseline situation (2013), where the maximum concentration is predicted to be 29.8 µg/m³, compared to an objective value of 40 µg/m³. In the future, with the Scheme in place in 2022, the maximum annual mean concentration of PM₁₀ within the study area is predicted to be 26.3 µg/m³. In locations such as parts of central London, where PM₁₀ air quality objectives may be exceeded, rates of improvement in PM₁₀ and the potential influence of dieselisation may be more important, but Highways England considers that this would not be the case for the Scheme study area.

- 3.9 *Provide a note regarding Highways England policy regarding speed limits for environmental mitigation.*

Highways England Comment

- 3.9.1 Highways England is in the process of considering matters in relation to speed limits for environmental mitigation. As such, Highways England is not able to update the Examining Authority on this matter at this time. However, it hopes to be able to update the Examining Authority on this point at Deadline V.

- 3.10 *Provide any monitoring information on the effectiveness of speed control eg during traffic management*

Highways England Comment

- 3.10.1 Highways England is unable to provide monitoring information on the effectiveness of speed control on air quality as there is no monitoring information available, which would enable a comparison of the situation before and after traffic management.

- 3.11 *Provide details of the trial using titanium oxide on noise barriers*

- 3.11.1 A copy of the 2009 paper entitled ‘Assessment of the Effect of a NO_x Barrier on Air Quality’ and is provided in Appendix F to the written summary of the Issue Specific Hearing relating to the Environment.

4. ENVIRONMENTAL HEARING – NOISE AND VIBRATION

4.1 *Provide TRL Report PPR485: The Performance of Quieter Surfaces Over Time*

Highways England Comment

4.1.1 A copy of the TRL Report PPR485: The Performance of Quieter Surfaces Over Time is provided in Appendix G to the written summary of the Issue Specific Hearing relating to the Environment.

4.2 *Provide details regarding Highways England surfacing maintenance regimes and testing arrangements for low noise surfacing.*

Highways England Comment

4.2.1 In accordance with the Design Manual for Roads and Bridges (“DMRB”), Highways England carries out two types of routine surveys to monitor the condition of the surface course on the Strategic Road Network. These surveys apply to low noise surfacing courses and comprise:

i) Sideway-force Coefficient Routine Investigation Machine (“SCRIM”) surveys, in accordance with HD28/15 Skidding Resistance, to measure skid resistance (DMRB, Volume 7 Section 3 Part 1); and

ii) TRAFFICspeed Condition Survey (“TRACS”), in accordance with HD29/08 Data for Pavement Assessment, to measure the functional characteristics, i.e. surface macrotexture, transverse profile (rut depth), longitudinal profile (bumpiness), cracking, fretting (estimated) (DMRB, Volume 7 Section 3 Part 2).

4.2.2 The above data is stored in the Highways Agency’s Pavement Management System (“HAPMS”). Highways England’s maintenance service providers are responsible for analysing this data to identify maintenance schemes required within their respective area. Guidance on technical investigations to derive the appropriate remedial treatment is given by HD 30/08 Maintenance Assessment Procedure (DMRB, Volume 7 Section 3 Part 3).

4.2.3 The maintenance service providers use Highways England’s Asset Renewal Scheme Justification and Appraisal guidance to develop and assess identified schemes. The assessment of each maintenance scheme is based on a Value Management scoring matrix/framework under three main criteria, namely: Safety, Value for Money and Sustainability, which are the key Highways England strategic maintenance objectives. The scoring matrix/framework is used to derive an assessment score for each scheme to allow justification and prioritisation within the forward programme.

4.2.4 Following this procedure, sections of the network which have been identified as having surface course in poor condition and also provide adequate justification through the Value Management process, will be programmed to be resurfaced to restore the necessary surface characteristics.

4.2.5 Whilst increased noise is not one of the triggers used for programming resurfacing work *per se*, the deterioration of the road surfacing is known to give rise to increased noise.

- 4.2.6 Paragraph 6.22 of HD 37/99 ((DMRB, Volume 2 Section 5 Part 2) states that “Satisfactory working lives between 7 to 15 years may be expected for thin wearing course systems – depending on their thickness, void content, the level of trafficking and the condition of the underlying pavement”.
- 4.2.7 Lane 1 and 2, which are located closest to properties, attract a greater level of trafficking, as they are the lanes which take the majority of heavy vehicles, which impose a disproportionate level of wear on the pavement. Therefore, it is expected that, all other criteria being equal, Lane 1 and 2 will deteriorate at a faster rate than other lanes and will require resurfacing at more frequent intervals, which will preserve the low noise qualities inherent in the surfacing of these lanes.
- 4.3 Provide an explanation of how an allowance for road surfacing is made within the noise model

Highways England Comment

- 4.3.1 Within the noise models used to calculate future noise levels, each road (including the M4) is defined as a large number of road segments. This is illustrated in Figure 1 below, which shows the area around Junction 10 of the M4. Each section of road between two of the markers is a road segment. For the M4 and all other roads within the study area, there are many thousands of road segments.
- 4.3.2 Each road segment has a number of parameters associated with that segment such as the correct traffic flow, speed and percentage of HGVs. Additionally, each road segment has a road surface correction assigned to it, to reflect the effects of that particular surface on road noise (as detailed in Table 1 below).
- 4.3.3 Highways England holds information on the location of existing sections of low noise road surfacing. The extent of low noise road surfacing assumed for the Do Minimum 2022 scenario is the existing low noise road surfacing and as a worst case approach includes low noise road surfacing through any Noise Important Areas not currently benefitting from low noise road surfacing (the Round 1 Strategic Noise Mapping Noise Action Plans for these Important Areas assume they would be resurfaced with low noise road surfacing at some time before 2021). For the Do Minimum 2037, Do Something 2022 and Do Something 2037 scenarios, low noise road surfacing has been assumed along the complete extent of the Scheme. This is based on the assumption that the motorway would require total resurfacing by fifteen years, whether the Scheme was progressed or not.
- 4.3.4 The available road surface corrections (as provided in Design Manual for Roads and Bridges (“DMRB”)), are shown in the table below:

Table 1 - Road Surface Corrections

Speed (kph)	Surface	Correction C1 (dB)
Less than 75 kph	All surfaces	-1
Greater than or equal to 75 kph	Hot rolled asphalt	0
Greater than or equal to 75 kph	Existing low noise surface	-2.5

Greater than or equal to 75 kph	New low noise surface	-3.5
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4.3.5 At any receptor, the noise contributions from all road segments (excluding those segments which do not make a significant contribution to the noise level at the receptor) are calculated.

4.3.6 The form of the calculation for each road segment is as follows:

$$LR = LB + C1 + C2 + C3 + C4$$

where:

LR = noise level at receptor from the road segment

LB = “basic noise level”, which is evaluated from the traffic flow, speed and percentage HGV on that road segment

C1 = correction for road surface, as given in Table 1 above

C2 = correction for distance of receptor from road segment

C3 = correction for barrier / shielding effects

C4 = correction for ground absorption

4.3.7 The contributions from all of the road segments are then summed to provide the total noise level at the receptor.

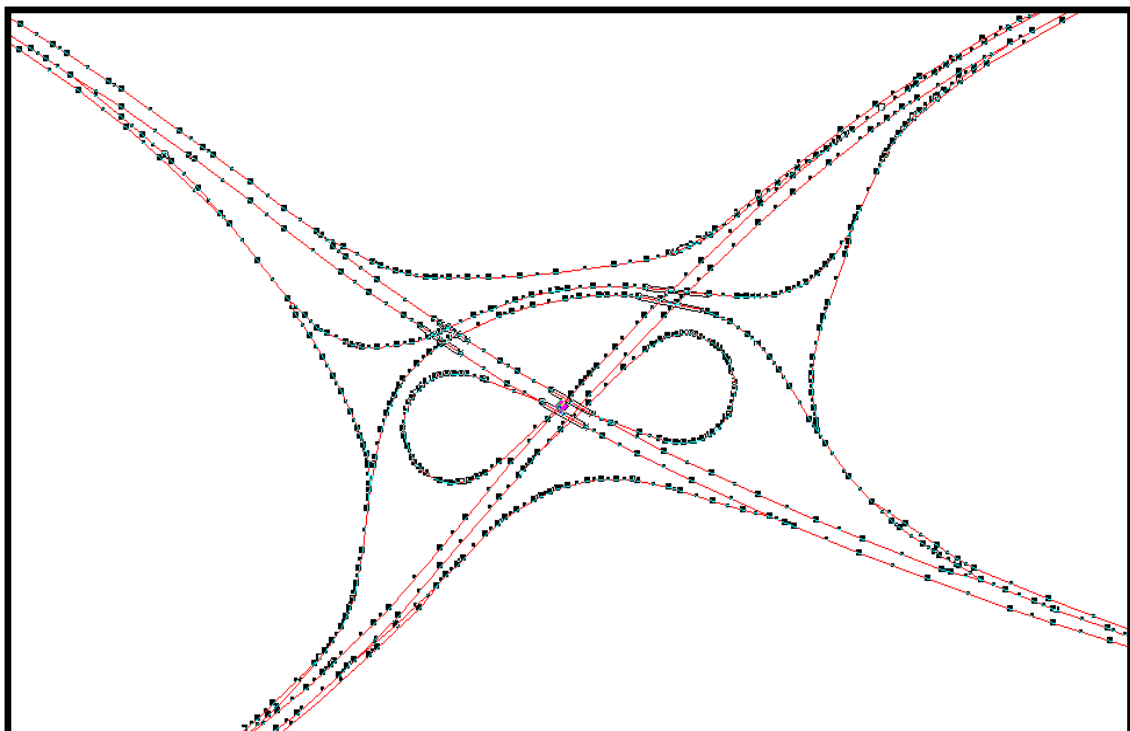


Figure 5.3.7 - Road segments at junction 10 of M4 motorway

4.4 *Provide details of receptors with façade levels above 68Db*

Highways England Comment

- 4.4.1 Appendix H to the written summary of the Issue Specific Hearing relating to the Environment contains 16 sheets plus a key plan showing, in red shading, those residential properties with façade noise levels greater than or equal to 68 dB LA10,18h with the Scheme in operation in the long term.
- 4.4.2 As outlined in paragraphs 12.4.100 to 12.4.102 and associated Table 12.18 of the Environmental Statement (Application Document Reference 6-1, APP-152), operation of the Scheme results in a decrease in the number of properties at or above the daytime Significant Observed Adverse Effect Level (“SOAEL”), which is equivalent to a façade noise level of 68 dB LA10,18h, in both the short term and in the long term.

4.5 *Provide details of discussions held to date with Wokingham Borough Council*

Highways England Comment

- 4.5.1 A copy of a technical note detailing the discussions held with Wokingham Borough Council is provided in Appendix I to the written summary of the Issue Specific Hearing relating to the Environment.

4.6 *Confirm which proportion of the existing M4 surfacing is low noise*

Highways England Comment

- 4.6.1 Table A12.1.2 of Appendix 12.1 of the Environment Statement (ES) (Application Document Reference 6-3, APP-347) outlines those sections of the Scheme which currently have low noise road surfacing which equate to a total of approximately 30%.

4.7 *Consider additional noise monitoring over 600m from the M4 at Lower Earley.*

Highways England Comment

- 4.7.1 Highways England does not intend to carry out noise monitoring in Lower Earley at distances greater than 600 metres from the motorway.
- 4.7.2 Noise monitoring was carried out in the period July 2013 to January 2014 at 21 locations along the extent of the Scheme between Junction 3 and Junction 12. The measured noise levels were employed to check the performance of the noise modelling work.
- 4.7.3 The noise assessment for the Scheme is based, by necessity, on calculation (noise levels prevailing in future years, with or without the Scheme in place, cannot be measured). The applicable method for the assessment is that provided in DMRB, which requires that noise level calculations are carried out using the methodology in Calculation of Road Traffic Noise ("CRTN"), in accordance with paragraph 5.191 of the National Networks National Policy Statement ("NN NPS").

- 4.7.4 DMRB defines the study area required for detailed noise level calculations. This study area comprises a 600 metre buffer around the Scheme and 600 metre corridors either side of any affected routes (an affected route is defined as any existing road which is predicted to experience significant changes in traffic flows, and consequent significant changes in noise levels, as a result of the Scheme). For the Scheme, there are no affected routes, and the study area for detailed noise level calculations is confined to the 600 metre buffer around the Scheme. It is noted in DMRB that outside of this 600 metre distance, the results of noise level calculations become uncertain, and thus comparison with measurement data would be unreliable.
- 4.7.5 The Do Minimum scenarios (i.e. without the Scheme) and the Do Something scenarios (i.e. with the Scheme) were modelled in a commercial software package called SoundPLAN which implements the CRTN methodology. The models are complex and include:
- 4.7.5.1 All significant roads within 2 km of the Scheme;
 - 4.7.5.2 All residential buildings within 2 km of the Scheme;
 - 4.7.5.3 All non-residential buildings within 2km of the Scheme;
 - 4.7.5.4 Areas of hard and soft ground (e.g. paved areas are acoustically reflective, grassed or wooded areas are acoustically absorbent) within 2 km of the Scheme; and
 - 4.7.5.5 Noise barriers (existing and proposed).
- 4.7.6 The models also incorporate a detailed ground model within this 2 km buffer. All roads, buildings and noise barriers are placed at their correct heights on this ground model. Additionally, all over bridges and under bridges on the motorway are included in the models. The varying ground elevation across Lower Earley was included in this detailed ground model.
- 4.7.7 The specification of mitigation is based on calculations to estimate the reductions in noise levels resulting from that mitigation. Predicting the effects at distances over 600 metres from the motorway will not be accurate, as noted above.
- 4.7.8 It may be that there are noticeably higher noise levels at locations in Lower Earley at significant distances from the motorway during particular weather conditions. The noise assessment, as reported in the ES, is based on a reasonable worst case (assuming a moderate adverse wind from each section of the motorway to every receptor, no matter where that receptor is) as provided in CRTN. This is accepted as a robust standard approach and cannot be tailored to account for limited noise measurements in one particular area at distances outside the accepted study area.
- 4.7.9 Mr Clive Jones, who attended Issue Specific Hearings and Open Floor Hearings, intends to carry out noise measurements in Lower Earley at significant distances from the motorway. Highways England can provide advice to Mr Jones on the appropriate methodology to employ for these measurements and on the interpretation of the measurements. However, it is unclear how these measurements can further inform the noise assessment in terms of the assessment of changes in noise levels and in terms of the analysis and specification of mitigation.

4.8 *Check assumptions used in noise modelling against details obtained during the site visit*

Highways England Comment

- 4.8.1 On the accompanied site visits, some inconsistencies were highlighted between existing noise barriers as viewed and those assumed in the noise modelling work. However, it should be noted that Highways England has made the following commitments, noted below, which are secured under Requirement 22, Schedule 2 of the revised Draft DCO submitted at Deadline III:
- 4.8.1.1 Any existing noise barrier not fit for purpose due to poor condition will be replaced with a new noise barrier.
- 4.8.1.2 Any barrier assumed to be a noise barrier in the noise modelling work, and which subsequently is identified as not being a noise barrier, will be replaced with a new noise barrier.
- 4.8.2 It should also be noted that existing noise barriers are included in the Do Minimum (i.e. without the Scheme) and the Do Something (i.e. with the Scheme) scenarios in the noise modelling work. Consequently, where a situation set out at 1) or 2) occurs, the actual beneficial noise changes resulting from the operation of the Scheme will be an improvement on those reported in the Environment Statement (Application Document Reference 6-1, APP-152).
- 4.8.3 Highways England confirms that the noise models will be revised accordingly following any future work, including the current work on enhanced mitigation.

4.9 *Confirm if Highways England is considering embankments for noise mitigation*

Highways England Comment

- 4.9.1 Highways England confirms that the use of embankments (earth bunds) for noise mitigation is not being considered on the Scheme.
- 4.9.2 The noise and vibration assessment for the Scheme is provided in Chapter 12 of the Environmental Statement (“ES”) (Application Document Reference 6-1, APP-152) (along with Appendices 12.1 to 12.5 (APP-347 to APP-351) and Drawings 12.1 to 12.6 (APP-253 to APP-276)).
- 4.9.3 Where mitigation is required, the noise mitigation strategy for the Scheme comprises: the provision of a low noise asphalt surfacing across all lanes of both carriageways (see paragraph 12.2.49 of the ES); the retention or replacement (if in poor condition) of existing noise barriers; and the provision of new noise barriers.
- 4.9.4 In the locations that additional noise barriers are required, vertical noise barriers have been proposed. The reasons for not providing earth bunds are:
- 4.9.4.1 In acoustic terms an earth bund can act as a noise barrier however, given that its peak is further away from the motorway than a vertical barrier, it is not as effective as a noise barrier.

- 4.9.4.2 The land-take required for the footprint of an earth bund is far greater than a vertical noise barrier, which means the locations where an earth bund could be located within the Order limits are limited.
- 4.9.4.3 In construction terms an extended construction period is required for earth bunds, which causes disruption for an increased duration and impacts on the construction cost. Other construction issues may also arise, depending on the location of the earth bund, such as access to the construction site or removal of vegetation.
- 4.9.5 In addition, Highways England is also currently considering whether there is potential to further improve the noise climate within the Scheme corridor through enhanced mitigation. Work is on-going to provide the quantitative assessment of the enhanced mitigation strategy originally outlined in Appendix 12.5 of the ES. However, in common with the Scheme mitigation strategy, the enhanced noise mitigation strategy will not consider the use of earth bunds for the same reasons outlined above.

5. **ENVIRONMENT HEARING – VISUAL IMPACT**

- 5.1 *Update the assessment to reflect the details on the drawing at Marsh Lane where a lower level of vegetation clearance was originally assessed. Reassess effects on receptors and update the photomontage for this area.*

Highways England Comment

- 5.1.1 Highways England has identified a location where the potential reduction in the area of existing vegetation has not been fully assessed in Chapter 8 of the Environmental Statement (“ES”) (Application Document Reference 6-1, APP-220). This is at Marsh Lane Overbridge where, assuming the reasonable worst case scenario, most of the existing vegetation on the south west facing approach embankment would be cleared for temporary access purposes.
- 5.1.2 With reference to paragraphs 8.4.16 and 8.4.17 of the ES (Application Document Reference 6-1, APP-148), every effort will be made to minimise the extent of the vegetation removal at this location during construction. However, assuming the reasonable worst case scenario, it is considered that the removal of the vegetation on the south west facing approach embankment would impact on the view from properties along Oak Stubbs Lane (indicated as receptor 10.1.3 on Drawing 8.2, Sheet 10 of the ES) (Application Document Reference 6-2, APP-220). The visual effect of the Scheme on these properties was predicted in the ES to be "slight adverse" during construction and for the Opening Year of the Scheme (2022), with a "neutral" effect predicted by the Design Year (2037). In light of the potential increase in the area of vegetation removal, it is predicted that the visual effect of the Scheme during construction and for the Opening Year of the Scheme (2022) would be "moderate adverse". However, as the replacement planting establishes on the embankment over time, the visual effects are predicted to be "neutral" by the Design Year (2037), as previously reported (see amended photomontage A4 3.9 Oak Stubbs Lane in Appendix J to the written summary of the Issue Specific Hearing relating to the Environment).

- 5.2 *Inform inspector how a section 253 agreement (off site planting) forms part of the DCO proposal*

Highways England Comment

- 5.2.1 Section 253 agreements are used to provide any planting to mitigate an adverse effect which the construction, improvement, existence or use of a highway has or will have on the surroundings of the highway. As such, Highways England will carefully consider where s.253 agreements are justified.
- 5.2.2 Section 253 of the Highways Act 1980 does not form part of the Planning Act 2008 regime, as the Development Consent Order ("DCO") only relates to the land within the Order limits, which does not include the land on which off-site planting is proposed.
- 5.2.3 Section 253 presupposes an agreement between the highway authority and the person interested in the land adjoining or in the vicinity of the highway, and agreements of this kind may make provision for planting. Section 253 agreements are binding on persons deriving title from the original party to the agreement and

that they are registered as local land charges. As a Section 253 agreement is a private agreement between two parties, a DCO cannot impose a Section 253 agreement and the agreement does not form part of the DCO proposal.

6. **ENVIRONMENT HEARING – WATER ENVIRONMENT**

6.1 *Update the flood risk assessment (following discussions / meeting with LBH and EA)*

Highways England Comment

6.1.1 Following further discussions with the Environment Agency, Highways England considers that it is appropriate to delay the submission of a further update to the FRA until Deadline V so that the document can reflect all changes required.

6.2 *Provide details on current drainage maintenance regimes*

Highways England Comment

6.2.1 An updated version of the Drainage Strategy Report will be provided at Deadline V which will include details regarding drainage maintenance regimes.

7. **ENVIRONMENT HEARING – OTHER MATTERS**

Provision of a written submission summarising all enhancements offered by the scheme

Highways England Comment

7.1.1 The proposed environmental enhancement measures for the M4 junctions 3 to 12 smart motorway scheme (the “Scheme”) are documented in the following chapters of the Environmental Statement (“ES”) (Application Document Reference 6-1):

7.1.1.1 Chapter 9 (Ecology and Nature Conservation, APP-149)

7.1.1.2 Chapter 10 (Geology and Soils, APP-150)

7.1.1.3 Chapter 12 (Noise and Vibration, APP-152)

7.1.1.4 Chapter 15 (Road Drainage and the Water Environment, APP-155)

7.1.2 Environmental enhancement measures are also discussed in the Engineering and Design Report (“EDR”) (Application Document Reference 7-3, APP-096), and referenced in the Environmental Masterplan (Annex A of the Engineering and Design Report (Application Document Reference 7-4, APP-097 to APP-101)).

7.1.3 The relevant extracts from the various ES chapters, describing the environmental enhancement measures, are re-produced below.

ES Chapter 9 (Ecology and Nature Conservation)

7.1.4 Paragraph 9.4.118: “Any reinstatement of vegetation on the affected verges will include reseeded with an appropriate native wildflower seed mix and only native species will be used in any landscape planting. The removal of invasive species to prevent spread during construction could also result in a beneficial effect.”

- 7.1.5 Paragraph 9.4.119: “The Environmental Masterplan will incorporate native tree planting in any re-instatement of woodland, with an emphasis on fruit bearing varieties in areas identified as supporting foraging mammals and birds.”
- 7.1.6 Paragraph 9.4.120: “In particular, the Environmental Masterplan will allow for the planting of native species of tree on the borders of any Local Wildlife Site (“LWS”) and Local Nature Reserve (“LNR”), where terrain permits.”
- 7.1.7 Paragraph 9.4.121: “The Environmental Masterplan will incorporate the installation of otter ledges on culverts or under bridges where no ledge is currently present, in accordance with DMRB Volume 10 Section 4 Part 4. This will ensure improved habitat connectivity for otters (and water vole) beneath the Scheme and allow for adaptation to climate change.”
- 7.1.8 Paragraph 9.4.122: “The Environmental Masterplan will incorporate the provision of approximately 60 bat boxes at suitable locations. A variety of boxes will be used to support a variety of species, for example:
- a) larger woodcrete boxes such as the Schwegler 1FW Hibernation box;
 - b) woodcrete boxes such as the Schwegler 2F suitable for smaller bat species; and
 - c) larger woodcrete boxes such as the Schwegler 2FN design suitable for larger bat species such as the noctule.”
- 7.1.9 Paragraph 9.4.123: “This will increase the available number and type of potential roosting sites for bats within the local area, including the new provision of potential hibernation sites.”
- 7.1.10 Paragraph 9.4.124: “For nesting birds, approximately 40 bird boxes will provide a variety of additional nesting opportunities and will be erected on trees at appropriate locations to be determined by an ecologist, for example:
- a) smaller wood or woodcrete boxes with a small hole entrance (around 25 to 32mm in diameter) suitable for smaller bird species such as blue tits;
 - b) larger wood or woodcrete boxes with a larger hole entrance (around 45mm in diameter) suitable for starlings and woodpeckers; and
 - c) wood or woodcrete open-fronted boxes suitable for robins, blackbirds and wagtails.”

ES Chapter 10 (Geology and Soils)

- 7.1.11 Paragraph 10.6.3: “the formation of new cuttings along the Scheme as a result of carriageway widening in some areas, has the potential to create geological exposures that may be of significance, and thus enhance the geodiversity of the area. Should such exposures be uncovered then the appropriate stakeholders would be consulted further, to ensure that such incidental benefits to the geodiversity of the Scheme are captured. It should be noted however that it is not currently proposed to engineer geodiversity directly”.

ES Chapter 12 (Noise and Vibration)

- 7.1.12 Highways England is currently considering whether there is the potential to improve further the noise climate within the Scheme corridor through enhanced mitigation. A qualitative appraisal of an enhanced mitigation strategy to achieve this is provided in Appendix 12.5 of the ES (Application Document Reference 6-3, APP-351). This enhanced mitigation strategy comprises the provision of additional noise barriers, as outlined in Table A12.5.1 of Appendix 12.5 of the ES and the replacement of some existing noise barriers with higher noise barriers as outlined in Table A12.5.2 of Appendix 12.5 of the ES.
- 7.1.13 The effects of implementing this enhanced mitigation strategy have not been assessed in Chapter 12 of the ES. Hence, the assessment provided in Chapter 12 of the ES exhibits a worst case scenario.
- 7.1.14 Work is on-going to provide the quantitative assessment of the enhanced mitigation strategy outlined in Appendix 12.5 of the ES. This comprises an iterative process which is employed to estimate the numbers of receptors experiencing specific reductions in noise levels (for an additional noise barrier, as detailed in Table A12.5.1 of Appendix 12.5 of the ES, or replacement of an existing barrier, as detailed in Table A12.5.2 of Appendix 12.5), monetising the benefits of these reductions in noise levels (as employed in Transport Analysis Guidance (“TAG”) appraisal) and comparing this monetisation value with the cost of the mitigation to provide a cost benefit analysis so that the lengths and heights of new barriers (if specified), and the heights of replacement barriers (if specified), can be optimised.
- 7.1.15 The results of this quantitative assessment will be submitted to the Examination by Deadline V.

ES Chapter 15 (Road Drainage and the Water Environment)

- 7.1.16 Paragraph 15.4.74: “the current drainage network within and serving the M4 is designed for a 1 in 2 year storm event and has not been designed with an allowance for climate change. The risk of flooding from the Scheme itself will be alleviated by the provision for road drainage as part of the Scheme described at paragraph 15.4.61. For the existing M4, improving the existing drainage system and by implementing a routine maintenance plan will have benefits. The proposed drainage within the ERAs will be designed for a 1 in 5 year storm event, with a 20% allowance for climate change, in accordance with the guidance in Section 6.2 of HD 33/06, Volume 4, Section 2. This enhances flood attenuation”.

Engineering and Design Report

- 7.1.17 Paragraph 6.3.49 “Vegetation lost to construction activities will be replanted where possible with locally appropriate species. Environmental enhancement will also be applied in appropriate circumstances, see chapter 8 of the ES. This will be developed through the preparation of an Environmental Masterplan, which will set out the proposed approach to environmental design. The Environmental Masterplan will be secured by a requirement attached to the proposed DCO. The draft Environmental Masterplan is discussed in section 7.12 of this EDR and the vegetation clearance and Environmental Masterplan drawings are included as Annex A to this EDR.”
- 7.1.18 Paragraph 7.12.1: “The vegetation clearance and Environmental Masterplan drawings for the Scheme provide an indication of how the land cleared of

vegetation for temporary construction works will be replanted following construction, and incorporates mitigation measures identified as part of the EIA process. Environmental enhancement is also incorporated in appropriate circumstances. Proposed planting will mainly consist of native tree and shrub species appropriate to the nature of the soil and the pre-existing vegetation composition. In the medium to long-term, this planting will mature to provide habitats and visual screening which will replace the vegetation removed.”

- 7.1.19 Paragraph 7.12.2: “The Environmental Masterplan will be developed further during the detailed design phase of the scheme. It currently includes the elements described below.”
- 7.1.20 Paragraph 7.12.3: “The Environmental Masterplan incorporates replacement habitat for affected protected and notable species where required, including:
- 7.1.21 a) appropriate receptor sites for amphibians and reptiles;
- 7.1.22 b) reinstatement of the affected verges includes reseeded with a wildflower seed mix;
- 7.1.23 c) native tree planting (particularly on the borders of any Local Wildlife Sites and Local Nature Reserves), with an emphasis on fruit bearing varieties in areas identified as supporting badgers;
- 7.1.24 d) installation of otter ledges on culverts or under bridges where no ledge is currently present;
- 7.1.25 e) provision of bat boxes; and
- 7.1.26 f) otter and badger resistant fencing.”

Additional Scheme Enhancements

- 7.1.27 Further Scheme enhancements include lighting proposals and bridge parapet proposals.
- 7.1.28 The proposed enhancements to the motorway lighting are outlined in paragraph 6.3.44, point c), of the EDR “where lighting is required, existing lighting will be removed and replaced with modern light emitting diode (“LED”) lighting with a central management control system.”
- 7.1.29 It is considered that LED luminaires use much less energy than the existing luminaires (paragraph 6.3.45), require a reduced maintenance regime and provide more directed lighting with reduced light divergence.
- 7.1.30 With regards to bridge parapets, there are six locations where the parapets proposed as part of construction of the Scheme are higher than the existing parapets to provide more safety to pedestrians/cyclists/ equestrians using those bridges. These locations are outlined below:
- Monkey Island Lane Bridge – Increase in parapet height from 1.0m to 1.4m as this structure has been confirmed as a national cycleway.

- Oldway Lane Footbridge – Increase in parapet height from 1.0m to 1.8m as this structure has been confirmed as a bridleway.
- Wood Lane Bridge – Increase in parapet height from 1.0m to 1.8m as this structure has been confirmed as a bridleway.
- Datchet Road Bridge – Increase in parapet height from 1.0m to 1.4m as this structure has been confirmed as a national cycleway.
- Recreation Ground Bridge – Increase in parapet height from 1.0m to 1.4m as this structure has been confirmed as a national cycleway.
- Old Slade Lane Bridge – Increase in parapet height from 1.0m to 1.8m as a bridleway has been confirmed to approach both sides of the structure.

7.2 *Provision of a written submission on how Climate Change has been considered in the DCO submission*

Highways England Comment

Summary

- 7.2.1 Climate change in the UK is anticipated to result in mild, wetter winters, and hotter, drier summers.
- 7.2.2 Whilst climate change is a consequence of the cumulative effect of many projects and activities, and cannot reasonably be assessed at the individual project level, climate change has been considered in the design of the M4 junctions 3 to 12 smart motorway (the “Scheme”), through the accommodation of a climate change allowance in the design of new drainage and floodplain compensation, and through opportunities to identify and procure low carbon materials for construction.
- 7.2.3 Furthermore, the Scheme’s air quality assessment includes estimates of emissions for the regional air quality assessment for the Opening Year (2022) and the Design Year (2037). The Web Based Transport Analysis Guidance (“WebTAG”) appraisal provides estimates of emissions of greenhouse gases and costs for the first 60 years of the Scheme. There is no discussion within the submitted Development Consent Order (“DCO”) Application documentation of the significance of these emissions in terms of climate change. However, the emissions predicted for the strategic road building programme are a small proportion of the total annual carbon budget, being less than 0.1% of the annual carbon emissions allowed in the fourth carbon budget. The Scheme will therefore not affect the ability of Government to meet its carbon reduction targets.
- 7.2.4 In addition, it is acknowledged that climate change may lead to changes in flora composition and increased frequency of high flows in drainage, which may in turn affect mammals reliant on watercourses, notably water voles and otters. However, the effects of climate change on the water environment is considered to be neutral, as the Scheme accommodates increased rainfall and flooding in the design.

- 7.2.5 Climate change is not envisaged to impact upon the other topics represented in the Environmental Statement (“ES”), including Cultural Heritage, Landscape, Geology and Soils, Noise and Vibration, Effects on all Travellers and Community and Private Assets.

Introduction

- 7.2.6 Climate change has been considered in the DCO Application in two ways, firstly in terms of provision for a changing climate in the design standards for the design life of the Scheme, and secondly in terms of the impact of the Scheme on the environment in combination with long term changes in the baseline conditions resulting from climate change.

Consideration of Climate Change in Scheme Design and Construction

Drainage Design

- 7.2.7 Paragraph 5.90 of the National Policy Statement for National Networks (“NN NPS”) notes: “Climate change over the next few decades is likely to mean milder wetter winters and hotter drier summers in the UK, while sea levels will continue to rise. Within the lifetime of nationally significant infrastructure projects, these factors will lead to increased flood risks in areas susceptible to flooding, and to an increased risk of flooding in some areas which are not currently thought of as being at risk. The applicant, the Examining Authority and the Secretary of State (in taking decisions) should take account of the policy on climate change adaptation in paragraphs 4.36 to 4.47”.
- 7.2.8 The Scheme crosses several floodplains associated with the River Thames and its tributaries. Consequently, the main impact of climate change on the Scheme is associated with drainage and flood risk, with the predicted increases in the prevalence of storms and extreme rainfall events resulting in increased surface water flooding and more frequent river channel capacity exceedance leading to fluvial flooding. The Scheme lies upstream of the tidal reach of the Thames, so flooding from sea level rise is not an issue.
- 7.2.9 Paragraph 4.41 of the NN NPS states that “Where transport infrastructure has safety-critical elements and the design life of the asset is 60 years or greater, the applicant should apply the UK Climate Projections 2009 (UKCP09) high emissions scenario (high impact, low likelihood) against the 2080 projections at the 50% probability level”.
- 7.2.10 Paragraph 5.94 of the NN NPS states “In preparing an FRA the applicant should:
- 7.2.10.1 consider the risk of all forms of flooding arising from the project (including in adjacent parts of the United Kingdom), in addition to the risk of flooding to the project, and demonstrate how these risks will be managed and, where relevant, mitigated, so that the development remains safe throughout its lifetime,
 - 7.2.10.2 take the impacts of climate change into account, clearly stating the development lifetime over which the assessment has been made;
 - 7.2.10.3 consider the vulnerability of those using the infrastructure including arrangements for safe access and exit;

- 7.2.10.4 include the assessment of the remaining (known as ‘residual’) risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular project;
 - 7.2.10.5 consider if there is a need to remain operational during a worst case flood event over the development’s lifetime”
- 7.2.11 A Flood Risk Assessment was undertaken for the Scheme, to assess all forms of flooding (Application Document Reference 5-3, APP-077). Section 7 discusses the implications of climate change for drainage design. The lifespan of a road is typically 60 years; hence, drainage systems are assumed also to have a 60 year lifespan. Figures from the UK Climate Projections: Briefing Report (MetOffice, December 2010) indicate that a climate change allowance of between 10% and 30% should be used in relation to winter storms on the M4 between junctions 3 and 12. A 20% allowance for climate change was adopted in accordance with Design Manual for Road and Bridges (“DMRB”), Volume 4, Section 2, Part 1, HD33/06 Surface and Sub-surface Drainage Systems for Highways (Highways Agency, 2006). The climate change allowance has been applied to runoff calculations for all additional paved areas, but not to runoff from paved areas within the Scheme that are unchanged, as these are not considered to be new “development” which requires consent.
- 7.2.12 Section 3.1 of the Drainage Strategy Report (Application Document Reference 7-5, APP-123) sets out the design philosophy of the Scheme for drainage design, including the accommodation in the design standards for climate change. The climate change allowance of 20% was applied to runoff calculations for all additional paved areas, such as sections of new carriageway, Emergency Refuge Areas (“ERA”) and existing paved areas within the Scheme that are not currently captured by an existing drainage pipe system, but will be following development. The proposed drainage collection and carrier pipe systems have been designed for a 1 in 5 year storm event, with a 20% allowance for climate change on additional paved areas. Paragraphs 3.1.20 to 3.1.31 of the Drainage Strategy Report go on to describe in more detail the proposals for drainage for the mainline carriageway and central reserve, ERAs, junctions, and underbridges, while sections 3.2 and 3.3 describe the proposed highway drainage design between junctions 12 and 8/9 and junctions 8/9 and 3 respectively.
- 7.2.13 Some sections of the Scheme will be constructed in the floodplain, notably bridges and their embankments. These features present an obstruction to flood water and without mitigation would result in the backing up of flood waters and the risk of flooding in locations which do not currently flood. This risk may be exacerbated by climate change due to increased flood risk.
- 7.2.14 The Environment Agency requires “floodplain compensation” so that there is no net change in the “space” available for floodwaters. The Scheme provides compensation for any loss of floodplain storage for flood events up to and including the 1 in 100 year flood event plus an allowance for climate change, with the influence of climate change incorporated by an addition of 20% to the peak 1 in 100 year flood flow in line with current best practice. These climate change adjusted fluvial floodplain levels have been projected for locations where carriageway widening and side road re-alignment works may affect the floodplain delineated and used to estimate the volume of floodplain compensation required at each location. The floodplain compensation is in the form of modifications to the existing topography or minor changes to the proposed earthworks, to ensure there

is no net loss of floodplain and floodplain compensation areas will be appropriately hydraulically linked to the wider floodplain in order to allow the flow of floodwater into the compensation storage areas and their subsequent drainage after the flood event has subsided.

- 7.2.15 The commitment to, and principle of providing, sufficient compensation storage where works are necessary in the floodplain is established in paragraphs 5.1.21 (Ascot Road), 5.1.22 (Thames Bray Underbridge), 5.1.26 (Monkey Island Lane Overbridge), 5.1.36 (Wood Lane Overbridge) and 5.1.45 (Riding Court Road Overbridge) of the Flood Risk Assessment and paragraphs 15.4.64 to 15.4.68 and Table 15.5 within Chapter 15 of the ES (Application Document Reference 6-1, APP-155). The flood compensation measures proposed as part of the Scheme are to be secured by way of a requirement in the DCO.

Materials and Waste

- 7.2.16 An assessment of embodied carbon has been undertaken in Chapter 11 of the ES (Application Document Reference 6-1, APP-151). A definition of embodied carbon for any type of material is provided in paragraph 11.2.19 and refers to the total carbon dioxide equivalent emission released prior to that material leaving the factory gate (Cradle-to-Gate). Carbon is used as a generic term to cover the six greenhouse gases recognised by the Kyoto Protocol. These gases are converted to carbon dioxide equivalents (“CO_{2e}”) based on their global warming potential per unit as compared to one unit of carbon dioxide (“CO₂”). This would normally include extraction or harvesting, the manufacturing process and any pre-distribution transportation, as shown in Figure 11.3 of Chapter 11 of the ES (re-produced below).



Figure 11.3: Diagrammatic representation of the measure of embodied carbon in relation to material life cycle

Cradle-to-Gate has been selected as the ideal scope of the embodied carbon assessment as it is considered the most commonly specified boundary condition as per the ICE University of Bath Inventory of Carbon and Energy. In addition, the Waste and Resources Action Programme ("WRAP") guidance, considered best practice in UK, indicates that embodied carbon covers greenhouse gas ("GHG") emissions that arise from only the Cradle-to-Gate activities. WRAP's guidance states that emissions associated with maintaining, repairing, replacing and disposing of these materials and components over the lifetime of the Scheme should be treated separately as indicated in CEN TC350 Sustainability of Construction Works. Therefore, the assessment of embodied carbon does not include the CO₂ emissions associated with transport from the factory gate to site, construction activities, maintenance, or de-commissioning.

- 7.2.17 There are no guidelines that relate quantified levels of embodied carbon to climate change. In the absence of any publically available guidance, Table 11.1 of the ES

was prepared to provide an indication of the magnitude of the impact of highway schemes in terms of carbon equivalents based on other projects promoted by Highways England. A scheme that would result in more than 40,000 tonnes of CO₂e is considered to have a major magnitude of impact. Table 11.10 of the ES provides a breakdown of the estimate of CO₂e by type of materials, totalling 42,510 tonnes of CO₂e. Therefore, as set out in paragraph 11.4.71 of the ES, the mass of embodied carbon required for the Scheme is assessed to have a major adverse impact. This is a reflection of the relative size of the Scheme in Highways England's portfolio, rather than a specific, quantifiable impact on climate change.

- 7.2.18 The mass of embodied carbon required for the Scheme can be mitigated through procurement procedures such as specifying low carbon products, and through the reuse and recycling of materials and waste on and off site, reducing the magnitude of impact to moderate adverse. These mitigation proposals will be developed through the Construction Environmental Management Plan ("CEMP"), including the Site Waste Management Plan ("SWMP"), the Materials Management Plan ("MMP"), and the Logistics Plan. The development, approval and implementation of these plans is secured through Requirement 8, Schedule 2, of the draft DCO (Application Document Reference 3-1, APP-026).
- 7.2.19 However, Highways England considers that reducing the embodied carbon in materials will not significantly affect climate change at the project level, as the savings in emissions are a very small fraction of total emissions.

Consideration of the Effects of the Scheme on the Environment in Combination with Climate Change

- 7.2.20 The effect of the Scheme on the environment in combination with a changing baseline, due to the influence of climate change, has been considered in relation to the assessment of air quality (Chapter 6 of the ES), ecology and nature conservation (Chapter 9 of the ES), and water (Chapter 15 of the ES).

Air Quality

- 7.2.21 The air quality assessment includes estimates of carbon emissions in the regional air quality assessment for the Opening Year (2022) and the Design Year (2037) and estimates of carbon emissions and costs for a 60 year period from Scheme opening for WebTAG.
- 7.2.22 The regional air quality assessment provides the change in pollutant emissions as a result of the operation of the Scheme. The approach to this assessment is described in paragraphs 6.2.71 to 6.2.75 of the ES (Application Document Reference 6-1, APP-146) and the results are presented in Tables 6.19 and 6.20 of the ES for the Opening Year (2022) and Design Year (2037) respectively.
- 7.2.23 The WebTAG assessment provides an indication of the overall change in operational air quality associated with the Scheme over a 60 year period. The results of the assessment are presented in Appendix B of the Socio-Economic Report (Application Document Reference 7-2, APP-090). The Scheme is predicted to result in 4.18 million tonnes of carbon over the 60 year assessment period.
- 7.2.24 The ES does not comment on the significance of the predicted increase of emissions as a result of the Scheme, or the consequence of increased emissions on climate change. However, as explained in paragraph 6.18.9 of the ES and

paragraph 3.8 of the NN NPS, the carbon emissions anticipated over the next 10 to 15 years from the strategic road building programme are considered to be small (less than 0.1% of the annual carbon emissions allowed in the fourth carbon budget) and the increases associated with the Scheme are part of that small increase. The Scheme will therefore not affect the ability of the Government to meet its carbon reduction targets.

Ecology and Nature Conservation

- 7.2.25 As stated in Paragraph 9.4.97 of the ES (Application Document Reference 6-1, APP-149), it is considered that climate change is unlikely to alter significantly the species composition or distribution of receptors within the Order limits.
- 7.2.26 Wetter winters may result in more frequent fluctuations of water levels in ditches, and this may affect local water vole populations. However, no significant impacts upon their distribution are envisaged as a result of the Scheme.
- 7.2.27 It is possible that, as a result of climate change, the culverts under the Scheme may flood more frequently, creating barriers to movement during storm events for otter (which then may try to cross the motorway only to find their way blocked by the new central concrete barrier). As stated in paragraph 9.4.13, otter resistant fencing will be installed at key locations to reduce the likelihood of otters accessing the Scheme in such situations. Table 9.5 of the ES summarises that with mitigation, the effect of the Scheme on otters is evaluated as neutral.
- 7.2.28 Paragraph 9.4.121 of the ES notes that allowance has been made for the incorporation of otter ledges in culverts and underbridges as an ecological enhancement measure. Ledges will be installed in selected locations, which will be confirmed at detailed design, to improve habitat connectivity for otter (and water vole) beneath the Scheme and thus to provide adaptation to climate change. As a minimum, otter ledges will be installed in Ashley's Arch Culvert and Chalvey Culvert.

Water

- 7.2.29 Climate change will be the main cause of increased flood risk in the Scheme area, as described in paragraph 15.4.35 of the ES. However, as stated in paragraph 7.1.10 of the Flood Risk Assessment, climate change has been taken into account in the design of the Scheme and as a result there will be no increase in flood risk to and from the Scheme due to climate change.

Matters not considered to be affected by climate change

- 7.2.30 The effect of the Scheme on the following topics was not assessed in combination with a changing baseline due to climate change:
- 7.2.30.1 Cultural Heritage (Chapter 7 of the ES (Application Document Reference 6-1, APP-147)). Climate change will not alter the presence of built and buried heritage assets.
- 7.2.30.2 Landscape (Chapter 8 of the ES (Application Document Reference 6-1, APP-148)). While the impact of a changing climate would likely affect plants, this is unlikely to result in any significant effect on existing or proposed planting, as described above under ecology and

nature conservation. The detailed planting plans will include UK native species and the planting would be implemented using best horticultural practice and standards. The choice of natives species will take account of the risk of drier summers and wetter winters and longer inundation periods. For example, on free draining embankment slopes, nature species tolerant of dry conditions would be specified, whereas on low lying areas which could potentially flood, nature species tolerant of waterlogging would be specified.

7.2.30.3 Geology and Soils (Chapter 10 of the ES (Application Document Reference 6-1, APP-150)). The effect of climate on geology and soils occurs over much larger time periods e.g. thousands of years.

7.2.30.4 Noise and Vibration (Chapter 12 of the ES (Application Document Reference 6-1, APP-152)). This topic is concerned with the noise and vibration impacts of the Scheme on residential and sensitive non-residential receptors. Noise and vibration have no direct effects on climate change. One of the outcomes of climate change is the increase in stormy weather, which can result in increased road traffic noise from the effects of wind on noise propagation and the effects of wet road surfaces on generated tyre/road noise. However, for this Scheme, climate change is not considered to affect the noise and vibration assessment, as:

(a) these effects will be evident in both the Do Minimum situation (i.e. without the Scheme) and the Do Something situation (i.e. with the Scheme); and

(b) the operation of the Scheme generally results in noise decreases within the Scheme corridor.

7.2.31 Effects on All Travellers (Chapter 13 of the ES (Application Document Reference 6-1, APP-153)). This topic is concerned with the impact of the Scheme on road users on the M4 and local highway networks, and non-motorised users on side roads and public rights of way. There is no connection with climate change.

7.2.32 Community and Private Assets (Chapter 14 of the ES (Application Document Reference 6-1, APP-154)). This topic provides an assessment of various types of impacts on community and private assets, such as residential and commercial property, recreational sites, and public rights of way. Climate change does not directly impact on the use (or users) of these facilities.

7.3 *Provide evidence of agreement from DfT of carbon figures used in the assessment*

Highways England Comment

7.3.1 Highways England is reconfirming the agreement from the DfT with regard to carbon figures. A further update will be provided at Deadline V.

7.4 *Consider providing a commitment to replace any fencing currently identified as a noise barrier (even if incorrectly) with a new noise barrier*

Highways England Comment

7.4.1 This commitment is already covered by Requirement 22, Schedule 2 of the revised Draft DCO submitted at Deadline III:

"Any barrier assumed to be a noise barrier in the noise modelling work, and which subsequently is identified as not being a noise barrier, will be replaced with a new noise barrier."

7.5 Consider the maintenance of measures provided in the requirements

Highways England Comment

7.5.1 Highways England is considering the need for such a provision to be included in the draft DCO. If such a provision is needed, it will be provided in the next version of the draft DCO to be submitted to the Examination at Deadline V.

7.6 Respond to whether we can provide dedicated cycle ways on the overbridges and add measures to making subways more cycle friendly

Highways England Comment

7.6.1 The over-arching approach for the Scheme is to replace those overbridges affected on a like-for-like basis in terms of their function.

7.6.2 It is acknowledged that a number of the existing overbridges are used by cyclists, as demonstrated by the Non-Motorised User ("NMU") survey undertaken in June 2015. A summary table showing the results of the survey is provided below at Table 2 below; surveys were undertaken over a 12 hour period on each day:

Table 2 - Results of the NMU Survey (Cyclists)

Bridge	Northbound		Southbound		Dates of Survey
	Footpath	Carriageway	Footpath	Carriageway	
Marsh Lane	6	48	2	50	Wednesday 3 June 2015
	19	127	14	110	Saturday 6 June 2015
Oldway Lane	0	3	0	4	Wednesday 3 June 2015
	12	22	0	22	Saturday 6 June 2015
Recreation Ground	14	54	1	73	Wednesday 3 June 2015

	11	52	0	72	Saturday 6 June 2015
Old Slade Lane	0	3	0	4	Wednesday 3 June 2015
	0	5	0	4	Saturday 6 June 2015

7.6.3 However, it is noted that none of the existing side roads or associated overbridges have a dedicated cycleway within the verge provisions. Therefore, following the over-arching approach for the Scheme, proposals to re-align or alter side roads and replace overbridges are based on shared use of footpaths by pedestrians, cyclists and in some cases equestrian users in line with the relevant highway design standards.

7.6.4 The provision of dedicated facilities for separate usages would require an increase to the width of the bridge and associated embankments to accommodate the wider cross-section of the structure. This in turn would be likely require additional land-take which may impact further on local residents and environment dependent on the location of the structure. In addition, the construction programme for the structure would almost certainly extend and construction costs would increase to accommodate the additional works.

7.6.5 Furthermore, it is evident from the NMU survey that cyclist usage of the overbridges over each of the 12 hour periods is not particularly high and thus dedicated provision to accommodate such movements would be difficult to justify when compared to the additional impacts that may arise as part of the works.

Subways

7.6.6 As a general rule, existing subways beneath the M4 are not affected by the Scheme. The exceptions are Sipson Road subway and Langley Interchange subway.

7.6.7 Neither of these subways are being widened by the Scheme, however Sipson Road subway is being lengthened on the south side by approximately 5m and Langley Interchange subway is being lengthened by 2.1m to the north and 2.1m to the south. The lighting will be extended to the full length of both subways. Some vegetation around the entrances to the subways will need to be cleared to enable the construction work. Replacement planting will be provided as shown on Sheets 25 and 28, for Langley Interchange subway and Sipson Road subway respectively, of the Environmental Masterplan (Annex A1 to the Engineering and Design Report, Application Document Reference 7-4, APP 101).

7.6.8 The footpath through Langley Interchange subway is a shared path for pedestrians and cyclists whereas the footpath at Sipson Road subway is for pedestrians only as demonstrated by the presence of cyclist dismount signs at both ends of the subway.

7.6.9 In particular, Highways England does not consider that the subway at Langley Interchange will become less attractive to users as the approach viaducts are

horizontal. This means that the appearance of the subway will not change from the approaches.

7.7 *Provision of a written submission confirming how embodied carbon is included in the scheme assessment*

Highways England Comment

Background

7.7.1 The assessment of embodied carbon impacts arising from the construction of the M4 junctions 3 to 12 smart motorway scheme (the “Scheme”) is reported in Chapter 11 of the Environmental Statement (“ES”) (Application Document Reference 6-1, APP-151). The assessment followed the guidelines set out in Highways England’s Interim Advice Note (“IAN”) 153/11 – Guidance on the Environmental Assessment of Material Resources.

7.7.2 As part of the assessment, the quantification of the embodied carbon impacts of different materials has been carried out. This provides another means to assess the magnitude of impact associated with the Scheme’s material resources requirements. The magnitude of the environmental impact has been assigned through an assessment of the embodied carbon emissions as a proxy of environmental effects associated with the material resources used on the Scheme.

Approach

7.7.3 The embodied carbon dioxide emissions of a material resource is the total carbon dioxide equivalent emissions released prior to it leaving the factory gate. ‘Carbon’ is used as short hand to refer to the basket of six greenhouse gases (“GHGs”) recognised by the Kyoto Protocol. GHGs are converted to carbon dioxide equivalents (“CO₂e”) based on their global warming potential per unit as compared to one unit of carbon dioxide (“CO₂”). This would normally include extraction or harvesting, the manufacturing process and any pre-distribution transportation (shown in Figure 11.3 from the ES). It does not include the CO₂ emissions associated with transport from the factory gate to site, construction activities, maintenance or decommissioning. This boundary condition is known as ‘cradle-to-gate’.



Figure 11.3: Diagrammatic representation of the measure of embodied carbon in relation to material life cycle

7.7.4 The scale of magnitude, presented in Table 11.1 of the ES and reproduced below, has been used to assess the magnitude of impact associated with the Scheme’s material resources requirements. Whilst there is no publically available guidance,

the scale in Table 11.1 is based on benchmark data from previous Highways England projects and informed by professional knowledge.

Table 11.1 Scale of magnitude for assessing embodied carbon (“CO₂e”) of material resources

Scale of magnitude of impact	Total CO ₂ e of material resources (tonnes)
Major	> 40,000
Moderate	20,000 – 40,000
Minor	5,000 – 20,000
Negligible	1,000 – 5,000
No change	< 1,000

Assessing Impacts and Mitigations

- 7.7.5 The significance of effect that the material resources' use, waste arisings from the construction, demolition and excavation (“CD&E”) phases and any proposed mitigation measures (e.g. waste reuse, recycling and or recovery), will have on the receptors is informed by the sensitivity of the affected receptor and the magnitude of impact on the receptor.
- 7.7.6 The sensitivity of receptor, magnitude of the impact and the significance of effect are assessed using the criteria provided in Appendix 11.1 of the ES (Application Document Reference 6-3, APP-344).

Embodied carbon content of material resources

- 7.7.7 The material resources presented in Table 11.9 are the estimated quantities needed for the construction phase of the Scheme.

Table 11.9 Estimated material resources for the construction phase

Material Resources	Estimated quantities (tonnes)
Steel	10,511
Aluminium	93
Concrete	145,823
Inert Fill Materials	1,106,245
Inert Soils (Structural)	13,376
Inert Black	259,461
Plastic	77
Timber	468

- 7.7.8 The total embodied carbon for each of the material resources has been calculated using the Highways England’s Carbon Calculation for Major Projects ("CCMP") (Highways Agency 2013).
- 7.7.9 Table 11.10 from the ES is reproduced below and provides details for the embodied carbon contained within the range of material resources identified for use on the Scheme.

Table 11.10 Embodied carbon content of material resources for the Scheme

Material Resource	Total estimated embodied carbon (tonnes of CO ₂ e)
Steel	15,831
Aluminium	851
Concrete	23,014
Inert fill materials	552
Inert Soils (Structural)	321
Inert Black	1,349
Plastic	255
Timber	337

Design mitigation methods

- 7.7.10 The Scheme will look to mitigate embodied carbon through the re-use of waste, re-cycling or recovery of materials to reduce the embodied carbon content of material resources.
- 7.7.11 The benefits of maximising the onsite reuse of material resources and waste quantities to reduce the embodied carbon within the main material resources are included in paragraphs 11.4.71 and 11.4.74 of the Chapter 11 of the ES.
- 7.7.12 These mitigation proposals will be developed through the Construction Environmental Management Plan (“CEMP”), including the Site Waste Management Plan (“SWMP”), the Materials Management Plan (“MMP”), and the Logistics Plan. The development, approval and implementation of these plans is secured through Requirement 8, Schedule 2, of the draft DCO (Application Document Reference 3-1, APP-026).

Assessment of residual effects

- 7.7.13 As shown in Table 11.10 above, the total estimated embodied carbon for the Scheme is 42,510 tonnes, which assesses the magnitude of impact of the embodied carbon contained within the main material resources to be used on the Scheme as **major adverse** against the scale outlined in Table 11.1 above.
- 7.7.14 However, through the use of the mitigation methods outlined above to reduce the overall demand for materials from offsite sources, it is considered that the impact could be reduced to **moderate adverse**.

