

A12 Chelmsford to A120 widening scheme

TR010060

6.3 ENVIRONMENTAL STATEMENT APPENDIX 12.2 NOISE ASSESSMENT METHODOLOGY

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ENVIRONMENTAL STATEMENT
APPENDIX 12.2 NOISE ASSESSMENT METHODOLOGY

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1 Introduction

- 1.1.1 This appendix provides descriptions of the various assessment guidance and methodologies summarised within Chapter 12: Noise and vibration, of this Environmental Statement [TR010060/APP/6.1], and used for the noise and vibration assessment.

2 Legislation

2.1 Land Compensation Act 1973

- 2.1.1 Part I of the Land Compensation Act 1973 provides a means by which compensation can be paid to owners of land or property due to a loss in value of these assets caused by public works, such as new or improved railways and roads. Noise and vibration are two of the factors which would be considered in any claims for compensation, but the claim should consider all changes and effects, including betterment.
- 2.1.2 Part II of the Act 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 Noise Insulation Regulations 1975, as amended 1988.

2.2 Control of Pollution Act 1974

- 2.2.1 The Control of Pollution Act 1974 (CoPA) grants powers to deal with noise nuisances and places a duty on local authorities to inspect their areas from time to time in order to detect anything which should be dealt with under the Act. It also defines and empowers local authorities to create noise abatement zones within their areas. However, these zones did not gain much popularity with local authorities, and few have chosen to implement them.
- 2.2.2 Much of CoPA has now been replaced and extended by the Environmental Protection Act 1990. However, Sections 60 and 61 which relate to noise and vibration from construction sites remain relevant.
- 2.2.3 Section 60 of CoPA allows a local authority to serve a notice of its requirements for the control of site noise to the individual or entity carrying out or controlling the works. The notice may stipulate noise limits for work, particular plant or machinery that should be avoided, hours during which construction activities may be carried out, and provide for any change in circumstances.
- 2.2.4 Section 61 of CoPA concerns the procedures adopted when a contractor or developer approaches the local authority prior to any construction activities taking place, with the intention of agreeing noise and vibration limits in advance of works.
- 2.2.5 If consent is granted under Section 61, this would be considered a valid defence by the magistrates' court if the local authority was later to reverse its position and pursue an action under Section 60, provided adherence to any conditions attached to the consent had been maintained.
- 2.2.6 Any application for a Section 61 agreement should contain detailed method statements for the works to be conducted, information on noise mitigation measures to be employed, details of working times and supporting calculations showing the predicted noise levels at noise-sensitive receivers around the site.

2.3 Environmental Protection Act 1990

- 2.3.1 Part III, Section 79, of the Environmental Protection Act 1990 defines what activities may constitute a statutory nuisance, and what activities are specifically exempt. Section 79 imposes a duty on local authorities to periodically survey environmental noise levels and to investigate noise complaints.
- 2.3.2 The Act requires local authorities to serve notice when noise nuisance exists. Under these statutory nuisance provisions, the operators of a site or facility could be required to adopt best practicable means to abate noise nuisance at any time once operations have commenced. It is therefore essential that potential nuisance effects are properly considered, so as to ensure that the operators are seen to adopt best practice, and that any potential requirements for mitigation are considered.

2.4 The Noise Insulation Regulations 1975

- 2.4.1 The Noise Insulation Regulations are intended to protect residents subject to increases in traffic noise at or above a specified level arising directly from the use of new or altered roads, by making available grants for noise insulation work to be carried out on their homes. Specific circumstances need to be present for the Regulations to apply. Where there is an 'additional carriageway' the authority has a duty to (i.e. they must) carry out insulation work or make grants. For an 'altered highway', the authority has a power to (i.e. they can) carry out insulation work or make grants.
- 2.4.2 To be eligible for a grant due to increased road traffic noise levels, the dwelling must be within 300m of the nearest point of the carriageway of the highway and the road traffic noise level at the dwelling after the work must be:
- Above a façade level of $L_{A10,18h}$ 68dB
 - Be at least 1dB(A) greater than the prevailing noise level immediately before the work
 - The noise level from the highway, additional carriageway, or alteration must contribute at least 1dB(A) to the relevant noise level at the receptor

2.5 Environmental Noise (England) Regulations 2006

- 2.5.1 The regulations relate to the assessment and management of environmental noise. They require the Secretary of State to: (a) make strategic noise maps showing peoples' exposure to environmental noise from major roads, railways and airports and in urban areas; and (b) draw up and periodically review action plans for places (including for the most important areas) near to major roads. The action plans aim to prevent and reduce environmental noise and its harmful effects on human health, preserve environmental noise quality where it is good, manage noise issues and effects and protect quiet areas against an increase in noise.
- 2.5.2 Important areas are defined in the strategic noise map as where the 1% of the population that are affected by the highest noise levels from roads or major railways are located according to the results of the strategic noise mapping.

3 Policy

3.1 Noise Policy Statement for England 2010

3.1.1 The government's noise policy is set out in the Noise Policy Statement for England (NPSE), which was published in March 2010 (Defra, 2010). It contains the high-level vision of promoting good health and good quality of life (wellbeing) through the effective management of noise. It is supported by three aims and together they provide the necessary clarity and direction to enable decisions to be made in any particular situation, both nationally and locally, regarding what is an acceptable noise burden to place on society. These three aims are:

- To avoid significant adverse impacts on health and quality of life
- To mitigate and minimise adverse impacts on health and quality of life
- Where possible, contribute to the improvement of health and quality of life

3.1.2 In defining these aims, the terms 'significant adverse' and 'adverse' are used for which the NPSE (paragraph 2.20) notes that:

'There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation (WHO). They are:

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

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse level.

- *SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.'*

3.1.3 The three aims of the NPSE are reiterated in other relevant policy documents.

3.2 National Networks National Policy Statement

3.2.1 The National Networks National Policy Statement (NNNPS) (Department for Transport, 2014) advises on noise and vibration in the context of Nationally Significant Infrastructure Projects (NSIP) on the road and rail networks. It sets out the policy and reasoning by which the Secretary of State for Transport will make decisions on NSIPs. The provisions on noise and vibration are contained in paragraphs 5.186 to 5.200 of the document.

3.2.2 Paragraph 5.188 states that the factors that will determine the likely noise impact include:

- 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

3.2.3 Paragraph 5.189 states that a noise assessment should be undertaken for developments that are subject to environmental impact assessments and are likely to result in significant noise impacts. The guidance includes advice on the contents the environment statement should include and for applicants to consider best available techniques to mitigate noise.

3.2.4 Paragraph 5.190 states that the potential noise impacts elsewhere that are directly associated with the project, should be assessed.

3.2.5 Paragraph 5.191 advises on appropriate assessment methodologies.

3.2.6 Paragraph 5.192 states that the applicant should consult with Natural England regarding the noise assessment as far as it affects protected sites and wildlife.

3.2.7 Paragraph 5.195 of the NNNPS notes that *'The Secretary of State should not grant development consent unless satisfied that the proposals will meet the following aims, within the context of Government policy on sustainable development:*

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

3.2.8 Paragraph 5.199 states that for most national network projects, the relevant Noise Insulation Regulations will apply. Thus, an indication of the likely eligibility for noise mitigation compensation should be included in the assessment.

3.3 National Planning Policy Framework

3.3.1 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government, 2021) was published in March 2012 and has been revised several times. The NPPF paragraph 174 states that the planning policies and decisions should contribute to and enhance the natural

and local environment by, among other things, preventing new and existing development from being put at unacceptable risk or being affected by unacceptable levels of noise pollution. Paragraph 185 goes on to state that planning policies and decisions should:

- Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and quality of life
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason
- Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation

3.3.2 Paragraph 187 of the NPPF draws specific attention to the need to ensure that new development is compatible with existing businesses and community facilities and introduces an ‘agent of change’ principle:

‘Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established.’

3.3.3 The NPPF expects local planning policies and decisions to ensure that new development is appropriate for its location and considers the effects of pollution on health, the natural environment and general amenity, including noise-sensitive development in locations that experience aircraft noise. The NPPF is quite clear that the planning system should prevent new development being built at unacceptable risk from, or being adversely affected by, unacceptable levels of noise pollution.

3.4 Planning Practice Guidance

3.4.1 The NPPF was supplemented in 2014 by the online Planning Practice Guidance (PPG) – Noise (Ministry of Housing, Communities and Local Government, 2019). This guidance was updated in July 2019. Unlike the NPPF, this guidance is not a material consideration in planning decisions. PPG-Noise advises on how planning can manage potential noise impacts in new development. It lists various acoustic and non-acoustic factors that could influence a decision on whether noise will be a concern for a project. These include the source and absolute level of noise, the time of day it occurs, and the number and frequency and pattern of noise events.

3.4.2 This document reaffirms the effect levels set out in the NPSE and also adds an additional term of Unacceptable Adverse Effect Level (UAEL) at which noise should be prevented from reaching sensitive receptors. Table 3.1 is from PPG-Noise (paragraph 005), and summarises the noise exposure hierarchy, based on the likely average response.

Table 3.1 Noise exposure hierarchy and effect levels

Perception	Examples of outcomes	Increasing effect level	Action
Not noticeable	No effect	No observed effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Noise can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No observed adverse effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up the television volume; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Noise affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed adverse effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant observed adverse effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, such as auditory and non-auditory.	Unacceptable adverse effect	Prevent

3.4.3 None of the policy documents assign numeric values to the effect levels. This is because the effect level should reflect the nature of the noise source and the sensitivity of the receptor considering also local context. The document states that:

'Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

In line with the Explanatory Note of the NPSE, this would include identifying whether the overall effect of the noise exposure is, or would be, above or below the Significant Observed Adverse Effect Level and the Lowest Observed Adverse Effect Level for the given situation.'

4 Guidance

4.1 World Health Organisation Guidelines for Community Noise 1999

- 4.1.1 The World Health Organisation (WHO) document Guidelines for Community Noise (World Health Organisation, 1999) provides a range of noise guideline values for noise in specific environments.
- 4.1.2 WHO guidance states that the critical effects of noise in a dwelling are on sleep, annoyance and speech interference. To avoid sleep disturbance, indoor guideline values for bedrooms are 30dB $L_{Aeq,8hr}$ for continuous noise and 45dB L_{Amax} for a single sound event.
- 4.1.3 At night, sound pressure levels at the outside façades of the living space should not exceed 45dB $L_{Aeq,8hr}$ and 60dB L_{Amax} so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15dB(A).
- 4.1.4 To protect the majority of people from being *seriously* annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55dB $L_{Aeq,16hr}$ for a steady, continuous noise. To protect the majority of people from being *moderately* annoyed during the daytime, the outdoor sound pressure level should not exceed 50dB $L_{Aeq,16hr}$.

4.2 World Health Organisation Night Noise Guidelines for Europe 2009

- 4.2.1 The WHO Night Noise Guidelines for Europe (World Health Organisation, 2009) sets out the night noise guideline of 40dB $L_{Anight,outside}$ with an interim target limit of 55dB $L_{Anight,outside}$. It also states that when the average night noise level over a year exceeds the 55dB target limit *'The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases'*.

4.3 World Health Organisation Environmental Noise Guidelines for the European Region 2018

- 4.3.1 The WHO Environmental Noise Guidelines for the European Region (ENG) (World Health Organisation, 2018) report provide recommendations for protecting human health from exposure to environmental noise originating from various sources. The sources considered are road traffic noise, railway noise, aircraft noise, wind turbine noise and leisure noise.
- 4.3.2 The guidelines are intended to be suitable for policy making and guiding principles and were developed within the document to provide generic advice and support for the incorporation of recommendations into a policy framework. The guideline exposure levels presented are not meant to identify effect thresholds.

4.3.3 The guidelines relevant to the proposed scheme are those relating to road traffic noise, reproduced in Table 4.1. The guideline noise levels are provided for exposure at the most exposed façade, outdoors.

Table 4.1 WHO ENG 2018 Recommendation for road traffic noise, outside

Recommendation
For average noise exposure, the Guideline Development Group (GDG) strongly recommends reducing noise levels produced by road traffic below 53 L _{den} dB, as road traffic noise above this level is associated with adverse health effects.
For night noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night-time below 45 L _{night} dB, as night-time road traffic noise above this level is associated with adverse effects on sleep.
To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from road traffic in the population exposed to levels above the guidance values for average and night noise exposure. For specific interventions, the GDG recommends reducing noise both at the source and on the route between the source and the affected population, by change in infrastructure.

4.3.4 Although the 2018 ENG supersede the WHO guidelines for community noise and WHO night noise guidelines for Europe, the GDG recommends that all guidelines not covered by the ENG should remain valid.

4.3.5 The guideline levels presented above have been reviewed in the development of the scheme-specific noise criteria for significance of impact. The levels themselves have not been adopted as threshold values, as there are UK Policy-based threshold noise levels that are considered to be more appropriate and established.

4.4 British Standard 5228:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites

Part 1 – Noise

4.4.1 British Standard 5228-1:2009+A1:2014 (British Standards Institution, 2014a) provides suitable methods for the calculation of noise from construction activities, including basic information regarding noise levels from a range of construction equipment. For the calculation of construction noise at the receptor locations, the selected A-weighted sound power levels of the plant and equipment are corrected to consider the ‘percentage on-time’ (portion of time in which the equipment is operating at its maximum power); ‘duration of activity’ (amount of time in relation to the ‘shift duration’ in which the equipment is expected to operate); distance between sound sources and receptors; percentage of soft ground; and any screening corrections from obstacles between the propagation path of the sound.

4.4.2 Annex E of BS 5228-1:2009+A1:2014 (British Standards Institution, 2014a) provides criteria for the assessment of the potential significance of effects from construction noise based different approaches.

4.4.3 Table 4.2 shows an example of the threshold of significant effect at dwellings when the site noise level, rounded to the nearest decibel, exceeds the listed value. This is based on measurements of ambient noise, which are rounded to the nearest 5dB for the time periods given. This is compared with the predicted site noise, and if the site noise exceeds the appropriate category value, then a potential significant effect is indicated.

Table 4.2 Example threshold of potential significant effect at dwellings (BS 5228-1 Table E1)

Assessment category and threshold value period	Threshold value, in decibels (dB) $L_{Aeq,T}$		
	Category A ^(A)	Category B ^(B)	Category C ^(C)
Night-time (23:00-07:00)	45	50	55
Evenings and weekends ^(D)	55	60	65
Daytime (07:00-19:00) and Saturdays (07:00-13:00)	65	70	75

(A) Category A: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are less than these values.
 (B) Category B: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are the same as Category A values.
 (C) Category C: threshold values to use when ambient noise levels (rounded to the nearest 5dB) are higher than Category A values.
 (D) 19:00-23:00 weekdays, 13:00-23:00 Saturdays and 07:00-23:00 Sundays

4.4.4 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.

4.4.5 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 3dB due to site noise.

Part 2 – Vibration

4.4.6 British Standard 5228-2:2009+A1:2014 (British Standards Institution 2014b) provides recommendations for basic methods of vibration control relating to construction and open sites where work activities and operations generate significant vibration levels. The method of measurement for characterising building vibration is also discussed.

4.4.7 Annexes C and D of BS 5228-2:2009+A1:2014 (British Standards Institution, 2014b) contain measured vibration levels for different forms of piling and ancillary operations which can be used for the estimation of vibration levels at a construction site. Annex E of the standard provides derived empirical formulae to predict the resultant Peak Particle Velocity (PPV) from a construction vibration activity. The formulae include a number of parameters specific for calculating vibratory compaction; percussive and vibratory piling; dynamic compaction; and the vibration of stone columns and tunnel boring operations.

For some processes, an indicator of the probability of these figures being exceeded is included as one of the variables in the formulae.

4.4.8 BS 5228-2:2009+A1:2014 sets out a significance of vibration effects, which is defined separately for human response and buildings response, referring to and reproducing the data from BS 6472-1:2008 (British Standards Institution, 2008) and BS 7385-2:1993 (British Standards Institution, 1993).

4.4.9 The effect of building vibration on people inside buildings is often assessed using the Vibration Dose Value (VDV) index, as described in BS 6472-1:2008. However, a simpler approach is often used initially to establish if there is potential for perceptible effects, and this is possible with the PPV index. This approach is described by BS 5228-2:2009+A1:2014, which states in paragraph B.2:

'BS 6472, as stated, provides guidance on human response to vibration in buildings. Whilst the assessment of the response to vibration in BS 6472 is based on the VDV and weighted acceleration, for construction it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is likely to be more routinely measured based upon the more usual concern over potential building damage. Furthermore, since many of the empirical vibration predictors yield a result in terms of PPV, it is necessary to understand what the consequences might be of any predicted levels in terms of human perception and disturbance.'

4.4.10 Further, BS 5228-2:2009+A1:2014 states (paragraph B.2) that:

'Human beings are known to be very sensitive to vibration, the threshold of perception being typically in the PPV range of 0.14mm/s to 0.3mm/s. Vibrations above these values can disturb, startle, cause annoyance or interfere with work activities. At higher levels they can be described as unpleasant or even painful. In residential accommodation, vibrations can promote anxiety lest some structural mishap might occur.'

4.4.11 Table 4.3 shows guideline values for the human response to vibration at certain levels.

Table 4.3 Guidance on effect of vibration levels on human receptors from BS 5228-2:2009+A1:2014

Vibration level	Effect
0.14 mm/s	Vibration might just be perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s	Vibration might just be perceptible in residential environments.
1 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 very brief exposure to this level in most building environments.

Vibration level	Effect
NOTES	
The magnitudes of the values presented apply to a measurement position that is representative of the point of entry into the recipient.	

- 4.4.12 For building structure response BS 5228-2:2009+A1:2014 (British Standards Institution, 2014b) reproduces the advice provided in BS 7385-2:1993 (British Standards Institution, 1993). The response of a building to groundborne vibration is affected by the type of foundation, underlying ground conditions, the building construction and the state of repair of the building. Table 4.4 reproduces the guidance detailed on building classification and guide values for cosmetic building damage.

Table 4.4 Transient Vibration Guide Values for cosmetic damage from BS 5228-2:2009+A1:2014

Type of building	PPV in frequency range of predominant pulse	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures	50 mm/s	50 mm/s
Industrial and heavy commercial buildings		
Unreinforced or light framed structures (1*)	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
Residential or light commercial buildings (2*)		
(1*) Values referred to are at the base of the building.		
(2*) At frequencies below 4 Hz, a maximum displacement of 0.6mm (zero to peak) is not to be exceeded.		

- 4.4.13 Minor damage is possible at vibration magnitudes which are greater than twice those given in Table 4.4, with major damage at values greater than four times the values in the table. BS 7385-2:1993 also notes that the probability of cosmetic damage tends towards zero at 12.5 mm/s peak component particle velocity.

5 Calculation methodologies

5.1 Introduction

- 5.1.1 This section describes the calculation methodologies that have been followed during the noise and vibration assessment of both construction and operational noise.
- 5.1.2 In Section 4 of this appendix the guidance within both parts of BS 5228:2009+A1:2014 has been described. These British Standards also provide calculation methodologies. These calculation methodologies are not repeated in this section of the appendix.

5.2 Calculation of Road Traffic Noise, 1988

- 5.2.1 The calculation method for predicting road traffic noise in the UK is defined within the Calculation of Road Traffic Noise (CRTN) a technical memorandum document produced by the Department of Transport in 1988 (Department of Transport and Welsh Office, 1988). The prediction method takes into account factors such as the traffic flow, composition, vehicles' speed, the alignment and distance of the road, the road surface type, the nature of the intervening ground cover between the road and reflections from building façades, in order to calculate the noise level from the road at a particular receiving property or receptor. The method considers the road traffic noise as a line source taken to be at 3.5m distance from the nearside carriageway edge and 0.5m above the ground as the effective source position.
- 5.2.2 Traffic and the level of noise it generates fluctuate in intensity hourly, daily and seasonally and so the impact of traffic noise is assessed in terms of a time-averaged indicator. In the UK, traffic noise is normally assessed using $L_{A10,18h}$ index, defined as the arithmetic mean of the dB(A) noise levels exceeded for 10% of the time in each of the 18, one-hour periods between 06:00-24:00 on a typical weekday. This takes account of the diurnal variation in traffic noise. Annual Average Weekday Traffic (AAWT) flows, speeds and percentage of heavy vehicles are normally used to allow for seasonal variations.
- 5.2.3 The calculation method consists of an initial Basic Noise Level (BNL) calculation at a reference distance of 10m which depends on the flow, traffic composition and speed of a road segment. Subsequently the method calculates all the corrections related with sound propagation at a receptor location where this includes distance, ground absorption, barrier screening, reflections, angle of view and façade correction.

6 Instructions

6.1 Introduction

- 6.1.1 The instructions provided by the overseeing organisation for the assessment of noise and vibration from a road project as contained within the Design Manual for Roads and Bridges (DMRB) Noise and Vibration, Revision 2 (DMRB LA 111) (Highways England, 2020). The instructions within DMRB LA 111 draw upon information contained within guidance documents and standards.
- 6.1.2 These instructions set out how to define the study areas for the various assessments (i.e. construction, operation) and then lists the process to follow to determine whether impacts are significant.

6.2 Construction activities

- 6.2.1 DMRB LA 111 lists noise impact thresholds for construction activities at residential premises and other noise sensitive receptors. Table 6.1 reproduces Table 3.12 of DMRB LA 111. These impact thresholds are considered to be appropriate for the proposed scheme.

Table 6.1 Construction time period impact thresholds

Time Period	LOAEL	SOAEL
Day (07:00-19:00 weekday and 07:00-13:00 Saturdays)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2009
Night (23:00-07:00)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2009
Evening and weekends (time periods not covered above)	Baseline noise levels $L_{Aeq,T}$	Threshold level determined as per BS 5228-1:2009+A1:2014 Section E3.2 and Table E.1 BS 5228-1:2009+A1:2009

- 6.2.2 To determine significance of effect from construction noise, the method involves a comparison between the predicted noise level arising from construction operations and the pre-construction ambient noise level. Table 3.16 of DMRB LA 111 includes a scale of magnitude that has been used to determine the impact, and this table is reproduced in Table 6.2.
- 6.2.3 The construction calculations should also include activities associated with the building and use of compounds, any haul roads and borrow pits.

Table 6.2 Magnitude of impact and construction noise descriptors

Magnitude of impact	Construction noise level
Major	Above or equal to SOAEL +5dB
Moderate	Above or equal to SOAEL and below SOAEL +5dB
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

6.2.4 A significant effect is likely when the impact is either moderate or major. This will constitute a significant effect if this impact at a receptor is exceeded for a duration of:

- 10 or more days or nights in any 15 consecutive days or nights
- a total number of days exceeding 40 in any six consecutive months.

6.3 Construction traffic

6.3.1 The significance of the impact from additional construction traffic on the road network is determined by comparing the existing level of traffic noise against that predicted during construction. Table 3.17 of DMRB LA 111 provides a scale of magnitude that can be used to determine the impact, and this table is shown in Table 6.3.

Table 6.3 Magnitude of construction traffic impact at receptors

Magnitude of impact	Increase in BNL of closest public road used for construction traffic (dB)
Major	Greater than or equal to 5.0
Moderate	Greater than or equal to 3.0 and less than 5.0
Minor	Greater than or equal to 1.0 and less than 3.0
Negligible	Less than 1.0

6.3.2 Construction traffic noise shall constitute a significant effect where it is determined that a major or moderate magnitude of impact will occur for a duration exceeding:

- 10 or more days or nights in any 15 consecutive days or nights
- a total number of days exceeding 40 in any six consecutive months.

6.4 Construction diversion routes

6.4.1 For diversions routes used at night, a major magnitude of impact for construction noise impact shall be determined at any noise sensitive receptors within the diversion route study area.

- 6.4.2 This would constitute a significant effect where it is determined that the diversion route is in use for a duration exceeding:
- 10 or more days or nights in any 15 consecutive days or nights
 - a total number of days exceeding 40 in any six consecutive months.

6.5 Construction vibration

- 6.5.1 To determine significance of effect from construction vibration, the magnitude of the predicted level has been compared against impact criteria shown in Table 3.31 of DMRB LA 111 and a magnitude scale shown in Table 3.33 of DMRB LA 111. These tables are reproduced below in Table 6.4 and Table 6.5.

Table 6.4 Construction vibration impact thresholds for all receptors

Time period	LOAEL	SOAEL
All time periods	0.3 mm/s PPV	1.0 mm/s PPV

Table 6.5 Magnitude of construction vibration impact at receptors

Magnitude	Vibration level
Major	Greater than or equal to 10 mm/s PPV
Moderate	Above or equal to SOAEL and below 10 mm/s PPV
Minor	Above or equal to LOAEL and below SOAEL
Negligible	Below LOAEL

- 6.5.2 Construction vibration shall constitute a significant effect where it is determined that a major or moderate magnitude of impact would occur for a duration exceeding:
- 10 or more days or nights in any 15 consecutive days or nights
 - a total number of days exceeding 40 in any six consecutive months.

6.6 Operation

- 6.6.1 When calculating the level of noise from a road, DMRB LA 111 (Highways England, 2020) describes procedures that follow the methodology within CRTN.
- 6.6.2 The suggested LOAELs and SOAELs within DMRB LA 111 for noise sensitive receptors within the study area for operational road traffic noise are reproduced in Table 6.6. Also shown within Table 6.6 are the equivalent LOAEL and SOAEL values in the L_{den} noise index. These are shown for information purposes only and are not used within the noise assessment. These have been converted from the equivalent $L_{Aeq,16hr}$ value using guidance provided in an article in the International Journal of Hygiene and Environmental Health in 2018 (Brink et al, 2018). The L_{den} noise index is seldom used for a noise impact assessment but is sometimes used when considering health effects. A description of the L_{den} index is provided within Chapter 18: Glossary and acronyms, of this Environmental Statement [TR010060/APP/6.1].

Table 6.6 Operational noise LOAELs and SOAELs for all receptors

Time Period	LOAEL	SOAEL
Day (06:00 – 24:00)	55dB $L_{A10,18hr}$ façade 50.5dB $L_{Aeq,16hr}$ free-field	68dB $L_{A10,18hr}$ façade 63.5dB $L_{Aeq,16hr}$ free-field
Night (23:00 – 07:00)	40dB $L_{night,outside}$ free-field	55dB $L_{night,outside}$ free-field
24 hour	52.9dB L_{den} free-field	65.9dB L_{den} free-field

- 6.6.3 These suggested values for the day and night LOAEL and SOAEL within DMRB LA 111 are based upon those used for recent large road projects and are considered appropriate for the proposed scheme.
- 6.6.4 The LOAEL for the daytime period is considered to be 50.5dB $L_{Aeq,16hr}$ (free-field). The WHO Guidelines for Community Noise (WHO, 1999) identify that 50.5dB $L_{Aeq,16hr}$ represents the outside (in amenity areas) day-time noise level below which the majority of the adult population will be protected from becoming moderately annoyed.
- 6.6.5 An external noise level of 50.5dB $L_{Aeq,16hr}$ would result in a noise level within a property of 35dB $L_{Aeq,16hr}$ when taking account a typical reduction from an open window. The WHO Guidelines for Community Noise deem this noise level to be where moderate annoyance could occur within properties.
- 6.6.6 Based upon the use of WHO, and the definition of No Observed Adverse Effect in PPG-Noise (Ministry of Housing, Communities and Local Government, 2019), it is concluded that external noise below 50.5 dB $L_{Aeq,16hr}$ would meet this PPG definition.
- 6.6.7 The LOAEL for the night-time period is considered to be 40dB $L_{night,outside}$ (free-field). This is consistent with WHO Night Noise Guidelines for Europe (WHO, 2009), which states that the night noise guideline of 40dB $L_{night,outside}$ should be the noise level target.
- 6.6.8 The SOAEL for the daytime period is considered to be 63.5dB $L_{Aeq,16hr}$ (free-field). This level is consistent with the specified level in the Noise Insulation Regulations 1975 (amended 1988) after adding a façade correction and converting from an $L_{A10,18hr}$ level to an $L_{Aeq,16hr}$ level.
- 6.6.9 On the worst case assumption of a closed single glazed window, an external noise level of 63.5dB $L_{Aeq,16hr}$ (free-field) would result in an internal noise level of 35dB $L_{Aeq,16hr}$. The WHO Guidelines for Community Noise (WHO, 1999) state that at this noise level, within a dwelling, speech intelligibility is affected, and moderate annoyance begins.
- 6.6.10 Therefore, based upon the definition of a Significant Observed Adverse Effect in PPG-Noise (Ministry of Housing, Communities and Local Government, 2019), a closed window would still result in noise levels exceeding 35dB $L_{Aeq,16hr}$, which is considered a SOAEL.
- 6.6.11 The SOAEL for the night-time period is considered to be 55dB $L_{night,outside}$ (free-field). This noise level represents the interim noise level target presented in the WHO Guidelines for Community Noise (WHO, 1999).

- 6.6.12 Exceedance of SOAEL in itself does not result in a significant effect for any given sensitive receptor. The noise level change in the Do-Something noise level, compared with the Do-Minimum noise level, also requires consideration. Table 6.7 and Table 6.8 provide a classification of the change in noise and associated magnitude of impact for the short and long term.

Table 6.7 Classification of magnitude of noise impacts from a change in road traffic noise – short term

Magnitude of impact	Short-term noise change $L_{A10,18hr}$ dB
Major	Greater than or equal to 5.0
Moderate	3.0 to 4.9
Minor	1.0 to 2.9
Negligible	Less than 1.0

Table 6.8 Classification of magnitude of noise impacts from a change in road traffic noise – long term

Magnitude of impact	Short-term noise change $L_{A10,18hr}$ dB
Major	Greater than or equal to 10.0
Moderate	5.0 to 9.9
Minor	3.0 to 4.9
Negligible	Less than 3.0

- 6.6.13 If any Do Something absolute noise levels are above the SOAEL (day or night), a noise change in the short term of 1.0dB(A) or over should be considered a significant effect, irrespective of other factors. DMRB LA 111 (Highways England, 2020) states that the initial determination of whether a significant impact constitutes a significant effect should be when there is a change in noise in the short term of 3dB(A) or more (i.e. a moderate or major impact). However, the change in noise alone should not be considered, and for impacts of minor, moderate or major, other factors need to be considered.
- 6.6.14 Provided within DMRB LA 111 is a table showing potential factors to consider, with a description on how these may influence the judgement of significance. This is reproduced in Table 6.9.

Table 6.9 Factors to consider in determining the final operational significance on noise sensitive buildings

Circumstance	Influence on significance judgement
Noise level change (is the magnitude of change close to the minor/moderate boundary?).	Noise level changes within 1 dB of the top of the 'minor' range can indicate that it is more appropriate to determine a likely significant effect. Noise level changes within 1 dB of the bottom of a 'moderate' range can indicate that it is more appropriate to consider a change is not a likely significant effect.
Differing magnitude of impact in the long term to magnitude of impact in the short term.	<ol style="list-style-type: none"> 1) Where the long term impact is predicted to be greater than the short term impact, it can be appropriate to conclude that a minor change in the short term is a likely significant effect. Where the long term impact is predicted to be less than the short term it can be appropriate to conclude that a moderate or major change in the short term is not significant. 2) A similar change in the long term and non-project noise change can indicate that the change is not due to the project and not an indication of a likely significant effect.
Absolute noise level with reference to LOAEL and SOAEL (by design this includes sensitivity of receptor)	<ol style="list-style-type: none"> 1) A noise change where all do-something absolute noise levels are below SOAEL requires no modification of the initial assessment. 2) Where any do-something absolute noise levels are above the SOAEL, a noise change in the short term of 1.0dB or over results in a likely significant effect.
Location of noise sensitive parts of a receptor	<ol style="list-style-type: none"> 1) If the sensitive parts of a receptor are protected from the noise source, it can be appropriate to conclude a moderate or major magnitude change in the short term and/or long term is not a likely significant effect. 2) Conversely, if the sensitive parts of the receptor are exposed to the noise source, it can be more appropriate to conclude a minor change in the short term and/or long term is a likely significant effect. 3) It is only necessary to look in detail at individual receptors in terms of this circumstance where the decision on whether the noise change gives rise to a significant environmental effect is marginal.
Acoustic context	If a project changes the acoustic character of an area, it can be appropriate to conclude a minor magnitude of change in the short term and/or long term is a likely significant effect.
Likely perception of change by residents	<ol style="list-style-type: none"> 1) If the project results in obvious changes to the landscape or setting of a receptor, it is likely that noise level changes will be more acutely perceived by the noise sensitive receptors. In these cases it can be appropriate to conclude that a minor change in the short term and/or long term is a likely significant effect. 2) Conversely, if the project results in no obvious changes for the landscape, particularly if the road is not visible from the receptor, it can be appropriate to conclude that a moderate change in the short term and/or long term is not a likely significant effect.

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