M25 junction 28 improvement scheme

TR010029

10.6 Environmental Statement: Chapter 6: Noise and vibration Changes 1-4

Regulation 5(2)(a)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

Volume 10

February 2021

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

M25 junction 28 scheme
Development Consent Order 202[x]

6.1 ENVIRONMENTAL STATEMENT
CHAPTER 6: NOISE AND VIBRATION CHANGES 1-4

Regulation Number:	Regulation 5(2)(a)
Planning Inspectorate Scheme Reference:	TR010029
Application Document Reference:	TR010029/EXAM/10.6
Author:	M25 junction 28 improvement scheme project team, Highways England

Version	Date	Status of Version
0	18 February 2021	Deadline 3 Change Request

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Executive summary

A noise and vibration assessment of the Scheme has been undertaken, comprising identification of the baseline conditions, identification of sensitive receptors, prediction of the expected noise and vibration impacts and the mitigation measures that may be required to avoid significant effects.

The assessment indicates that the Scheme would have no residual significant adverse effects from construction noise and vibration at any sensitive receptors from daytime and night-time construction activities and construction traffic.

The assessment indicates that the Scheme would have no significant adverse effects at any sensitive receptors from operational traffic noise and vibration. No significant adverse effects or perceptible noise increases are predicted at sensitive receptors located in Noise Important Areas.

6. Noise and vibration

6.1 Introduction

6.1.1 This chapter reports the findings of the noise and vibration assessment undertaken for the Scheme, consisting of information relating to the baseline conditions, identification of sensitive receptors, the expected noise and vibration impacts and the mitigation measures that may be required to avoid significant effects. The way in which noise and vibration impacts from the Scheme could affect human health is explained in the People and Communities chapter (Chapter 13) of this Environmental Statement (ES) (application document TR010029/APP/6.1).

6.1.2 This chapter has been updated following more detailed noise modelling and to report results at additional receptors.

6.2 Competent expert evidence

6.2.1 This noise and vibration chapter has been undertaken by the following individuals who have used their knowledge and professional judgement to undertake this assessment:

- A qualified acoustician (BEng, CEng, FIOA), who holds professional membership with the Institute of Acoustics. They have over 25 years of knowledge and experience in noise and vibration.
- A qualified acoustician (BEng, MSc, MIOA), who holds professional membership with the Institute of Acoustics. They have 10 years of knowledge and experience in noise and vibration.
- A qualified acoustician (BEng, AMIOA), who holds a professional membership with the Institute of Acoustics and has over five years of knowledge and experience in noise and vibration.
- A qualified acoustician (PhD, BEng, MIOA), who holds professional membership with the Institute of Acoustics. They have over 20 years of knowledge and experience in noise and vibration.

6.3 Legislative and policy framework

6.3.1 Current noise policy in England is based on the Noise Policy Statement for England (NPSE)[1], 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.

[1] Department for Environment and Rural Affairs (2010). Noise Policy Statement for England. London: Defra

6.3.2 These aims reflect those contained in the National Planning Policy Framework (NPPF)[2] and the National Policy Statement for National Networks (NPS NN)[3] and Planning Practice Guidance concerning noise[4].

6.3.3 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.

6.3.4 Government policy and guidance do not state values for the NOEL, LOAEL and SOAEL; rather, the policy considers that the relevant values should be different for different noise sources, for different receptors and at different times. This means that the relevant noise levels at which effects arise should be defined on a strategic or project basis taking into account the specific features of that area, source or project. The concepts of NOEL, LOAEL and SOAEL apply to the assessment of noise and vibration in the construction and operational phases of the Scheme.

6.3.5 The legislation and policies considered in undertaking this assessment are detailed in Table 6.1.

Table 6.1: Legislation, regulatory and policy framework for noise and vibration

Legislation / regulation / policy	Summary of requirements
National	
Land Compensation Act 1973[5]	Part I of the Land Compensation Act 1973 includes provision for compensation for loss in property value resulting from physical agents including noise. Part II includes provision for noise mitigation measures at dwellings adjacent to new highways if certain conditions are satisfied.
Infrastructure Act 2015[6]	Section 5(2) of the Infrastructure Act states that Highways England must, when exercising functions, have regard to the effect of those functions on the environment.
Control of Pollution Act 1974 (as amended)[7]	The Control of Pollution Act 1974 Section 61 sets out the procedures whereby contractors may obtain 'Prior Consent' for construction works within agreed noise limits. Applications for such consents would be made to the local authority and would contain a construction method statement and the steps to be taken to minimise noise. The local authority has the power to attach conditions to any consent given.

[2] Ministry of Housing, Communities and Local Government (2019). National Planning Policy Framework. London: MHCLG
[3] Department for Transport (2014). National Policy Statement for National Networks. London: TSO
[4] Department for Communities and Local Government (2014). Planning Practice Guidance: Noise. Available at: http://planningguidance.planningportal.gov.uk/
[5] Land Compensation Act 1973. Retrieved 2019 from http://www.legislation.gov.uk/ukpga/1973/26
[6] Infrastructure Act 2015. Retrieved 2019 from http://www.legislation.gov.uk/ukpga/2015/7
[7] Control of Pollution Act 1974. Retrieved 2019 from https://www.legislation.gov.uk/ukpga/1974/40

Legislation / regulation / policy	Summary of requirements
Environmental Protection Act 1990 (as amended)[8]	Under Part III of the Environmental Protection Act 1990 as amended by the Noise and Statutory Nuisance Act 1993, local authorities have a duty to investigate noise complaints relating to a variety of sources such as construction noise but excluding road traffic noise. If the local authority is satisfied that the noise amounts to a statutory nuisance it shall serve an Abatement Notice which may require that the noise be stopped altogether or limited to certain times.
Noise Insulation Regulations 1975 (as amended)[9]	Operational phase: • 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. Construction phase: 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.
National Policy Statement for National Networks (NPS NN)[3]	The NPS NN states the following factors as determinants of the likely noise impact: • construction noise and the inherent operational noise from the proposed development and its characteristics. • the proximity of the proposed development to noise sensitive premises (including residential properties, schools and hospitals) and noise sensitive areas (including certain parks and open spaces). • the proximity of the proposed development to quiet places and other areas that are particularly valued for their tranquillity, acoustic environment or landscape quality such as National Parks, the Broads or Areas of Outstanding Natural Beauty. • the proximity of the proposed development to designated sites where noise may have an adverse impact on the special features of interest, protected species or other wildlife.
National Planning Policy Framework (NPPF) 2019[2]	Paragraph 180 states that decisions on development should aim to: • ensure that new development is appropriate for its location, taking into account the likely effects (and cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site and wider area impacts that could arise from the development. • mitigate and reduce to a minimum, other adverse impacts resulting from new development, and avoid noise giving rise to significant adverse effects on health and quality of life. • identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

[8] Environmental Protection Act 1990. Retrieved 2019 from http://www.legislation.gov.uk/ukpga/1990/43
[9] Noise Insulation Regulations 1975. Retrieved 2019 from http://www.legislation.gov.uk/uksi/1975/1763/made

Legislation / regulation / policy	Summary of requirements
Planning Practice Guidance Noise (PPGN) 2014[4]	PPGN provides advice on how planning can manage potential noise impacts in new development. Noise should not be considered in isolation and should instead be viewed in relation to its social, economic and environmental context.
Environmental Noise (England) Regulations 2006[10]	These regulations are relevant to the operational phase of the Scheme. The regulations implement the European Environmental Noise Directive (END) in England. Developments must take into account Noise Action Plans.
Noise Policy Statement for England (NPSE) 2010[1]	The NPSE sets out the long term vision of Government noise policy and states the following Noise Policy Aims for the effective management and control of environmental noise within the context of Government policy on sustainable development: • Avoid significant adverse effects as a result of the Scheme. • Mitigate and minimise adverse impacts as a result of the Scheme • Contribute to the enhancement of the acoustic environment. The Explanatory Note to the NPSE assists in the definition of significant adverse and adverse with reference to NOEL, LOAEL and SOAEL values. 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.
Road Investment Strategy (RIS) and Strategic Business Plan 2015[11]	The DfT and Highways England RIS for the 2015/16 - 2019/20 Road Period 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 of the Noise Important Areas (NIAs), which is expected to reduce the number of people severely affected by noise from the strategic road network by at least 250,000. The Highways England: Licence[12] paragraph 5.23 states that the Licence holder should ensure the best practicable environmental outcomes across its activities, while working in the context of sustainable development and delivering value for money.
RIS2 2020 – 2025[13]	The RIS2 sets out the Governments strategic vision, performance specification and investment plan for the Strategic Road Network. The strategy contains the aim to deliver better environmental outcomes, including a target for 7,500 households in Noise Important Areas to be mitigated using funding from the Environmental Wellbeing designated fund.
The Control of Noise (Code of Practice for Construction and Open Sites)	This is relevant to the construction phase of the Scheme and 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.

[10] Environmental noise (England) Regulations 2006. Retrieved 2019 from http://www.legislation.gov.uk/uksi/2006/2238
[11] DfT and Highways Agency (2015) Road Investment Strategy: for the 2015/16 – 2019/20 Road Period, March 2015. Retrieved 2019 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/408514/ris-for-2015-16-road-period-web-version.pdf
[12] DfT Highways England: Licence 2015. Retrieved 2020 from https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/431389/strategic-highways-licence.pdf
[13] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/872252/road-investment-strategy-2-2020-2025.pdf

Legislation / regulation / policy	Summary of requirements
(England) Order 2015[14]	
The Highways Noise Payments and Movable Homes (England) Regulations 2000[15]	These regulations are relevant to the operational phases of the Scheme. They 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.
Local	
Brentwood Council, Replacement Local Plan (25 August 2005)[16]	• Policy CP1, a general development criteria policy, outlines the requirement for new development proposals to have no 'unacceptable detrimental effect on health, the environment or amenity' on paragraph 'vii', which includes 'light, noise pollution and vibration'. • Policy PC6, concerning transport pollution, states that 'all new transport proposals and improvements to existing transport infrastructure and services will be assessed against their impact on Air Quality, Noise Levels, and Visual Amenity, and will need to be designed so as to minimise any negative impacts and, where necessary, incorporate reasonable and appropriate mitigation measures'.
Brentwood Draft Local Plan (January,2016)	• Policy 6.3 of the Brentwood Draft Local Plan, a general development criteria policy, outlines the requirement for proposals to meet criteria including have no 'unacceptable effect on health, the environment or amenity' due to the release of pollutants to land, water or air (light, noise pollution, vibration, odour, smoke, ash, dust and grit)';cause no unacceptable effects on adjoining sites, property, or their occupiers, though excessive noise, activity, or vehicle movements'.
London Borough of Havering[17]	Havering Core Strategy 2008 • Policy CP15 notes that construction and new use development should 'avoid a noise sensitive use being exposed to excessive noise', that the policy aims to ensure that 'noise sensitive developments are located away from existing sources of significant noise (or programmed development such as new roads)' and that 'potentially noisy developments' should be 'located in areas where noise will not be such an important consideration'. Alongside this, Policy DC55 states that 'exposure to noise or vibrations above acceptable levels' will result in permission being refused for development where this affects noise sensitive development such as dwellings, schools and hospitals. Local Plan Proposed Submission August 2017 • In accordance with Policy 34 the Council will support development proposals that do not unduly impact upon amenity, human health and safety and the natural environment by noise emissions.

Table Source: Various

[14] BS 5228-1:2009+A1:2014, Code of practice for noise and vibration control on construction and open sites – Part 1 Noise and Part 2 Vibration
[15] The Highways Noise Payments and Movable Homes (England) Regulations 2000. Retrieved 2019 from www.legislation.gov.uk/uksi/2000/2887/made
[16] Brentwood Borough Council (2005) http://www.brentwood.gov.uk/blp/
[17] London Borough of Havering (2008) Core Strategy and Development Control Policies Development Plan Document. Retrieved 2019 from https://www.havering.gov.uk/download/downloads/id/1632/core_strategy_development_control.pdf

6.4 Study area

Construction

6.4.1 The Design Manual for Roads and Bridges Volume 11, Section 3, Part 7 HD 213/11 Noise and Vibration[18] (referred to hereafter as DMRB 11:3:7) refers to BS 5228 for assessing noise and vibration impacts resulting from construction works. The study area for the construction noise and vibration assessment is 300 m from the Scheme Development Consent Order (DCO) boundary. Based on the site geometry, a study area of this size enabled the effects of the main construction works to be assessed over a wide area as many of the sensitive receptors are located in close proximity to works on the A12. A construction noise study area of 300 m is commonly adopted as the prediction methodology in BS 5228 cautions against predictions at distances greater than 300 m.

6.4.2 The study area for the construction traffic assessment is also 300 m from the roads used by construction traffic.

Operation

6.4.3 The study area for the assessment of noise and vibration effects is defined in the DMRB 11:3:7 as 600 m from the carriageway edge of any proposed new routes or existing routes to be bypassed or improved, and 600 m from any other affected routes within 1 km of the proposed new routes or altered existing routes. An affected route is defined as a route where it is calculated that there is a possibility of a change of 1dB $L_{A10,18h}$ in the short-term or 3dB $L_{A10,18h}$ in the long-term (assessed between the opening year and the future year, which is typically 15 years after Scheme opening).

6.4.4 The DMRB provides the following methodology for identifying the size and extents of the study area:

1. Identify the start and end points of the physical works associated with the road project.
2. Identify the existing routes that are being bypassed or improved and any proposed new routes between the start and end points (for each option).
3. Define a boundary 1 km from the carriageway edge of each of the options identified in (2) above.
4. Define a boundary 600 m from the carriageway edge around each of the options identified in (2) above and also 600 m from any other affected routes within the boundary defined in (3) above. The total area within these 600 m boundaries is termed the 'calculation area'.
5. Identify any affected routes beyond the boundary defined in (3) above.
6. Define a boundary 50 m from the carriageway edge of routes identified in (5) above.

[18] The Highways Agency, Transport Scotland, Welsh Government and The Department for Regional Development Northern Ireland (2011). Design Manual for Roads and Bridges, Volume 11, Section 3, Part 7: Noise and Vibration. HD 213/11. London: TSO

6.4.5 Based on the above, the detailed noise calculation area (within 600 m of any affected route that is within 1 km of the Scheme) has been determined as shown in Figure 6.1 (application document TR010029/APP/6.2).

6.5 Assessment methodology

Construction

Noise

6.5.1 The construction noise calculations and assessments have been undertaken in accordance with guidance in BS 5228 Part 1[19], which DMRB 11:3:7 recognises as the most appropriate standard to use for such assessments. The construction activity noise levels in dB $L_{Aeq,T}$ were calculated at a reference distance of 10 m from each main construction activity, taking into account the list of construction plant expected to be in use and their anticipated usage patterns. The activity noise levels were corrected for distance between the activity and the sensitive receptor, using the equations provided in Annex F of BS 5228 Part 1 and based on the predominant intervening ground type. In the case of existing noise barriers or screening topography and structures, screening has been accounted for as per guidance in BS 5228.

6.5.2 The effects of construction activity phasing were considered where this information was available, as it is possible that sensitive receptors can be affected by construction noise from multiple locations within the study area. Where this occurs, the predicted construction noise levels at the sensitive receptor from each construction site was combined to determine the total construction noise level.

6.5.3 BS 5228 Part 1 contains example methods for deriving appropriate limit values that can be used as significance criteria. BS 5228 Part 1 explains that the assessor needs to consider other project-specific factors, such as the number of receptors affected and the duration and character of the impact, to determine if there is a significant effect.

6.5.4 Annexes C and D of Part 1 of BS 5228 provide generic source noise data for various items of plant used on open sites which can be used in the absence of measured data.

6.5.5 BS 5228 Part 1 Annex E provides example threshold levels that can be used to identify potential significant effects at sensitive receptors, as shown in Table 6.2 – the ABC method. The ABC method assigns a threshold category for sensitive receptors depending on the baseline ambient noise level. If the construction noise level exceeds the threshold level for the assigned category, a potential significant effect can occur depending on other factors, such as duration of the construction works.

[19] British Standards Institution (2014). BS 5228:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites, Part 1: Noise. London: BSI

Table 6.2: Example construction noise threshold levels

Assessment category and threshold value period	Threshold value ($L_{Aeq,T}$ dB)		
	Category A	Category B	Category C
Night-time (23:00 – 07:00)	45	50	55
Weekday evenings (19:00 – 23:00) and weekends (Saturdays 13:00 – 23:00, Sundays 07:00 – 23:00)	55	60	65
Weekday daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
Notes: 1. A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. 2. If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise. 3. Applied to residential receptors only.			
Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are less than these values. Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values. Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values. If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.			

Table Source: BS 5228 Part 1, Annex E, Table E.1

6.5.6 The ABC method has been used to assess the impacts of the construction activities. Using this method, the impact of an activity has potential to be significant if the noise levels from the construction activities are shown to exceed the relevant threshold value.

6.5.7 The consideration of significance then needs to take the duration of the activity into account along with the characteristics of the existing noise climate.

6.5.8 In line with the advice in BS 5228 Part 1 and common practice on similar major infrastructure construction Schemes, a “significant time period” for the threshold levels shown in Table 6.2 to be exceeded for is:

- A period of 10 or more days of working in any 15 consecutive days during construction, or
- For a total of 40 days or more in any 6 consecutive months during construction.

6.5.9 Based on the information provided in BS 5228 Part 1, the noise thresholds and averaging periods shown in Table 6.2 are indicative of a SOAEL exceedance occurring at an affected property, where these occur for a significant time period. Suitable LOAEL threshold levels are construction noise levels that are equivalent to the existing ambient noise levels for each of the corresponding time periods in Table 6.2. Non-residential receptors, such as educational buildings and medical centres, will be subject to individual considerations and have been assessed against the same criteria for periods when they are open.

6.5.10 Noise impacts from construction traffic on the wider traffic network, including heavy goods vehicles (HGVs), have been assessed separately by calculating the road traffic noise levels inclusive of construction traffic flows using the Calculation of Road Traffic Noise (CRTN)[20] and using the same assessment criteria used to determine impact significance during the operational phase.

Vibration

6.5.11 Construction generated vibration has been assessed in accordance with guidance in BS 5228 Part 2[21]. The main construction activities that can result in significant levels of vibration are percussive piling, earth compaction works, or other works requiring the use of a vibratory roller. The resulting peak particle velocity (PPV) in mm/s from potential works were calculated at sensitive receptors using the empirical formula in Annex E of BS 5228 Part 2.

6.5.12 Annex B of BS 5228 Part 2 provides guidance on the likely significance of PPV levels in mm/s due to construction works, which is reproduced in Table 6.3 below.

Table 6.3: Guidance on the effects of PPV vibration levels perceptible to humans

Vibration level *	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower levels, people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.
* The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into a recipient. A transfer function (which relates an external level to an internal level) needs to be applied only if external measurements are available. Single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. The values are provided to give an initial indication of potential effects, and where these values are routinely measured or expected then an assessment in accordance with BS 6471-1 or -2, and/or other available guidance, might be appropriate to determine whether the time varying exposure is likely to give rise to any degree of adverse comment.	

Table Source: BS 5228 Part 2, Annex B, Table B.1

6.5.13 Table 6.3 suggests that vibration levels of 0.3 mm/s from construction activities could suitably represent the LOAEL threshold as this is when vibration becomes perceptible. Typically, there are no significant sources of vibration in the general environment to influence people's perceptions and experiences. Therefore, as complaints become more likely, for example when vibration levels are 1 mm/s, this would be an appropriate threshold to use as a SOAEL for construction vibration.

[20]Department of Transport and the Welsh Office (1988). Calculation of Road Traffic Noise. London: HMSO
[21] British Standards Institution (2014). BS 5228:2009 + A1:2014 Code of practice for noise and vibration control on construction and open sites, Part 2: Vibration. London: BSI

6.5.14 Where high levels of vibration are predicted, the values in Table 6.4 are used to determine the potential for cosmetic damage to buildings.

Table 6.4: Guidance on the effects of vibration levels perceptible to buildings

Type of building	Peak component particle velocity in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
1. Reinforced or framed structures Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	50 mm/s at 4 Hz and above
2. Unreinforced or light framed structures Residential or light commercial buildings.	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Notes : 1. Values referred to are at the base of the building. 2. For line 2, at frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) is not to be exceeded.		

Table Source: BS 5228 Part 2, Annex B, Table B.2

Operation

Noise

Road traffic noise modelling

6.5.15 Noise modelling has been undertaken to predict noise levels with and without the Scheme in its projected opening year (2022) and future assessment year (2037) to complete a “detailed” assessment as defined within the DMRB 11:3:7, which consists of the following elements:

- Prediction of daytime ($L_{A10,18h}$) noise levels in the short-term (Scheme opening) and the long-term (future assessment year) at noise-sensitive receptors in the study area using the CRTN procedures and the advice in DMRB 11.3.7, Annex 4.
- Prediction of night-time (L_{night}) noise levels in the long-term at noise-sensitive receptors within the study area.
- Assessment of noise levels at traffic links located in the wider area.
- Assessment of traffic nuisance impacts.

6.5.16 To complete a “detailed” assessment, the following traffic scenarios have been modelled and assessed:

- Do Minimum (without the Scheme) in the opening year (DM 2022)
- Do Something (with the Scheme) in the opening year (DS 2022)
- Do Minimum in the future assessment year (DM 2037)
- Do Something in the future assessment year (DS 2037)

6.5.17 The noise modelling was undertaken using NoiseMap v5.2.4 software and traffic projections from strategic traffic modelling to permit the degree of accuracy required for a detailed assessment. For further details refer to the Transport assessment report (application document TR010029/APP/7.4). The traffic data comprised 18-hour average annual weekday traffic flows for each traffic link in the study area and the wider area, and the corresponding traffic speed and fleet composition for each traffic link. The noise modelling software predicted the road traffic noise levels at sensitive receptors by implementing the calculation procedure detailed in CRTN, using the traffic parameters described above and taking into account road surfacing assumptions, topography, ground absorption and screening from intervening structures.

6.5.18 The noise model has included an existing noise barrier, located to the south of the junction on the southbound carriageway of the M25, approximately 130 m in length and assumed to be 3 m in height. In addition to this, the noise model has also included any additional noise mitigation measures that are included in the Scheme's design (such as low noise surfacing) to reduce noise pollution. The topographical model was built from Scheme drawings and Ordnance Survey Landform 5 m data at locations further away from the Scheme. The noise barrier in the existing and all future scenarios is at the same assumed height, therefore the assumed height does not affect the change in road traffic noise levels between scenarios. As the barrier is located south of the Scheme in an area not affected by high noise levels close to SOAEL, any reduction in assumed barrier height would result in marginally higher noise levels but would not lead to any new significant effects.

6.5.19 Ordnance Survey base mapping and Addressbase data were used to establish the relevant noise sensitive receptors within the appropriate calculation area. This included residential noise sensitive receptors and non-residential noise sensitive receptors, such as schools, medical facilities and places of worship. Outdoor recreational facilities such as golf courses are not considered as noise sensitive receptors as the use of the facility is of a transient nature and is therefore not considered further in this assessment. All buildings in the noise model were set to 8 m in height except single storey buildings adjacent to the A12 where heights were set to 6 m and the Holiday Inn, which was set to 10 m. Receivers were added to each façade of noise sensitive buildings to predict noise levels at heights of 1.5 m and 4 m above ground level, to represent the ground floor and first floor heights of buildings. Further assessment heights were included for tall buildings and the worst-case noise levels predicted for each property have been reported.

Assessment criteria

6.5.20 The assessment criteria for the Scheme take into account significance of impacts from a policy perspective and from an environmental impact assessment (EIA) perspective. From a policy perspective, it is relevant to consider the number of properties which are above or below the thresholds for significant adverse effects (SOAEL) and adverse effects (LOAEL). From an EIA perspective it is relevant to consider the magnitude of change at receptors, with larger increases in noise being more adverse than smaller increases in noise.

6.5.21 The assessment of the Scheme against policy is undertaken at a scheme-wide level, whereas the assessment of the Scheme against EIA guidelines is

undertaken on a receptor by receptor basis using the magnitude of change descriptors provided in the DMRB.

6.5.22 The criteria for assessing significance from an EIA perspective is set out in Table 6.5.

Table 6.5: Classification of magnitude of noise impacts

Short-term noise change ($L_{A10,18h}$, dB)	Long term noise change ($L_{A10,18h}$, dB)	Magnitude of impact (adverse or beneficial)	Potential significance, depending on context
0	0	No change	Not significant
0.1 - 0.9	0.1 - 2.9	Negligible	Low likelihood of significant effect
1 - 2.9	3 - 4.9	Minor	
3 - 4.9	5 - 9.9	Moderate	
5+	10+	Major	High likelihood of significant effect

Table Source: IEMA (2014) and DMRB Volume 11, Section 3, Part 7, HD 213/11

6.5.23 For the assessment from a policy perspective, the absolute[22] noise levels predicted at noise sensitive receptors in the opening year and future assessment year of the Scheme have been compared with the SOAEL and the LOAEL. Existing policy guidance (as summarised in Table 6.1) and DMRB 11:3:7 do not provide a formal methodology for establishing the significance of effects from road traffic noise, receptor sensitivity or set specific LOAEL and SOAEL threshold levels to use in assessments. Table 6.6 shows the thresholds assigned to represent the LOAEL and the SOAEL based on other guidance for environmental noise assessments and noise thresholds associated impacts to human health.

Table 6.6: Significance threshold levels for road traffic noise

Effect level	Time period	Noise threshold	Relevant guidance
LOAEL	Day	50 dB $L_{Aeq,16h}$ (free-field[23]) 55 dB $L_{A10,18h}$ (1 m from façade)	WHO Community Noise Guidelines (WHO, 1999)
	Night	40 dB L_{night} (free-field)	WHO Night Noise Guidelines for Europe (WHO, 2009)
SOAEL	Day	63 dB $L_{Aeq,16h}$ (free-field) 68 dB $L_{A10,18h}$ (1 m from façade)	Noise Insulation Regulations 1975 (amended 1988)
	Night	55 dB L_{night} (free-field)	WHO Night Noise Guidelines for Europe (WHO, 2009), Transport Analysis Guidance (DfT, 2015)

Table Source: Various

[22] The term 'absolute' is commonly used to describe the actual level of noise, as opposed to the change in noise.
[23] Free-field refers to noise levels measured or predicted away from large reflective surfaces (other than the ground) and are typically taken to be at least 3.5 m from buildings of other large reflective objects.

6.5.24 It is noted that new guidance was issued by the World Health Organisation in October 2018 where the threshold noise levels for adverse effects to human health were revised. The threshold levels in this assessment are based on recommendations from original guidance from the World Health Organisation, which provide similar thresholds for daytime adverse (LOAEL) noise levels and more stringent criteria for night-time noise levels than the 2018 guidance.

6.5.25 Overall, the assessment of significance takes both policy factors and EIA factors into account and the final decision additionally takes the context of the situation at receptors into account, within the following assessment framework:

- Where changes in noise are shown to be negligible, the effect is considered not to be significant.
- Where noise levels are below LOAEL, impacts are not considered to be significant.
- Where noise levels are between LOAEL and SOAEL, impacts may be considered to be significant if the changes in noise are moderate or major.
- Where noise levels are above SOAEL, impacts may be considered to be significant if changes in noise are perceptible.

6.5.26 The assessment considers if changes in noise are expected to occur in the short-term or over the long-term.

6.5.27 Where significant effects are identified, it is necessary to consider mitigation to avoid those significant effects occurring.

6.5.28 Additionally, mitigation may be considered to:

- To reduce adverse effects at noise sensitive receptors.
- To mitigate noise levels in areas with existing high noise levels, such as NIAs, which is a stated objective of the overarching RIS programme.
- To reduce adverse effects at ecologically sensitive areas.

6.5.29 Additional Scheme mitigation in such locations would be considered when it is shown to be cost effective to do so, in line with the context of the Government policy on sustainable development.

6.5.30 Detailed noise modelling has been undertaken based on traffic projections provided by the design team. Further details are provided in the Transport assessment report (application document TR010029/APP/7.4). The detailed noise modelling included noise mitigation measures that will be introduced by the Scheme.

Vibration

6.5.31 Road traffic can give rise to vibration impacts in two different ways:

- Airborne vibration that normally occurs if the exhaust note of (usually heavy) vehicles coincides with the resonant frequency of a building element, resulting in badly fitting windows or light fittings rattling.
- Ground-borne vibration that may result from the passage of vehicles over discontinuities in the road surface.

6.5.32 Regarding airborne traffic-induced vibration, the DMRB 11:3:7 states that impacts should be considered at properties within 40 m of the road and there is a close correlation between road traffic noise levels and annoyance from airborne traffic-induced vibration. This means that if there are no changes to road traffic noise levels at noise sensitive properties then the airborne traffic-induced vibration impact would be unchanged from existing conditions. Furthermore, the DMRB 11:3:7 states that no traffic-induced vibration impacts should be assumed for noise levels below 58 dB. Therefore, the airborne traffic-induced vibration assessment only considered properties within 40 m of the Scheme where noise levels above 58 dB $L_{A10,18h}$ were predicted.

6.5.33 The DMRB 11:3:7 provides some guidance on assessment criteria to use for determining vibration impacts from road traffic, applicable to properties within 40 m for the new or altered road. It states that a PPV of 0.3 mm/s measured on the floor of a property in the vertical direction is perceptible and that "if the level of vibration at a receptor is predicted to rise above a level of 0.3 mm/s, or an existing level of 0.3 mm/s is predicted to increase, then this should be classed as an adverse impact from vibration". The threshold level for perceptibility of vibration stated in the DMRB 11:3:7 corresponds with that shown in Table 6.3 taken from BS 5228 Part 2. On this basis, a PPV of 0.3 mm/s would be an appropriate threshold to represent the LOAEL.

6.5.34 The DMRB 11:3:7 also notes: "for vibration from traffic…structure damage can occur when levels are above 10 mm/s…PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 2 mm/s and typically are below 1 mm/s. Normal use of a building such as closing doors, walking on suspended wooden floors and operating domestic appliances can generate similar levels of vibration to those from road traffic noise." On this basis, a SOAEL threshold of 1 mm/s has been selected to appraise the Scheme, noting that if this value is exceeded damage to buildings is unlikely to occur. This value corresponds with the threshold for complaints shown in Table 6.3 taken from BS 5228 Part 2.

6.5.35 Research undertaken by Watts (1987)[24] into ground-borne vibration concluded there was a possibility of perceptible ground-borne vibrations generated during the passage of heavy vehicles when there is a road surface irregularity of about 20 mm within about 5 m of a building. This indicates that the condition of the road surface is a significant factor in determining the likelihood of ground-borne vibration impacts, which can be predicted if information about the ground type and the dimensions of the road surface irregularities are known (Watts, 1990)[25]. Road surface irregularities can be removed through remedial works and are most likely to occur if the road is poorly maintained. As the new roads and widened roads introduced by the Scheme would have new road surfaces free from irregularities, ground-borne vibration impacts would not occur. Therefore ground-borne vibration was scoped out of the assessment as it is assumed that the new road surface will be adequately maintained to be free of irregularities over the long term assessment period.

[24] Watts, G.R. (1987). Traffic-induced ground-borne vibrations in dwellings. Research Report 102. Crowthorne: TRRL
[25] Watts, G.R. (1990). Traffic induced vibrations in buildings. Research Report 246. Crowthorne: TRRL

6.6 Assumptions and limitations

Construction

Construction noise

6.6.1 The construction noise assessment was based on the information presented in the high level construction programme that has been produced by the buildability contractor and additional information provided by the buildability contractor and reflects the best information available at the time of assessment. The plant lists, construction methods, phasing of works or the construction programme may change during the detailed design of the Scheme, which may affect the resultant noise levels at sensitive receptors. The assumptions used for the construction noise assessment are stated below:

- Construction activities, plant lists, on-times and durations used in the assessment are those that were provided by the buildability contractor. Some minor adjustments were made to the on-times/quantity of plant in some activities where it was determined that not all plant would be operating simultaneously at the closest position to a receptor for a given activity, to better represent the expected conditions during a 'typical' working day for each activity.
- The construction phasing and all periods of night-time working were shown in the buildability contractor's construction programme.
- Working hours are noted as being daytime 06:00 to 19:00 Monday to Friday. The majority of construction works will take place between 07:00 to 19:00 Monday to Friday. It is anticipated that between the hours of 06.00 to 07.00 on weekdays site activities will exclude noisy works. Where noisy works are proposed between these hours, this will be agreed in advance with the local authority pursuant to section 61 of the Control of Pollution Act 1974.
- It is anticipated that night-time working Monday to Friday will also be required on the existing highway network when closures would take place. It is anticipated that these activities will be undertaken between 23.00 and 07.00. These activities are likely to include; installing traffic management, and various construction activities such as: working on the gantries, road surfacing, white lining, constructing the tie ins to the existing network.
- Where working outside of these hours, for instance, at weekends to enable programme efficiency, these would take place between 06.00 to 17.00 on Saturdays and Sundays. Any proposals for weekend working would be agreed in advance with the local authority pursuant to Section 61 of the Control of Pollution Act 1974.
- All calculations assume soft ground attenuation, which is the predominant ground type in the study area.
- Screening effect of the elevated topography of the railway line towards south of the Scheme and the existing noise barriers along M25 to the south of railway bridge is considered in the calculations.

- It is assumed that the railway embankment and the existing noise barrier would provide an effective screening of -10 dB in accordance with BS 5228 for receptors along Nags Head Lane as both are considered to fully screen the construction noise propagation based on a review of site photography and topography.
- Screening from other intervening objects or topography have not been considered in the calculations.
- All calculations are free-field noise levels and do not include a façade correction.

6.6.2 The results of the construction noise calculations provide a worst-case assessment of construction noise levels by assuming that all plant for each activity is operating at the closest point to the sensitive receptors. In reality, much of the work for each activity will occur at greater distances as the construction works are not fixed at one location for the duration of the build.

Construction vibration

6.6.3 Based on measurement data in BS 5228:2009 + A1:2014 Part 2, vibration levels from vibratory ground compaction are generally imperceptible (or perceptible for a short duration only i.e. pass by of vibratory roller) at distances greater than around 20 m.

6.6.4 Construction vibration assessments have been scoped out for receptors greater than 20 m from this activity.

6.6.5 All retaining walls are earth reinforced and sheet piling is not considered for construction of the retaining walls, thus vibration impacts are not expected from any percussive piling activities.

6.6.6 The low vibration rotary bored piling method is considered for all piling works undertaken for new bridges and gantries. If ground conditions on site require a different piling method this would need to be assessed at that time and discussed with the local authority.

6.6.7 The results of the construction vibration calculations provide a worst-case assessment of construction vibration levels by assuming that the vibration-generating plant is operating at the closest point to the sensitive receptors. The worst-case vibration levels would be temporary as the construction works are not fixed in one location for the duration of the build. Lower levels of vibration would occur when the vibration-generating activities take place at greater distances from the sensitive receptor.

Construction traffic

6.6.8 A construction traffic assessment has been undertaken based on construction traffic data provided by the appointed buildability contractor. The assessment has been completed by comparing the existing road traffic with the additional construction traffic.

6.6.9 Construction traffic flows considers construction workers travelling to/from the sites, construction traffic routes to/from the site compound and separate work

sites. The traffic data assumed that construction traffic will travel to and from the Scheme using trunk roads as far as possible to minimise disruption.

Operation

Traffic data

6.6.10 The results from the detailed noise modelling are directly affected by the input data sources. Crucially, the results from the detailed noise modelling are influenced by the assumptions used to derive traffic flow, speed, and fleet composition data from the strategic traffic model for the Scheme.

6.6.11 The noise predictions were based on the speed bands assigned to each road link rather than speeds generated by the traffic model, in line with IAN 185/15 and current Highways England guidance. Where the speed band changed between traffic scenarios, advice was sought from traffic modellers to ensure that the change in speed band was appropriate.

6.6.12 The noise model included detailed information about road surfacing in each of the traffic scenarios that were modelled, and this was based on the following assumptions and data sources:

- In the Do Minimum scenario in the opening year, the road surface corrections applied to the M25 and A12 were assigned according to the road surfaces identified in the Highways Agency Pavement Management System (HAPMS) for each lane of each carriageway. From this information, an overall correction was applied to sections of each carriageway[26]. In accordance with the DMRB 11:3:7, sections where an existing lower noise road surface was present were assigned a correction of -2.5 dB. Where HAPMS data was unavailable for the local road network, a bituminous road surface with a texture depth of 1.5 mm was assumed. As the speed on this road for all traffic scenarios was below 75 km/h, a correction of -1dB was applied in line with the CRTN prediction methodology.
- In the Do Something scenario in the opening year, it is assumed that all new and altered roads would be resurfaced with new lower noise surfacing. In accordance with the DMRB 213/11, sections of new lower noise road surfacing were assigned a correction of -3.5 dB. Where a mixture of road surfaces will be present on a given section of carriageway, an overall correction was determined. Road surfacing on all other roads was the same as the Do Minimum scenario.

6.6.13 The heights and widths of the M25~~,~~ junction 28 and the access road to the site were modelled based on the Scheme layout plans (application document TR010029/APP/2.7). The layout of local roads was based on Ordnance Survey data sources.

6.6.14 The resolution of the ground topography data imported into the road traffic noise model influences the results as it affects sound propagation. To minimise uncertainty and to improve the accuracy of the noise model, the ground topography close to the Scheme used very detailed topographical information from the design drawings and aerial Lidar survey data. Further away from the

[26] Muirhead, M (2017). CRTN revision and update. Paper presented to the Institute of Acoustics Sound Transport Modelling conference, Manchester 14 March 2017

Scheme, where these data sources were unavailable, Ordnance Survey Terrain 5 data was used. This dataset provided equal height ground contours at 5 m height intervals and would therefore not take into account small variations in ground level between each contour interval.

~~6.6.14~~6.6.15 The ground topography for 'Do Something' traffic scenarios include the proposed environmental bund (Work No. 18) located south-east of Maylands golf course. The environmental bund was modelled with a height of approximately 2.5 m.

~~6.6.15~~6.6.16 All noise sensitive receptors within the study area have been identified using Ordnance Survey Addressbase and added to the noise model accordingly. Therefore, it is assumed that Addressbase is up to date and has not mislabelled land use categories for addresses. Noise sensitive receptors have also been identified and agreed at a meeting with the Local Authorities.

Calculation method

~~6.6.16~~6.6.17 The DMRB 11:3:7 requires an assessment of night-time noise levels (23:00 to 07:00) using the L_{night} noise index. These were calculated by the noise modelling software using "TRL Method 3", which calculates L_{night} based on the predicted daytime $L_{A10,18h}$ noise level. This approach assumes that the diurnal traffic pattern is typical for the roads in the study area.

~~6.6.17~~6.6.18 The noise model used a cut-off distance or search area of 2,000 m to ensure that noise emissions from the M25 were fully accounted for in the noise predictions.

6.7 Baseline conditions

Sensitive receptors

6.7.1 The Scheme is located between Romford and Brentwood, which are separated by agricultural land and the M25. Road traffic noise from the M25 and the A12 is the dominant source of ambient noise in the study area. The land use within 600 m of the M25 junction 28 is generally agricultural and commercial~~, with the closest business located 55 m from the junction on Brook Street. Maylands Golf Club is located approximately 600 m from the existing junction layout~~.

6.7.2 The closest residential areas to the Scheme are Grove Farm (immediately to the northwest of junction 28), Maylands Cottages (120 m), The Poplars (60 Brook Street) (50 m), Caravan Park, Putwell Bridge (80 m) and Nag's Head Lane (250 m) as included in Figure 6.1. Further residential communities which lie outside of the study area and are therefore not included in Figure 6.1 are located at Brook Street (600 m), Harold Park (800 m), Wigley Bush Lane (850 m), and South Weald (1.1 km). ~~These are areas of mixed residential and commercial land use.~~

6.7.3 Non-residential noise sensitive receptors identified within proximity of the proposed design options at M25 junction 28 include Holiday Inn Brentwood (100 m) and Harold Park Baptist Church (450 m)~~,~~. Other non-residential locations which lie outside the study area include St Peters Church (1000 m) and~~,~~ St Peter's C of E Primary School (850 m)~~, and Holiday Inn Brentwood (100 m).~~

~~These non-residential receptors lie outside of the study area and are therefore not included in Figure 6.1~~.

Noise climate

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

- Environmental noise survey conducted on 20 and 21 June 2019 by Atkins as presented in Appendix 6.1 (application document TR010029/APP/6.3).
- Environmental noise survey conducted between 14 and 23 June 2019 by SRL Ltd also presented in Appendix 6.1.
- Ordnance Survey base mapping to identify locations of residential and non-residential noise sensitive receptors (residential properties, schools, hospitals and elderly care homes).
- Natural England's MAGIC website (MAGIC, 2017) to identify boundaries of designated ecological sites that may be considered as sensitive to noise.
- Defra Strategic Noise Mapping for Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended) (2015).

6.7.5 The measured noise levels obtained during the baseline noise survey have been supplemented with information from publicly available online mapping sources. Strategic noise maps were published during 2015 by Defra for both major road and railways sources to meet the requirements of the Environmental Noise Directive (Directive 2002/49/EC) and the Environmental Noise (England) Regulations 2006 (as amended). The Defra noise maps for day/night are shown in Figure 6.2 and Figure 6.3 respectively.

6.7.6 The 'Important Areas' for noise (NIAs) were identified to highlight any particular constraints for the Scheme. NIAs are defined by Defra and ~~the~~ locat~~e~~ions ~~where~~ the 1% of the population most affected by the highest noise levels from England's major roads and railways, ~~are located~~ according to their strategic noise mapping ~~undertaken by Defra~~. The summary of the NIAs are listed in Table 6.7 below.

Table 6.7: Location and distances of NIAs from the Scheme (information as obtained from Extrium Noisemap Viewer and online mapping sources)

NIA ID	Location	Source of noise	Distance in metres
5750~~*~~	The Poplars, Brook Street. Adjacent to M25 J28 southbound on-slip	Road	On junction 28 (approx. 12 m)
13448	61-63 Brook Street, at intersection with Roman Road	Road	260
5749	Nags Head Lane adjacent to the M25	Road	400
5752	Leonard Way and Wingrave Court	Road	810

NIA ID	Location	Source of noise	Distance in metres
RI_596	Railway line close to Mascalls Lane, Shevon Way and Southall Way	Rail	920
13446	London Road between The Grove and Jason Close	Road	1000

6.7.7 The locations of the NIAs in proximity to the Scheme are shown in the Environmental constraints plan (Figure 2.1) and are also shown in Figure 6.1.

Baseline noise monitoring

6.7.8 A series of noise surveys have been undertaken to ascertain the baseline noise levels at noise sensitive receptors within the study area of the Scheme. The noise surveys have been completed using one of the following methods:

- Unattended continuous noise monitoring for at least one week, where noise levels were logged in one-hour intervals. A weather station was also installed at each continuous monitoring station so that noise levels corresponding with periods of adverse weather conditions, such as precipitation and wind speeds exceeding 5 m/s, could be excluded from the results.
- Attended short-term measurements following the Shortened Measurement Procedure stated in the CRTN. This requires three measurements at the same location in consecutive one-hour periods (10:00 to 17:00) of 15 minutes duration, from which the daytime $L_{A10,18h}$ can be calculated. Weather conditions and the main noise sources present during the measurements were noted.

6.7.9 For both measurement methods, the noise measurements were completed in accordance with BS 7445:2003 Part 1[27]. The sound level meter was tripod mounted with a microphone height of 1.5 m above ground level. All of the measurements were completed under free-field conditions (more than 3.5 m from reflective surfaces other than the ground).

6.7.10 The noise measurements were completed using Class 1 integrating sound level meters that were field calibrated before and after the measurements. The instrumentation used was within two years of their most recent laboratory calibration testing.

6.7.11 A summary of the measured noise levels is provided in Table 6.8 and Table 6.9, with detailed results provided in Appendix 6.1. A map showing baseline noise survey locations is provided in Figure 6.4. Local Authorities were contacted to define the outline baseline noise monitoring prior to the surveys commencing and agreed to the monitoring locations.

[27] British Standards Institution (2003). BS 7445:2003 Description and measurement of environmental noise, Part 1 - Guide to quantities and procedures. London: BSI

Table 6.8: Summary of survey results at each continuous monitoring location

Location	Survey dates	Weekday noise levels, dB				Main sources
		$L_{A10,18h}$ (day)	$L_{Aeq,16h}$ (day)	$L_{A90,16h}$ (day)	$L_{Aeq,8h}$ (night)	
L1 – Grove Farm	14–23d June 2019	66*	64*	61*	61	A12, M25
* daytime noise levels between 10:00 and 16:00 on Monday 17th June 2019 are excluded from calculation due to atypical noise levels						

Table 6.9: Summary of daytime survey results at each short-term measurement location

Location	Survey date	Noise levels, dB				Main sources
		$L_{A10,18h}$	$L_{Aeq,3h}$	$L_{A90,3h}$	$L_{Amax,3h}$	
S1	20/06/2019	69	67	65	79	A1023, M25
S2	20/06/2019	68	68	67	76	M25
S3	20/06/2019	73	71	67	88	A12

6.7.12 The primary noise sources noted at S1 were road traffic from A1023 Brook Street, A12 and M25. During the daytime road noise from A1023 was most prominent however during the night-time noise from M25 prevailed. One aircraft flyover was noted during the daytime. Near-field traffic along Vicarage Close was infrequent.

6.7.13 The primary noise source noted at S2 during the daytime and night-time was road traffic from M25. Road traffic along Nags Head Lane was infrequent. Two aircraft flyovers were noted during the daytime.

6.7.14 The primary noise sources noted at S3 were road traffic from A12 and M25. During the daytime road noise from A12 was most prominent however during the night-time noise from M25 prevailed. One aircraft flyover was noted during the daytime.

6.7.15 At locations S1, S2 and S3 the loudest noise maxima were noted from passing HGVs and vehicles fitted with aftermarket exhausts.

6.7.16 As the measured noise levels are representative of discrete locations, this information has been supplemented with information from Defra~~EFRA~~ strategic noise maps, which are publicly available.

6.7.17 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 Figures 6.2 and 6.3. A map showing the locations of the baseline noise surveys for comparison is provided in Figure 6.4.

6.8 Potential impacts

Construction

Construction noise

6.8.1 The proposed construction activities associated with the Scheme have the potential to give rise to adverse or significant adverse impacts at sensitive receptors. An assessment has been undertaken to calculate the construction noise levels that are expected to be generated during key phases of work.

6.8.2 The buildability contractor's programme of work and associated equipment lists for each construction activity have been provided. Further information about the plant lists is available in Appendix 6.2. This information has been used to calculate the construction noise levels as described in section 6.4.5 above.

6.8.3 The construction programme indicates that the construction phase will last 32 months and will consist of the following main activities that have the potential to generate noise and/or vibration:

- Site enabling works
- Utilities diversion
- Site compounds set-up
- Site compounds maintenance
- Cadent gas diversion works and UKPN diversion works
- Traffic management
- Earthworks
- Drainage
- Retaining walls
- Road formation level
- Paving and surface course
- Ground stabilisation
- Abutments and bridges
- Embankments
- Watercourse realignment
- Install culvert
- Assembly of beams and construction of bridge deck
- Road construction
- Installation of the road restraint system
- Installation of ancillary infrastructure
- Road remarking
- Disassemble gantry structure

- Demolish gantry base
- Construct piled foundation for gantry
- Construct gantry base
- Install steel works
- Install/remove ~~sing~~ sign plates and equipment
- Landscaping
- Construct piling mats
- Trimming piles
- Capping beam / RECO walls
- Abutment diaphragm walls
- String course
- Environmental bund constructed from site-won construction material

6.8.4 Traffic management (TM) will be undertaken during night-time. Some of the other activities have the potential for limited night-time works to minimise impacts on traffic, such as gantries, surfacing, road remarking and constructing the tie-ins to the existing network. There is also some stationary plant operating 24/7 such as the generator at both of the site compounds.

6.8.5 The predicted construction noise levels at a variety of distances up to 300 m from the construction works are presented in Table 6.10 for each of the sub-activities identified in the construction programme. The plant list assumptions are provided in Appendix 6.2. The significance of these predicted noise levels is discussed in section 6.10 below.

Table 6.10: Predicted construction activity noise levels

Construction activity	Predicted construction noise levels at different distances (L_{Aeq}, dB)								
	10 m	25 m	50 m	75 m	100 m	150 m	200 m	250 m	300 m
Site enabling works	82	75	67	63	59	55	52	50	48
Utilities diversion	79	71	64	60	56	52	49	46	44
Site compound set-up	92	84	77	72	69	65	62	59	57
Site compounds maintenance	82	74	67	62	59	55	52	49	47
Cadent Gas and diversion works UKPN works	85	77	70	65	62	58	55	52	50
Traffic management	76	68	61	56	53	49	45	43	41

Construction activity	Predicted construction noise levels at different distances (L_{Aeq}, dB)								
	10 m	25 m	50 m	75 m	100 m	150 m	200 m	250 m	300 m
Earthworks	89	82	74	70	66	62	59	57	55
Drainage	85	77	70	65	62	58	55	52	50
Retaining walls	83	75	68	63	60	56	53	50	48
Road formation level	90	82	75	71	67	63	60	57	55
Paving and surface course	87	79	72	67	64	60	57	54	52
Ground stabilisation	81	73	66	61	58	54	51	48	46
Abutments and bridges	83	75	68	63	60	56	53	50	48
Embankments	90	82	75	71	67	63	60	57	55
Watercourse realignment	89	82	74	70	66	62	59	57	55
Install culvert	86	78	71	66	63	59	56	53	51
Assembly of beams and construction of bridge deck	87	79	71	67	64	59	56	54	52
Road construction	91	83	75	71	68	63	60	58	56
Install road restraint system	83	75	67	63	60	55	52	50	48
Installation of ancillary infrastructure	85	78	70	66	62	58	55	53	51
Road remarking	82	74	66	62	59	54	51	49	47
Disassemble gantry structure	86	78	71	66	63	59	55	53	51
Demolish gantry base	89	81	73	69	66	62	58	56	54
Construct piled foundation	85	78	70	66	62	58	55	53	51

Construction activity	Predicted construction noise levels at different distances (L_{Aeq}, dB)								
	10 m	25 m	50 m	75 m	100 m	150 m	200 m	250 m	300 m
Construct gantry base	80	72	65	60	57	53	50	47	45
Install steel works	85	78	70	66	62	58	55	53	51
Install/Remove sign plates and equipment	83	75	67	63	60	56	52	50	48
Landscaping	79	71	64	59	56	52	49	46	44
Create piling mats	85	77	69	65	62	57	54	52	50
Trimming piles	89	81	73	69	66	61	58	56	54
Capping beam / RECO walls	85	77	69	65	62	58	54	52	50
Abutment diaphragm walls	79	71	64	59	56	52	49	46	44
String course	83	75	67	63	60	55	52	50	48

Legend			
	75 dB L_{Aeq} or higher		55.0 to 64.9 dB L_{Aeq}
	65.0 to 74.9 dB L_{Aeq}		45.0 to 54.9 dB L_{Aeq}

6.8.6 Table 6.10 shows that the construction activity that was predicted to generate the highest noise levels was site compound set-up, with noise levels in excess of 75 dB L_{Aeq} within 50 m of the works. The lowest construction noise levels were predicted for traffic management, utility diversions, ~~and~~ landscaping and abutment diaphragm walls, which were predicted construction noise levels less than 65 dB L_{Aeq} within 50 m of the works.

6.8.7 As the construction programme indicates that several construction activities would occur in parallel to expedite the build, construction noise levels were predicted at a selection of sensitive receptors across the study area to establish the combined noise levels from construction activities occurring simultaneously as shown in the proposed construction programme. Table 6.11 shows the range of predicted construction noise levels at the selected noise sensitive receptors, along with their estimated ambient noise levels to the nearest decibel based on either the measurements from the baseline noise surveys or the data published in the Defra strategic noise maps, as shown in Figure 6.2 and Figure 6.3.

~~6.8.7~~6.8.8 The calculations have examined potential noise levels on a ~~detailed~~ month by month basis to determine the highest noise levels likely in any month. These predictions are included in Tables 6.2 and 6.4 in Appendix 6.2.

Table 6.11: Combined construction activity noise levels

Sensitive receptor	Estimated ambient noise levels (L_{Aeq}, dB)		Daytime construction noise levels (L_{Aeq}, dB)		Night-time construction noise levels (L_{Aeq}, dB)	
	Day	Night	Lowest	Highest	Lowest	Highest
Grove Farm, CM14 5NG	64[1]	61[1]	53	78	0	75
Maylands Cottages, RM3 0AZ	60[2]	55[2]	61	75	0	60
Caravan Park, Putwell Bridge RM3 0AW	71[1]	64[1]	56	7~~5~~7	0	61
17 Colchester Road, RM3 0AW	70[2]	65[2]	58	7~~2~~3	0	64
12 Craven Gardens, RM3 0DF	60[2]	55[2]	51	61	0	53
Gardens of Peace Muslim Cemetery	62[2]	55[2]	53	6~~2~~4	0	59
10 Woodstock Avenue, RM3 9NF	60[2]	55[2]	48	58	0	51
42 Woodstock Avenue, RM3 9NF	60[2]	55[2]	49	58	0	53
63 Brook Street, CM14 5NA	67[1]	62[1]	44	58	0	56
60 Brook Street, CM14 5ND	70[2]	65[2]	46	59	0	61
13 Nags Head Lane, CM14 5NJ	68[1]	61[1]	30	4~~3~~4	0	40
31 Wingrave Cres, CM14 5PA	60[2]	55[2]	36	50	0	47
7 Leonard Way, CM14 5PD	60[2]	55[2]	35	49	0	46
12 Talbrook, CM14 4PY	60[2]	55[2]	32	4~~6~~7	0	44
Weald Hall, Wigley Bush Lane, CM14 5QP	60[2]	55[2]	35	~~49~~50	0	47
Notes~~-~~: 1 Measurement data from the baseline noise surveys 2 Data from Defra strategic noise maps						

~~6.8.8~~6.8.9 The predictions provided in Table 6.11 indicate that sensitive receptors close to the main site compound and new A12 off-slip are most likely be affected by high noise levels from construction works. This includes receptors close to Grove Farm that would be affected by earthworks occurring very close to the receptor and construction of the new A12 off-slip, and receptors close to Maylands

Cottages that would be affected by site compound set-up and maintenance activities.

~~6.8.9~~6.8.10 The predicted night-time construction noise levels are also shown in Table 6.11. The highest construction noise levels during the night were associated with road paving works at the new A12 off-slip.

~~6.8.10~~6.8.11 Recommended management and mitigation measures to minimise potential vibration impacts are outlined in section 6.9.

Construction vibration

~~6.8.11~~6.8.12 Based on the buildability contractor's programme, the following vibration-generating activities were identified:

- Rotary bored piling for the new bridges and gantries
- Vibratory rolling plant for ground compaction and road surfacing works~~.~~

~~6.8.12~~6.8.13 Piling using the rotary bored method results in low vibration levels that are unlikely to be high enough to give rise to complaints or cause cosmetic damage. On this basis it is expected that there would not be a vibration impact in proximity to sites using the rotary bored technique or other methods that result in low vibration levels.

~~6.8.13~~6.8.14 Vibration levels from ground compaction are generally imperceptible at distances greater than around 20 m from the source. The only property within this distance and potentially impacted by ground compaction works is Grove Farm located adjacent to the new A12 off-slip. To avoid any perceptible vibration from ground compaction at Grove Farm, no vibratory rolling within 20 m is recommended as outlined in section 6.9.11.

~~6.8.14~~6.8.15 The expected construction vibration levels from bored piling and vibratory rolling are well below the criterion for potential risk of cosmetic damage to buildings at all buildings for all construction activities.

~~6.8.15~~6.8.16 Recommended management and mitigation measures to minimise potential vibration impacts are outlined in section 6.9.

Construction traffic

~~6.8.16~~6.8.17 There will be a number of HGV movements (approximately 75 HGV deliveries each day) to/from site during construction of the Scheme for the import and removal of materials and equipment. There will also be approximately 10 light vehicle movements per day for staff movements and other smaller deliveries.

~~6.8.17~~6.8.18 It is considered likely that construction traffic would access both of the construction compounds and various works sites from the M25 and A12.

~~6.8.18~~6.8.19 The bidirectional traffic flow of M25 is approximately 143,000 vehicles of which approximately 27,000 are HGVs. The bidirectional traffic flow of A12 is approximately 54,500 vehicles of which approximately 2,350 are HGVs.

~~6.8.19~~6.8.20 The construction traffic of the Scheme is very low compared to the traffic of the M25 and A12, and a change in traffic flow of 25% is needed to increase noise by 1 dB $L_{A10,18h}$. The construction traffic flows would not increase existing

traffic flows by this magnitude on the M25 and A12, therefore unlikely to give rise to a perceptible change in traffic noise at the nearest receptors.

Operation

Noise

6.8.206.8.21 Detailed predictions have been carried out for a total of 1,065 residential receptors identified within the study area; together with a total of ~~three~~ four non-residential noise sensitive receptors comprising ~~a~~ Harold Park Baptist Church, Holiday Inn, Gardens of Peace Cemetery and the~~a~~ Club House at Maylands Golf Club. Results at specific selected receptor locations are presented in Appendix 6.3.

6.8.216.8.22 The sections below detail the short-term and long-term impacts of the Scheme, including the proposed environmental bund situated to the south-east of Maylands golf course. For short-term impacts, a comparison is made between the Do something and Do Minimum scenarios in 2022, the opening year of the Scheme. For long-term impacts as a result of the Scheme, a comparison is made between the Do Minimum scenario in 2022 and the Do Something scenario in 2037. Long-term Do Minimum impacts without the Scheme have also been considered.

6.8.226.8.23 DMRB reporting tables for noise nuisance are included in Appendix 6.4.

Daytime road traffic noise changes

6.8.236.8.24 Table 6.12 to Table 6.14 show the predicted changes in daytime noise levels (06:00 to 00:00) for residential and non-residential receptors in the study area. The predicted daytime noise levels throughout the study area, including across Maylands Golf Club, are shown in noise change contours provided in Figures 6.9 and 6.10 to illustrate how road traffic noise levels change in the short-term and the long-term.

Table 6.12: Short-term traffic noise magnitude changes with the Scheme

Change in noise level		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	Negligible	167	1
	1 - 2.9	Minor	0	0
	3 - 4.9	Moderate	0	0
	≥ 5	Major	0	0
No change	0	No change	355	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 0.9	Negligible	543	3~~2~~
	1 - 2.9	Minor	0	0
	3 - 4.9	Moderate	0	0
	≥ 5	Major	0	0

6.8.246.8.25 Table 6.12 shows that when the Scheme becomes operational, most properties will be subject to negligible decrease in noise levels. No change is

expected at 355 properties and a further 167 properties will be subject to a negligible increase in noise level.

~~6.8.25~~6.8.26 The predicted noise levels at NIAs will change by less than 1 dB $L_{A10,18h}$ in the opening year of the Scheme.

~~6.8.26~~6.8.27 The predicted road traffic noise levels in the opening year without the Scheme were below 55 dB $L_{A10,18h}$ at Harold Park and residential areas located near Brook Street. Road traffic noise levels above 68dB $L_{A10,18h}$ were predicted in close proximity to most roads, including the A12, M25, Mascalls Lane and Nags Head Lane, and generally within around 100 m of junction 28. With the Scheme, the predicted road traffic noise levels were similar, noting that noise levels below 55 dB were predicted approximately 500 m from the proposed slip road. Operational noise results for a representative sample of receptors is shown in Appendix 6.3.

~~6.8.27~~6.8.28 The predicted changes in daytime road traffic noise levels in the long-term with and without the Scheme are shown in Table 6.13 and Table 6.14, and Figures 6.10 and 6.11.

Table 6.13: Long-term traffic noise magnitude changes without the Scheme

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	919	3
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	65	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	81	1~~0~~
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

Table 6.14: Long-term traffic noise magnitude changes with the Scheme

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	911	3
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	48	0
Decrease in noise level, $L_{A10,18h}$ dB	0.1 - 2.9	Negligible	106	1~~0~~
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
	≥ 10	Major	0	0

~~6.8.28~~6.8.29 Table 6.13 and Table 6.14, along with Figures 6.10 and 6.11 show that for most of the receptors, the pattern of long-term changes to road traffic noise levels with and without Scheme are similar, with most receptors being subject to negligible increase in noise levels.

~~6.8.29~~6.8.30 With the Scheme it is predicted that 911 properties will be subject to a negligible increase in noise level. At 48 properties the prediction shows no change in noise level and a further 106 will be subject to negligible decrease.

~~6.8.30~~6.8.31 No long-term noise increases greater than 1 dB $L_{A10,18hr}$ were predicted at any of the NIAs in the study area.

~~6.8.31~~6.8.32 The changes at non-residential noise sensitive receptors are negligible.

6.8.33 The predicted road traffic noise levels without the Scheme were below 55 dB $L_{A10,18h}$ at Harold Park and residential areas located near Brook Street. Road traffic noise levels above 68 dB $L_{A10,18h}$ were predicted close to any road, including the A12, M25, Mascalls Lane and Nags Head Lane, and within 100 m of junction 28. With the Scheme, the predicted road traffic noise levels were similar, noting that noise levels below 55 dB were predicted approximately 500 m from the proposed loop road. Results at a representative sample of receptors is shown in Appendix 6.3.

Night-time road traffic noise changes

~~6.8.32~~6.8.34 The change in road traffic noise levels at night throughout the study area has also been considered in the appraisal of the Scheme.

~~6.8.33~~6.8.35 Table 6.15 and Table 6.16 show the change in night-time noise levels in the long-term for properties predicted noise levels above 55 dB L_{night}, as required by the DMRB 11:3:7.

Table 6.15: Long-term traffic night-noise magnitude changes without the Scheme

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, L_{night} dB	0.1 - 2.9	Negligible	123	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	2	0
Decrease in noise level L_{night} dB	0.1 - 2.9	Negligible	21	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
	≥ 10	Major	0	0

Table 6.16: Long-term traffic night-noise magnitude changes with the Scheme

Change in noise level, dB		DMRB impact magnitude	Number of dwellings	Number of other sensitive receptors
Increase in noise level, L_{night} dB	0.1 - 2.9	Negligible	92	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0
No change	0	No change	1	0
Decrease in noise level L_{night} dB	0.1 - 2.9	Negligible	25	0
	3 - 4.9	Minor	0	0
	5 - 9.9	Moderate	0	0
	≥ 10	Major	0	0

~~6.8.34~~6.8.36 Table 6.15 and Table 6.16 show that no noise sensitive receptors with noise levels above 55 dB L_{night} were predicted are to have a noise increase greater than 3 dB.

~~6.8.35~~6.8.37 Road traffic noise levels exceeding 55 dB L_{night} were predicted within 450 m of junction 28 and 150 m of the proposed loop road. Properties adjacent to the A12 and Brook Street also have been predicted noise levels above 55 dB depending on their proximity to the edge of the road.

Changes to road traffic noise levels in the wider area

~~6.8.36~~6.8.38 To determine the potential effects within the wider area, the Basic Noise Levels (BNLs) were calculated using the methodology in the CRTN for road links outside of the detailed calculation area.

~~6.8.37~~6.8.39 In the short-term and the long-term, the BNL calculations indicated that there are no affected road links outside of the DMRB detailed calculation area.

Vibration

~~6.8.38~~6.8.40 The long-term change in airborne vibration nuisance for road traffic as a result of the Scheme is shown in

~~6.8.39~~ Table 6.17 for properties within 40 m of ~~the~~ roads ~~included~~ in the study area and ~~, as required by DMRB. The sensitive receptors reported in~~

~~6.8.40~~6.8.41 ~~Table 6.17 are those~~ with ~~where~~ road traffic noise levels above 58 dB $L_{A10,18h}$ ~~, were predicted during the operational phase of the Scheme~~as required by DMRB.

Table 6.17: Traffic airborne vibration nuisance

Change in nuisance level		Number of dwellings	
		Do Minimum	Do Something
Increase in nuisance level	< 10%	4	4
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0
No change	0%	0	0
Decrease in nuisance level	< 10%	0	0
	10 < 20%	0	0
	20 < 30%	0	0
	30 < 40%	0	0
	> 40%	0	0

~~6.8.41~~6.8.42 Table 6.17 shows that the predicted long-term traffic-induced airborne vibration nuisance levels are the same with and without the Scheme. All four properties ~~within 40 m of the roads included in the study area~~ would be subject to a less than 10% increase in nuisance level regardless of whether the Scheme is built. On this basis, it is considered that the Scheme would not adversely affect airborne vibration levels at properties in the study area.

~~6.8.42~~6.8.43 In summary there are no adverse impacts from airborne or ground-borne vibration predicted due to road traffic from the Scheme.

6.9 Design, mitigation and enhancement measures

Construction

6.9.1 An Outline Construction Environmental Management Plan (CEMP) (application document TR010029/APP/7.2) and Register of Environmental Actions and Commitments (REAC) (application document TR010029/APP/7.3) have been developed for the Scheme which outline all the mitigation measures listed in this section.

6.9.2 To mitigate any potential noise and vibration impacts during the construction phase, the Principal Contractor should consult with the Environmental Health Departments at the relevant local authorities to obtain guidance on their requirements for managing and controlling noise and vibration from construction works.

6.9.3 The CEMP, based on the Outline CEMP, shall be prepared and implemented by the Principal Contractor in consultation with the local authorities prior to the commencement of construction works. The CEMP shall include the following:

- 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

6.9.4 A Traffic Management Plan will be prepared by the Principal Contractor to manage the routing of construction traffic and road diversions during the construction phase of the Scheme.

6.9.5 The Principal Contractor also will have the option to apply for a Section 61 consent under the Control of Pollution Act 1974 for some construction works, particularly if night-time working is proposed. This should be discussed when engaging with the local authorities prior to works commencing and any additional assessment undertaken at that stage.

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

6.9.7 Good stakeholder relations are often the most effective way to manage potential noise impacts on-site. Therefore, the Principal Contractor shall 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 shall be effectively recorded, investigated and addressed.

6.9.8 In addition, the Principal Contractor shall implement good working practices that will minimise impacts to local residents and ecological receptors (as outlined in the Outline CEMP and REAC). Examples include:

- All night-time works should be avoided as far as reasonably practicable.
- All vehicles and plant 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 turned off 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 not be louder than the noise levels provided in Annex C and D of BS 5228 Part 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.
- Cleaning of concrete mixers should not be undertaken by hammering the drums.
- When handling materials, care shown not to drop materials from excessive heights.
- Speed restrictions should be implemented for all worksites and haul routes for safety, but also to control noise emissions.

6.9.9 Rotary bored piling methods should, where possible, be used for all piling activities related to bridges and gantries construction. If ground conditions on site require a different piling method this would need to be assessed at that time and discussed with the local authority.

6.9.10 A temporary noise barrier providing a minimum of 10 dB insertion loss (i.e. completely blocking line-of-sight) will be provided for Grove Farm and Maylands Cottages to shield these properties from construction activities and avoid significant adverse effects. In the case of Maylands Cottages, this would be achieved through the inclusion of solid site hoarding around the main construction compound.

6.9.11 Dead rolling is recommended for all ground compaction works with~~-~~in 20 m of ~~the~~ receptors to avoid perceptible vibration, particularly adjacent to Grove Farm.

6.9.12 Site compound entrance and all traffic within the site compound should be as far toward the east as possible to minimise impacts on Maylands Cottages.

6.9.13 The site office and car parking should be positioned at the western end of the site compound to ensure the noise generating activities are as far away from the nearest sensitive receptor Maylands Cottages. Associated stationary noise sources to the site office should be located on the eastern façade in order to shield noise towards the west.

6.9.14 With appropriate mitigation in place significant adverse effects will be eliminated. With this mitigation in place, it may not be possible to eliminate all adverse effects. However, best practice, considerate working hours as well as frequent and open communications with stakeholders will help to reduce the overall impact of construction noise and vibration.

Operation

6.9.15 The Scheme has noise mitigation measures inherent in the design to minimise the potential for adverse effects occurring. The inherent ~~se~~ mitigation measures com~~prise~~~~nsist of~~ low noise road surfacing.

6.9.16 There are sections of the A12 and M25 within the study area that already have a low noise surfacing installed. By 2022, all these surfaces will have been in place for several years and are therefore assumed to be performing less effectively.

6.9.17 In the opening year scenarios, the unchanged low noise surfaces were modelled with a correction of -2.5 dB, with all altered roads in the 'Do Something' scenario modelled as -3.5 dB; when compared with a standard hot rolled asphalt road.

6.9.18 Any road resurfacing that takes place prior to the Scheme opening or during routine maintenance will ensure that road roughness is minimised and will reduce the likelihood of vibration effects arising at sensitive receptors.

6.10 Assessment of effects

Significant effects

Construction noise

6.10.1 Based on the construction noise levels predicted in section 6.8 and the month by month calculations presented in Tables 6.2 and 6.3 in Appendix 6.2, an assessment of the potential construction noise significance has been undertaken.

6.10.2 The predicted construction noise levels shown in Table 6.10 (in section 6.8) indicate that a potential significant effect could occur at sensitive receptors during the daytime within 50 m of the loudest construction activities, provided that the noise levels exceed the SOAEL for a significant time period. Table 6.11 identified several sensitive receptors where the SOAEL would be exceeded from daytime and night-time working based on the predicted activity noise levels, the construction programme and phasing of activities. Taking into account the duration of the loudest combinations of activities and whether these would occur for a significant time period, Table 6.18 identifies the sensitive receptors where significant adverse effects and adverse effects are likely without mitigation.

Table 6.18: Significance of construction noise levels (without mitigation)

Daytime construction noise		Night-time construction noise	
Significant adverse effects	**Adverse effects**	**Significant adverse effects**	**Adverse effects**
• Grove Farm • Maylands Cottages • Caravan Park, Putwell Bridge	• Gardens of Peace • ~~Caravan Park, Putwell Bridge~~ • 17 Colchester Road • 12 Craven Garden	• Grove Farm • Maylands Cottages • (Gardens of Peace*)	None ~~Maylands Cottages~~
*Receptor not in use at night			

6.10.3 Table 6.18 shows that significant adverse effects would occur from daytime construction works at receptors close to Grove Farm, ~~and~~ Maylands Cottages and the Caravan Park without mitigation.

~~6.10.3~~6.10.4 The significant effect at Grove Farm, which is located close to the intersection of A12 off-slip and M25 on-slip, is attributed to multiple construction activities on the new A12 off-slip, M25 on-slip and the construction of the haul road. The SOAEL exceedances are expected to occur for more than 40 days in a 6 months construction period.

6.10.5 The significant effect at Maylands Cottages, which is located adjacent to the main site compound, is attributed to the construction and maintenance of ~~this~~ the main site compound and ~~the site compound maintenance~~construction of the proposed environmental bund. For the compound setup ~~and environmental bund construction~~, the worst-case daily noise levels are expected when the activity occurs close to the western boundary, which is estimated to last not more than two weeks and the noise levels would be lower when the activity occurs further east within the site. For site compound maintenance, noise levels exceeding the SOAEL are expected to occur throughout the construction duration. For the environmental bund construction, the solid hoarding around the construction compound would reduce bund construction noise levels so the potentially significant effects would not occur.

~~6.10.4~~6.10.6 The significant effect at the Caravan Park is due to the Cadent gas diversion works taking place in the area adjacent to the caravan park. This would be mitigated by a solid hoarding between the caravan park and the works, either at the boundary of the caravan park or the boundary of the works area.

~~6.10.5~~6.10.7 Adverse effects would occur at properties where the LOAEL is exceeded, affecting sensitive receptors such as ~~Caravan Park~~The Gardens of Peace~~, Putwell Bridge, and~~ 17 Colchester Road and 12 Craven Garden. The adverse effects at 17 Colchester Road and 12 Craven Garden are from compound construction and then from works on the A12 off-slip. The adverse effects at the Gardens of Peace are from the different activities on the A12 off-slip, and for the construction of the environmental bund.

6.10.8 Night-time noise levels above the significant effect ~~adverse effects~~ threshold are predicted for Grove Farm due to night-time paving and road construction activity on adjacent A12 off-slip and on M25 on-slip. However, these works do not meet the duration criteria necessary, as presented in paragraph 6.5.8, to be considered a significant adverse effect.

~~6.10.6~~6.10.9 Maylands Cottages and the Gardens of Peace are also affected by night time noise from tie-in works on the A12 off-slip. ~~-~~It is noted that the Gardens of Peace would not be in use during the night time, and this receptor is not considered any further for consideration of night time impacts. Noise levels at Maylands Cottages would be mitigated through the solid hoarding around the construction compound. ~~Also, adverse effects would occur at sensitive receptors at Maylands Cottages due to night-time road paving activity carried out on the nearest section of A12 off-slip, however, these do not meet the duration criteria necessary, as presented in paragraph 6.5.8, to be considered a significant adverse effect.~~

6.10.10 Receptors further from the works on the Havering side of the M25 are shown not to have impacts during daytime or night-time, including on Woodstock Avenue.

6.10.11 No noise impacts are predicted for receivers during daytime or night-time on the Brentwood side of the M25, including ~~close to 63~~ Brook Street, ~~60 Brook Street and 13~~ Nags Head Lane, Wingrave Crescent, Leonard Way, Talbrook and Wigley Bush Lane ~~during daytime or night-time~~.

~~6.10.7~~6.10.12 Recommended noise management and mitigation measures to minimise potential impacts are outlined in section 6.9. The residual effects with implemented management and mitigation measures are reported in Table 6.20.

Construction vibration

6.10.13 Based on the predictions shown in section 6.8, significant adverse effects from construction vibration are unlikely due to the distance and duration of vibration generating works. However, without vibration mitigation, there is a potential for short-term vibration impacts at Grove Farm adjacent to the new A12 off-slip from ground compaction during Earthworks activity occurring within 20 m of the property. Due to the short duration of these potential vibration impacts, ~~no~~ significant adverse effects are not anticipated.

~~6.10.8~~6.10.14 Recommended vibration management and mitigation measures to minimise potential impacts are outlined in section 6.9. The residual effects with implemented management and mitigation measures are reported in the residual effects section below.

Construction traffic

~~6.10.9~~6.10.15 No significant adverse effects, adverse effects or perceptible noise increases resulting from construction traffic are expected during the construction phase of the Scheme.

Operational noise

~~6.10.10~~6.10.16 As described in section 6.7.17, a significant adverse effect occurs if the LOAEL is exceeded and a moderate or major adverse change to the road traffic noise levels is predicted, or if the predicted noise levels exceed the SOAEL and increase by at least 1 dB.

~~6.10.11~~6.10.17 Table 6.19 identifies the general locations where significant effects are predicted, taking into account the following factors:

- Comparing short-term and long-term changes in road traffic noise levels.
- Comparing day-time and night-time noise levels with LOAEL and SOAEL.
- The sensitivity and circumstances of the receptor (for example, if it is located within a NIA).
- The proportion of sites affected by noise changes (for example, designated sites, parks and open spaces).
- How the Scheme may affect the acoustic character of the study area.
- The likely perception of changes in noise by local residents, which may be influenced by visibility of the Scheme from their properties and landscaping changes.
- Whether the effect is adverse or beneficial.

Table 6.19: Significance of road traffic noise in the operational phase

Receptor(s)	DMRB impact magnitude		Conclusion of significance of environmental effect	Justification of significance conclusion
	Opening year (2022)	Future year (2037)		
London Road (CM14 4NP), Fairford Way (RM3 9YR), Brook Street (CM14 5LZ), Mascalls Lane (CM14 5LR), Nags Head Lane (CM14 5NJ), Colchester Road (RM3 0AZ), Leonard Way (CM14 5PD), Spital Lane (CM14 5PG), Wingrave Crescent (CM14 5PA), NIA 13446, NIA 13448, NIA 5750*, NIA 5749, NIA 5752	Negligible	Negligible	Not significant	All of the properties in this area are expected to experience negligible increases in noise in both opening and future years. At some of the properties road traffic noise levels without the Scheme were above the SOAEL and are expected to increase by up to 1dB in the Opening and Future year. Changes of this magnitude are not perceptible and are not considered significant.
Brook Road (CM14 4PT), Jason Close (CM14 4PG), Lilley Close (CM14 4PP), Selwood Road (CM14 4PX), Talbrook (CM14 4PY), Westbourne Drive (CM14 4PH), NIA 5751	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Mascalls Gardens (CM14 5LT), Southall Way (CM14 5LS), NIA RI_596	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
River Road (CM14 5NU), Spital Lane (CM14 5NT), Tern Way (CM14 5NY), The Grove (CM14 5NS),	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Wigley Bush Lane (CM14 5QP)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.

Receptor(s)	DMRB impact magnitude		Conclusion of significance of environmental effect	Justification of significance conclusion
	Opening year (2022)	Future year (2037)		
Ingreway (RM3 0BN), Maylands Way (RM3 0BG)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Craven Gardens (RM3 0DF), Mount Avenue (RM3 0DE)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Amelle Gardens (RM3 0HW), Greenway (RM3 0HH), Homeway (RM3 0HD), Willow Way (RM3 0HE)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Church Road (RM3 0JX)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Elgin Avenue (RM3 0YP), Halidon Rise (RM3 0YL), Harold Court Road (RM3 0YU), Thurso Close (RM3 0YS)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Mawbery Grove (RM3 9FB)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Kenilworth Avenue (RM3 9NE), Woodstock Avenue (RM3 9NF)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Dagnam Park Drive (RM3 9XH), Dagnam Park Gardens (RM3 9XJ), Petersfield Avenue (RM3 9XA)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.
Dagnam Park Close (RM3 9YL), Dagnam Park Square (RM3 9YP), Fairford Close (RM3 9YS), Sheffield Drive (RM3 9YH)	Negligible	Negligible	Not significant	The criteria for a significant effect outlined in section 6.4.5 were not met.

6.10.126.10.18 Table 6.19 shows that no significant adverse effects have been identified. At some of the properties, road traffic noise levels without the Scheme were above the SOAEL and are expected to increase by up to 1 dB in the opening and future year. Changes of this magnitude are not perceptible and are not considered significant.

Vibration

6.10.136.10.19 The airborne vibration nuisance assessment provided in section 6.7.17 indicated that the Scheme would not adversely affect airborne vibration nuisance levels, and no significant adverse effects are expected.

6.10.146.10.20 No significant adverse effects are likely from ground-borne vibration as all new roads will have a smooth road surface and be located at least 5 m from properties.

Residual effects

Construction noise

6.10.156.10.21 Table 62.4 and 62.5 of Appendix 6.2 shows the predicted highest daily daytime and night-time construction noise levels from month to month with the recommended mitigation as outlined in section 6.9.

6.10.166.10.22 Table 6.20 shows the locations where residual significant effects are expected after implementation of the recommended mitigations as outlined in section 6.9.

Table 6.20: Construction noise residual effects

Daytime construction noise		Night-time construction noise	
Significant adverse effects	**Adverse effects**	**Significant adverse effects**	**Adverse effects**
None	• Maylands Cottages • Grove Farm • Caravan Park, Putwell Bridge • Gardens of Peace • 17 Colchester Road • 12 Craven Garden	None	• Grove Farm

6.10.23 With the recommended management and mitigation measures implemented at the site compound, receptors at Maylands Cottages will only have short-term (less than two weeks) predicted high daytime noise levels before the solid boundary fence along the western boundary is installed and therefore it is expected that the duration required for a significant adverse effect, as presented in paragraph 6.5.8, will not be exceeded. The construction compound hoarding also mitigates night time impacts at Maylands Cottages from tie-in works.

6.10.176.10.24 For the remainder of the construction phase no exceedances of the SOAEL are predicted and this receptor is not considered to experience significant effects.

~~6.10.18~~6.10.25 With the recommended management and mitigation measures implemented at Grove Farm, as presented in Section 6.9, no daytime exceedances of the SOAEL are predicted. At night, with mitigation, there would be limited residual impacts ~~of significant magnitude above~~above the significance threshold ~~SOAEL~~ at Grove Farm caused by night-time paving and road construction activities during the tie-in of the A12 off-slip with the roundabout. However, as these activities are not expected to maintain noise levels of significant magnitude for durations that trigger a significant effect, as presented in paragraph 6.5.8, there are no significant residual effects anticipated at Grove Farm.

Construction vibration

~~6.10.19~~6.10.26 With the recommended management and mitigation measures as outlined in section 6.9, receptors at Grove Farm are not anticipated to experience perceptible vibration levels from ground compaction.

Construction traffic

~~6.10.20~~6.10.27 As discussed in section 6.7.17 no significant effects were shown, there are no residual impacts from construction traffic with mitigation measures in place.

Operation noise

~~6.10.21~~6.10.28 As discussed in section 6.7.17 and section 6.10, no noise mitigation measures are proposed other than those already included in the design of the Scheme. This is because no significant adverse effects were identified.

Operation vibration

~~6.10.22~~6.10.29 As discussed in section 6.7.17, there are no significant operational vibration impacts, therefore there are no residual vibration impacts.

6.11 Cumulative effects

6.11.1 There is potential for cumulative effects to occur during the construction and operational phases of the Scheme due to other developments located near to or within the study area. The Assessment of Cumulative Effects chapter (Chapter 15) provides further details on these effects. The cumulative effects arising from these other developments in relation to noise are shown in Table 6.21.

Table 6.21: Cumulative effects

Other schemes	Distance from junction 28	Cumulative impact on assets affected by the scheme	Potential additional significant construction effects	Potential additional significant operation effects
Small, Medium, Large Wind Development Sites	Partly within DCO boundary	Construction effects may occur if construction of ~~both~~ these schemes ~~take~~ took place simultaneously, however, currently information is not available to undertake a	Yes (potentially)	No

Other schemes	Distance from junction 28	Cumulative impact on assets affected by the scheme	Potential additional significant construction effects	Potential additional significant operation effects
		cumulative construction noise assessment. The council requires that any proposals include a noise impact assessment, which considers all relevant national and local guidance and that appropriate noise mitigation measures are included to reduce the impacts on the surrounding occupants. Therefore, no residual operational noise impacts are expected. No operational noise impact expected.		
Cycleway Proposals	Within DCO boundary	Construction effects may occur if construction of both schemes take place simultaneously, however, currently information is not available to undertake a cumulative construction noise assessment No operational noise impact expected.	Yes (potentially)	No
Lower Thames Crossing	5 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. Development included in traffic scenarios. Therefore, operational impacts from this development are inherent in the noise modelling results for the Scheme.	No	No
Gallows Corner	2.70 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Caravan Park, Putwell Bridge	Within DCO boundary	Construction effects may occur if construction of both schemes take place simultaneously, however, currently information is not available to undertake a cumulative construction noise assessment The additional traffic accessing this development when operational would not give rise to a significant effect.	Yes (potentially)	No
Land East of Nags Head Lane	0.25 km	Construction effects may occur if construction of both schemes take place simultaneously., however, currently information	Yes (potentially)	No

Other schemes	Distance from junction 28	Cumulative impact on assets affected by the scheme	Potential additional significant construction effects	Potential additional significant operation effects
		is not available to undertake a cumulative construction noise assessment Development included in traffic scenarios. Therefore, operational impacts from this development are inherent in the noise modelling results for the Scheme.		
Westbury Road Car Park	1.30 km	No cumulative construction effects are expected as the Schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Chatham Way/ Crown Street Car Park	1.50 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Land at Hunter House	1.40 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
William Hunter Way Car Park	1.50 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Dunton Hills Garden Village	6.30 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Gardens of Peace (formerly known as Land at Oak Farm)	Adjoining site	Construction effects may occur if construction of both schemes take place simultaneously, however, currently information is not available to undertake a cumulative construction noise assessment	Yes (potentially)	No

Other schemes	Distance from junction 28	Cumulative impact on assets affected by the scheme	Potential additional significant construction effects	Potential additional significant operation effects
		The additional traffic accessing this development when operational would not give rise to a significant effect.		
Former Harold Wood Hospital	1.60 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Regent House	0.30 km	Construction effects may occur if construction of both schemes take place simultaneously, however, currently information is not available to undertake a cumulative construction noise assessment The additional traffic accessing this development when operational would not give rise to a significant effect.	Yes (potentially)	No
Essex Police & La Plata House,	1.10 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
141 to 147 High Street	1.35 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Kings House 101 – 135 Kings Road	1.50 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No
Land Formerly Known As NV Tools	1.45 km	No cumulative construction effects are expected as the schemes are sufficiently far apart. The additional traffic accessing this development when operational would not give rise to a significant effect.	No	No

6.12 NPS NN compliance

6.12.1 In line with the national guidance discussed in section 6.3, the Scheme aims to avoid significant adverse effects from noise and vibration as far as possible and to use mitigation measures to reduce significant adverse and adverse impacts. To date, this has been achieved by noise modelling different option variants of the Scheme in previous assessment stages to determine what impacts may occur and where, and which areas may require mitigation.

6.12.2 As the design of the proposed Scheme has progressed, the following activities have been undertaken in order to meet the national policy objectives:

- Examination of locations where significant adverse impacts were previously predicted to determine the feasibility of noise mitigation options for these areas.
- Incorporation of mitigation measures in the Scheme's design to improve road traffic noise levels at Important Areas wherever possible. This has included low noise road surfacing at junction 28.

6.12.3 It can be concluded that the Scheme is therefore in accordance with the NPS NN in respect of noise and vibration.

6.13 Monitoring

Construction

6.13.1 As detailed in the Outline CEMP and REAC, noise monitoring may be included in the CEMP at sensitive areas. This may also be a requirement if Section 61 consents are sought from the local authorities.

6.13.2 The predicted vibration levels were well below those with potential for structural damage to occur. Attended vibration monitoring may be appropriate at Grove Farm during vibratory rolling activities in close proximity to this receptor and will be confirmed in the CEMP.

Operation

6.13.3 The noise monitoring requirements are outlined in the REAC (application document TR010029/APP/7.3).

6.14 Summary

6.14.1 No residual significant adverse effects from day and night-time construction activities are expected provided that noise and vibration management and mitigation measures as outlined in section 6.9 are implemented by the appointed Principal Contractor. Residual adverse effects will be managed as far as practicable using good practices during construction, which will be outlined in the CEMP.

6.14.2 No significant adverse effects or perceptible noise increase resulting from construction traffic are expected during the construction phase of the Scheme.

6.14.3 The road traffic noise modelling results for the operational phase identified that no significant adverse effects would occur at dwellings or sensitive receptors due to the Scheme. No significant adverse effects or perceptible noise increases were predicted at sensitive receptors located in Noise Important Areas.

6.14.4 No significant adverse effects from airborne or ground-borne vibration are expected as a result of the Scheme.

6.14.5 No cumulative effects would occur during the operational phase of the Scheme. However, some slight adverse cumulative effects are possible during construction where construction activities from nearby developments occur simultaneously.

6.14.6 The Scheme includes low noise road surfacing within its design . The benefits of this mitigation measure are inherent in the outcomes of the noise and vibration assessment.

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Registered office Bridge House, 1 Walnut Tree Close, Guildford GU1 4LZ
Highways England Company Limited registered in England and Wales number 09346363