

Appendix 9.2: Assessment Methodologies and Criteria

The methodology for the noise and vibration assessment of the proposed development to both existing and proposed development is based upon that contained within, Planning Policy Guidance, British Standards and industry standards and is detailed below.

Noise

WCC's environmental health department confirmed that the methodology contained within Planning Policy Guidance Note 24 (PPG 24) 'Planning and Noise' should be followed for the assessment of noise and vibration at new dwellings at Barton Farm, Winchester.

The four Noise Exposure Category (NEC) bands within PPG 24 are designed to assist local planning authorities in evaluating applications for residential development in areas that may be exposed to noise. In accordance with PPG 24, Table A9.2/1 shows each NEC band, defined by a range of 'free-field' noise levels, into which the development land is classified, together with relevant planning advice to the Local Authority.

Table A9.2/1 PPG 24 Noise Exposure Categories (NECs) and advice

NEC	Rail Noise Source Band		Mixed Sources Band		Planning Advice
	Daytime 0700- 2300 $L_{Aeq,16hr}$	Night-time 2300-0700 $L_{Aeq,8hr}$	Daytime 0700- 2300 $L_{Aeq,16hr}$	Night-time 2300-0700 $L_{Aeq,8hr}$	
A	<55	<45	<55	<45	Noise need not be considered as a determining factor in granting planning permission, although noise at the high end of the category should not be regarded as a desirable level.
B	55-66	45-59	55-63	45-57	Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.
C	66-74	59-66	63-72	57-66	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	>74	>66	>72	>66	Planning permission should normally be refused.

All levels dB

WCC confirmed that they would recommend refusal of permission on noise grounds for proposed residential development (including the gardens of dwellings) in NEC D. WCC also advised that new dwellings in NEC B and C should be designed so that the internal noise level with windows closed is not greater than 35 dB $L_{Aeq,16hour}$ during the daytime in living rooms and is not greater than 30 dB $L_{Aeq,8hour}$ at night-time in bedrooms. WCC advised that alternative means of ventilation (passive ventilation for NEC B and mechanical ventilation for NEC C) would be required to those rooms.

As proposed by WSP Acoustics and agreed by WCC, for the parts of the site where rail traffic is the dominant noise source (adjacent to the mainline railway), the NECs are defined by the free-field levels of noise that are shown in Table A9.2/1. For the remaining parts of the site where road + rail traffic noise prevail, the NECs are defined by the 'mixed sources' free-field levels of noise that are also shown in Table A9.2/1. The free-field noise levels that define the NECs and are shown in Table A9.2/1 have been taken directly from PPG 24.

It should be noted that the levels advised by PPG 24 that classify each NEC for road traffic and mixed sources (any combination of road, rail, air or industrial sources where no one source is dominant) are lower than those for where rail noise is the dominant source.

In addition to the advice within Table A9.2/1, PPG 24 also states that during the night, (2300-0700 hours): 'Sites where individual noise events regularly exceed 82 dB L_{Amax} (slow time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8\text{ hour}}$ (except where the $L_{Aeq,8\text{ hour}}$ already puts the site into NEC D)'. Therefore, the 82 dB $L_{Amax,slow}$ noise level that is exceeded several times in any one hour will also define the onset of NEC C. Guidance from the Government advises that 'several times in any hour' means more than three times in any hour.

PPG 24 advises that the NEC values shown in Table A9.2/1 refer to noise levels on an open site at the position of the proposed dwellings, well away from any existing buildings, and 1.2m to 1.5m above ground. WCC stipulated that noise levels and the NEC classification must also be considered at the positions and elevations above ground floor level where dwellings are proposed.

As advised in PPG 24, for proposed dwellings in NEC A, WCC will not refuse permission on noise grounds. As also advised in PPG 24, for new dwellings in NEC B with appropriate mitigation measures to ensure adequate protection against noise, WCC will not refuse permission on noise grounds. Appropriate mitigation measures that were discussed with WCC are included in the mitigation section of this report.

In summary, the 'build-line' up to which WCC will generally permit residential development (that includes dwellings and their gardens) where rail noise is dominant will be denoted by either the day time 66 $L_{Aeq,16\text{ hour}}$, the night-time 59 $L_{Aeq,8\text{ hour}}$ or the night-time 82 $L_{Amax,slow}$ noise level. Whichever of these values 'encroach' furthest 'into' the site will govern the constraint of rail noise to proposed residential development.

The 'build-line' up to which WCC will generally permit residential development (that includes dwellings and their gardens) where road noise or mixed sources are dominant will be denoted by either the day time 63 dB $L_{Aeq,16\text{ hour}}$, the night-time 57 dB $L_{Aeq,8\text{ hour}}$ or the night-time 82 dB $L_{Amax,slow}$ noise level. Whichever of these values 'encroach' furthest 'into' the site will govern the constraint of road or mixed sources to proposed residential development. However, during subsequent discussions WCC has stated that residential development in NEC C would be decided on a case by case scenario. Such a case may be strengthened where it can be proved that the scheme brings benefits in other areas.

Vibration

PPG 24 (Annex 3) suggests that 'advice on acceptable levels of vibration can be found in BS 6472: 1992 'Guide to Evaluation of human exposure to vibration in buildings (1 to 80 Hz)', since superseded by BS 6472: 2008

Vibration from rail traffic was discussed with WCC and it was agreed that in accordance with the advice in PPG 24, with respect to human exposure to building vibration, assessments would be undertaken in accordance with BS 6472: 2008 which provides guidance that relates to the probability with which various degrees of adverse comment to vibration are likely. Following this guidance for residential dwellings, Table A9.2/2 details the vibration levels at which varying degrees of adverse comment may be expected. These vibration criteria apply to dwellings and do not include gardens of those dwellings.

WCC advised that they would recommend refusal of permission on vibration grounds if residential development were proposed in areas where adverse comment regarding vibration were possible (i.e. $>0.4\text{ ms}^{-1.75}$ daytime or $>0.2\text{ ms}^{-1.75}$ night-time).

Table A9.2/2 Vibration Dose Values (VDV $\text{ms}^{-1.75}$) above which various degrees of adverse comment may be expected

Place	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings. 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings. 8 hour night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Criteria for the Proposed School

PPG 24 (Annex 1) identifies that the NEC principle cannot be applied to other noise-sensitive developments such as offices, hospitals and schools and that it will be more appropriate to refer to specific guidance on internal noise standards in respect to the activities being conducted within each building. For offices and schools PPG 24 advises that general information is contained within BS8233: 1987 (since superseded by the 1999 version) and for schools within The Department for Education Design Note 17: Guidelines for Environmental Design in Educational Buildings. This latter document has since been superseded and the relevant guidance for schools is now given in Building Bulletin (BB) 93.

For indoor ambient levels within unoccupied classrooms, BS 8233: 1999 advises that for reasonable listening conditions an $L_{Aeq,T}$ noise level of between 35 dB (good) to 40 dB (reasonable) should prevail. For reasonable conditions for study and work requiring concentration this Standard advises on levels of noise between 35 dB to 50 dB $L_{Aeq,T}$.

BB93 identifies that the 'objective is to provide suitable indoor ambient noise levels for (a) clear communication between teacher and student, and between students and (b) for study activities. BB93 identifies that indoor ambient noise level includes noise contributions from external sources (that includes road, rail and air traffic) building services but excludes noise from teaching activities within the school, equipment used in the space and rain noise. BB93 recommends performance standards for various spaces and rooms. In general the level of noise within teaching classrooms (including music classrooms) should not normally be above 35 dB $L_{Aeq,30min}$. Furthermore, to minimise disruption during noisy events such as aircraft flyovers, BB93 advises that such rooms should not regularly exceed 55 dB $L_{A1,30min}$. According to BB93 these criteria should be achieved with windows open if the space is ventilated naturally or with windows closed if ventilated mechanically. BB93 advises that when external noise levels are higher than 60 dB $L_{Aeq,30min}$, simple natural ventilation solutions may not be appropriate as the ventilation openings also let in noise. However, it is possible to use acoustically attenuated natural ventilation rather than full mechanical ventilation when external noise levels are high but do not exceed 70 dB $L_{Aeq,30min}$. Table A9.2/3 summarises the acoustic criteria relevant to schools.

Table A9.2/3 Summary of the Acoustic Assessment Criteria Applicable to School Classrooms

Reference	Application	Criterion
BS 8233: 1999	Indoor levels in unoccupied classrooms	35 dB to 40 dB $L_{Aeq,T}$
BS 8233: 1999	Reasonable conditions for study and work requiring concentration.	35 dB to 50 dB $L_{Aeq,T}$
BB93	Primary School: Classrooms, class bases, general teaching areas, small groups. Secondary School: Classrooms, general teaching areas, seminar rooms, tutorial rooms, language labs.	35 dB $L_{Aeq,30min}$
BB93	Teaching can be disrupted by noisy events such as aircraft flyovers. Noise levels within classrooms should not regularly exceed this value.	55 dB $L_{A1,30min}$
BB93	When external noise levels are higher than 60 dB $L_{Aeq,30min}$, simple natural ventilation solutions may not be appropriate.	-
BB93	When external noise levels exceed 70 dB $L_{Aeq,30min}$ use full mechanical ventilation.	-

All levels dB.

Criteria for other Proposed Development

BS 8233: 1999 advises that the indoor ambient noise levels for executive offices and meeting rooms should be in the range of 35 dB to 40 dB $L_{Aeq,T}$ and for cellular offices the design range should be 40 dB to 50 dB $L_{Aeq,T}$. For reasonable listening conditions within a public space BS 8233: 1999 advises a design range of 30 dB to 40 dB $L_{Aeq,T}$. For reasonable conditions for study and work requiring concentration this Standard advises a design range of 35 dB to 50 dB $L_{Aeq,T}$. To maintain reasonable speech or telephone communications a design range of 45 dB to 55 dB $L_{Aeq,T}$ is advised. These design ranges relate to internal noise levels within different areas when they are unoccupied. These ranges of internal levels are appropriate to uses, such as healthcare facilities.

Discussions have taken place between WSP Acoustics and WCC regarding noise criteria applicable to informal open space and/or playing fields.

It was agreed that for informal open space and/or playing fields, it would not be appropriate to adopt noise criterion, such as is sometimes used for the external amenity areas of residential property, as the use of the proposed open areas will be transitory. Furthermore, uses of the open areas are not particularly noise-sensitive and it was agreed that such areas could provide a 'buffer area' between the adjacent existing transport corridors and proposed residential development. It was also agreed that playing fields/areas could very often be a source of noise themselves. Therefore, it was agreed with WCC that no noise criteria would be applicable to informal open space and/or playing fields.

It was agreed that any CHP plant should meet the guidance for external noise levels in the WHO *Guidelines for Community Noise*, i.e. 55 dB $L_{Aeq,16hour}$ and 45 dB $L_{Aeq,8hour}$.

Construction Noise and Vibration

PPG 24 paragraph 21 advises that British Standard BS 5228: 1984, since superseded by the revised BS 5228: 2009, provides general advice on construction noise and vibration and also describes a detailed method for predicting noise from such sites. Information relating to equipment type, numbers and size together with detailed information on the work methodologies are required to accurately predict construction noise levels.

The Noise Exposure Category principle within PPG 24 for new dwellings does not apply to construction noise. Furthermore, there are no British Standards that define or stipulate noise limits for demolition and/or construction work. However, guidance is given in BS 5228 regarding a number of factors that are likely to affect the acceptability of construction noise. It advises these factors as '*site location, existing ambient noise levels, duration of site operations, hours of work, attitude of the site operator and noise characteristics of the work being undertaken*'.

The Department of the Environment (DoE) Advisory Leaflet (AL) 72 and the revised BS 5228 advises construction noise limits applicable at residential locations during daytime hours (0700-1900 hours). Although AL 72 is out of print, it remains as a paper giving guidance on acceptable levels of noise. This publication states that the noise level outside the nearest occupied room of a receptor should not exceed:

- 75 dB(A) in urban areas near to main roads in heavy industrial areas; or
- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise.

These limits are taken as façade $L_{Aeq,T}$ noise levels. Following this advice, a daytime construction noise limit of 70 dB $L_{Aeq,T}$ can be used as the indicator above which a significant construction noise impact may be registered. T equates to the period in hours over which construction activities will be undertaken.

To assess the change in noise levels during the demolition and construction processes during the daytime the impact scale shown by Table A9.2/4 was used.

Table A9.2/4 Descriptors and impact rating for construction noise at noise-sensitive receptors

Predicted external $L_{Aeq, T}$ at the façade (dB)	Descriptor	Impact
< 65	Insignificant	Negligible
> 65 - < 70	Slight	
> 70 - < 75	Moderate	Significant
> 75 - < 80	Substantial	
85 or more	Severe	

All levels dB.

At this early stage of the project insufficient information relating to the proposed construction methodologies exists to enable detailed construction noise predictions to be undertaken. However, indicative noise levels during the construction of the proposed development can be predicted for operations that are likely to take place on the site.

Therefore, based on typical construction activities that are likely to be undertaken on the site a generic noise and vibration assessment was carried out. For the purpose of predicting the likely noise and

vibration impact during the demolition and construction works the following generic phases and equipment are assumed:

- **Grading/Profiling of the site (Grading).**
It is assumed that any grading of the site will use dozers, excavators and lorries.
- **Piling works for the building foundations (Foundation).**
It is assumed that the foundations of the proposed buildings will either be strip foundations or by a bored piling method, such as continuous flight auger piling (CFA) that may involve a piling rig, a support crane, a bentonite pump and a small backactor for moving spoil/handling materials.
- **Building erection (Erection).**
This phase of the works is assumed to involve the casting of concrete floor slabs 'in-situ', brickwork/blockwork, scaffold erection and roofing, etc. It is assumed that any concreting works will require the use of concrete truck mixers, a compressor and hand tools. It is also assumed that a wheeled loader and a wheeled crane may be used as support plant.
- **Drainage and road paving (Services).**
This stage of the works may comprise of several operations that may include excavation for and laying of drainage, excavation and road surfacing. Given that much of the precise construction detail is not known at present an average source noise level of 80 dB(A) at a distance of 10 metres has been derived from BS 5228: 1997 for this phase of the works.

Assessments were conducted assuming that all plant, and hence the source of noise and/or vibration, is positioned at the 'mid-point' of the closest proposed development 'block' shown by the masterplan to each representative receptor where the levels were predicted.

It is recognised that such assumptions will produce levels that, on occasions, may both underestimate and over-estimate the impact. However, given that much of the detailed information relating to construction methodologies is not yet known at this stage it is only possible to undertake a generic assessment of construction noise and vibration.

The piling methodology will be dependent on the ground conditions. If the eventual piling technique differs from bored piling then noise and vibration assessments of that method will need to be made.

Vibration from construction activities is very dependent upon ground conditions, underlying geology and upon the foundations and construction of the receiving structure. Vibration such as from piling, demolition or road breaking can be impulsive. Continuous vibration can arise from vibratory piling or from an operating generator or compressor located close to a building.

It is generally accepted that for the majority of people vibration levels in excess of between 0.1mms^{-1} and 0.3mms^{-1} PPV (peak particle velocity) are just perceptible. Table A9.2/5 details the distances at which certain activities give rise to a just perceptible level of vibration. This table was based on historical field measurements.

Table A9.2/5 Distances at Which Vibration from Construction Activities May just be Perceptible

Construction Activity	Distance from activity when vibration may just be perceptible (metres)
Excavation	10 - 15
Hydraulic Breaker	15 - 20
Hydraulic Vibratory Pile Hammer	50 - 100
Hydraulic Impact Pile Hammer	40 - 50
Auger Piling	15

With respect to human exposure to building vibration, as mentioned previously, BS6472: 2008 provides guidance relating to the probability with which various degrees of adverse comment are likely and Table A9.2/2 refers.

To protect buildings from risk of structural damage due to excessive levels of vibration, guidance is given in BS 7385: Part 2: 1993. For intermittent and continuous vibration these standards indicate 10 mms^{-1} and 5 mms^{-1} PPV, respectively, as the level below which cosmetic damage (hairline cracks) is unlikely to occur.

Traffic Noise and Vibration Criteria

It was discussed and agreed with WCC that the assessment of traffic noise and vibration from the operation of the proposed development would consider the change in road traffic noise and vibration at existing noise-sensitive receptors.

Traffic noise

To enable the assessment of any change in traffic noise and vibration at existing noise-sensitive premises, the noise prediction procedures detailed in the Department of Transport and Welsh Office document Calculation of Road Traffic Noise 1988 (CRTN) were followed. CRTN describes the procedures for calculating noise from road traffic. These procedures are used to enable entitlement under the Noise Insulation Regulations 1975 (as amended 1988) to be determined and commonly also to provide guidance appropriate to the calculation of traffic noise for more general applications, such as the environmental appraisal of road schemes, highway design and land use planning.

The noise from a traffic stream is not constant but varies from moment to moment and it is necessary to use an index to arrive at a single-figure estimate of the overall noise level for assessment purposes. The index adopted by the Government to assess road traffic noise is the $L_{A10,18\text{hour}}$, which is the noise level exceeded for 10% of the 18-hour, 06:00 to 24:00 period. This parameter has been used to assess traffic noise for some time because of its good correlation with subjective response.

The Design Manual for Roads and Bridges (DMRB) Volume 11 gives advice on the environmental assessment of noise and vibration impacts due to changes in road traffic noise and vibration. The DMRB identifies three different stages in the assessment, with each stage becoming increasingly detailed as the scheme develops.

The objective of the DMRB noise assessment is to establish the magnitude of the significance of noise changes for areas where existing traffic is likely to increase by 25% or reduce by 20%. The DMRB advises that these changes are equivalent to a change in the noise levels of 1 dB(A). The DMRB assessment methodology dictates that all properties experiencing changes in the level of noise greater than 1 dB(A) should be quantified. Properties experiencing a change in the level of noise of less than 1 dB(A) are not required to be quantified, the inference being that such a slight change in the level of noise is so small as to be imperceptible.

A doubling or halving of the total flow of traffic would cause the noise level to change by 3 dB(A) and such a change in the level of noise is subjectively regarded by PPG 24 as being just perceptible. PPG 24 states that a change in the noise level of 1 dB(A) is only perceptible under controlled conditions. However, the DMRB indicates that those subjected to a sudden change in noise level as low as 1 dB(A), such as that that accompanies a road scheme opening, may just perceive the change and experience either a benefit or disbenefit. A change in the level of noise of less than 1 dB(A) is considered to be so slight as to be imperceptible.

It is assumed that the minimum perceptible change in the level of traffic noise is between 1 dB(A) to 3 dB(A) and can be termed just perceptible. A change in the level of traffic noise of less than 1 dB(A) is deemed imperceptible and a change greater than 3 dB(A) can be classified as perceptible.

For the purposes of this assessment a perceptible change in the level of traffic noise greater than 3 dB(A) is termed significant and a change of less than 3 dB(A) is considered insignificant.

Further guidance relating to changes in noise levels may be taken from the draft findings of The Institute of Acoustics / Institute of Environmental Management and Assessment Working Party that is

producing guidelines for noise impact assessment. Taking into consideration the draft findings of the Working Party and the advice given in PPG 24 and DMRB, Table A9.2/6 details the subjective response, the subjective scale of change in the levels of road traffic noise and the significance of the road traffic noise impact used in this assessment.

Table A9.2/6 Descriptors and Impact Scale for Comparisons of The Change in Traffic Noise Levels

Change in noise level dB(A)	Subjective response	Subjective scale of change in noise level	Significance of noise impact
0–0.9	No difference	No change	Insignificant
1.0–2.9	May be just perceptible	Minor change	Insignificant
3.0–4.9	Perceptible	Moderate change	Significant
5.0–9.9	Up to a doubling or halving in loudness	Substantial change	Significant
10.0 or more	More than a doubling or halving in loudness	Severe change	Significant

The assessment of traffic noise in accordance with the DMRB, and taking account of the appraisal guidance of NATA, GOMMMS and the Bridging Document, uses criteria in terms of comparisons of the change in the noise level. The comparisons are between the future with development (2023) (do-something) and the future (2023) no development (do-minimum).

Traffic Vibration

Ground-borne vibration from road traffic is difficult to predict accurately and is extremely unlikely to cause damage to buildings. However, it is possible that ground-borne vibration can cause disturbance to residents where the sub-grade is soft, the road surface is uneven and/or when dwellings are within a few metres of the carriageway.

Previous studies reported in the DMRB have found that the $L_{A10,18\text{hour}}$ index was one of the physical variables closely associated with average vibration disturbance ratings. The relationship between the percentage of people bothered by largely airborne vibration and this noise exposure index is similar to that for noise disturbance except that the percentage of people bothered by vibration is lower by 10% at all exposure levels.

The DMRB states that there is little evidence that noise levels below about 58 dB $L_{A10,18\text{hour}}$ at a façade produce significant vibration disturbance.

For assessments to DMRB Stage 3, such as the assessments presented within this report, the DMRB advises that 'an accurate assessment of vibration nuisance is difficult to carry out. However, for unscreened buildings within 40m of an existing or proposed route option Figure 2 (of the DMRB) should be used to estimate the degree of airborne, traffic induced vibration'.

Operational Noise from any Fixed Plant or New Commercial Development

Paragraph 19, Annex 3 of PPG24, recommends that where appropriate, BS 4142: 1990, since superseded by BS 4142: 1997, should be used to assess the likelihood of complaints of noise from commercial (shops, retail outlets etc) or industrial development.

BS 4142: 1997 describes methods for determining noise levels from new, modified or existing factories, industrial premises, fixed installations or sources of an industrial nature in commercial premises. Clearly noise from any fixed plant associated with the operation of any commercial development should be considered in accordance with the requirements of BS 4142: 1997. Furthermore, the noise impact of such commercial development should also be considered at proposed noise-sensitive development, such as dwellings.

This Standard effectively compares and 'rates' the difference between the rating noise level from the source ($L_{Ar,Tr}$) and the background noise level ($L_{A90,T}$). If appropriate, the specific (source) noise level ($L_{Aeq,Tr}$) is corrected for such acoustic features such as tonal qualities and/or distinct impulses to give the $L_{Ar,Tr}$. When comparing the rating and background noise levels a difference of more than +10 dB is an indication that complaints are likely whereas a difference of around +5 dB is of marginal significance. Complaints are very unlikely at a difference of -10 dB or more. It is assumed that at differences less than +5 dB, the lower the difference there is less likelihood of complaint.

For any fixed plant noise associated with the development (such as noise from any HVAC systems) or noise from a commercial or industrial source (defined in accordance with BS 4142: 1997), it was agreed with WCC that the ES would specify noise design criteria in accordance with the guidance given in BS 4142: 1997. Consideration of these criteria during the detailed design of the development and selection of plant will ensure that such noise would not give rise to nuisance at existing and proposed dwellings. WCC agreed with this approach and specified that the rating noise level ($L_{Ar,Tr}$) should be no greater than the $L_{A90} -5$ dB.

Baseline Methodology

To assist in establishing the noise and vibration impact to proposed sensitive locations on the site, noise and vibration measurements were made on the site itself. Furthermore, measurements of the baseline noise levels were also made at locations off the site. Judicious assessments were made of the existing and proposed noise-sensitive locations where changes in noise levels were likely during construction and operational activities. These assessments were based upon the information contained in the masterplan (Drawing Number 405) and locations where future changes in noise levels are likely.