

11. NOISE AND VIBRATION

INTRODUCTION

- 11.1 This chapter assesses the effects of the four Development Scenarios with regard to noise and vibration. It has been written by Hann Tucker Associates, with input from Waterman Environmental.
- 11.2 The chapter sets out planning policies and guidance of relevance to the issues of noise and vibration. The chapter then describes the methods used to assess effects, and describes the existing baseline noise and vibration climate in and around the application sites. It also describes sensitive receptors which are likely to be affected by the four Development Scenarios. Potential effects are then discussed, together with appropriate mitigation, and the resulting residual effects.
- 11.3 This chapter is supported by the following Technical Appendices:
- Technical Appendix 11a: Acoustic Terminology and Supplementary Information;
 - Technical Appendix 11b: Environmental Noise Survey Report; and
 - Technical Appendix 11c: Train Induced Vibration Report.
- 11.4 This chapter has been prepared following liaison with Westminster City Council's (WCC's) Environmental Health Department (EHD), and addresses their advice and policies.

LEGISLATIVE AND PLANNING POLICY CONTEXT

Legislation

Approved Document E: 2003 Edition - Resistance to the Passage of Sound, 2003

- 11.5 Sound separation between and within residential properties and residential types of accommodation is governed by The Building Regulations 2000 (Ref. 11.1). Approved Document E: 2003 Edition (ADE 2003) of The Building Regulations 2000 is applicable to the residential elements of the four Development Scenarios in that it specifies minimum sound insulation to be approved by the Local Planning Authority (LPA) Building Control Department (or other such approved inspectors). A summary of the performance objectives of ADE 2003 is presented within Section 4.2.3 of Technical Appendix 11a.

National Planning Policy

Planning Policy Guidance Note 24: Planning and Noise, 1994

- 11.6 The principal purpose of Planning Policy Guidance (PPG) 24 (Ref. 11.2) is to determine the suitability of land for proposed residential development, particularly where land is affected by noise from transportation sources.
- 11.7 PPG24 provides advice on how the planning system can be used to minimise the adverse effects of noise without placing unreasonable restrictions on development or adding unduly to the costs and administrative burden of business. It outlines some of the main considerations which LPAs should take into account when determining planning applications for development that:
- Will generate noise; and/or
 - Be exposed to existing noise sources.

- 11.8 In relation to residential development, the guidance is presented in terms of four Noise Exposure Categories (NECs). These range from NEC A (where noise need not normally be considered in determining planning applications) to NEC D (where planning permission should normally be refused on noise grounds). Further detail on the guidance contained within PPG24 is presented within Section 4.2.3 of Technical Appendix 11a and later in this chapter.
- 11.9 A number of measures can be used to reduce noise exposure. PPG24 mentions three principal areas where noise control measures can be introduced. These are:
- **Engineering:** Reduction of noise at source, or by containment of noise, and by protecting noise sensitive buildings;
 - **Layout:** Providing adequate distance between the noise source and noise sensitive buildings, and by screening using natural barriers such as buildings or non-critical rooms in a building; and,
 - **Administrative:** Limiting times of operation, restricting activities on-site, or specifying an acceptable noise limit.

Regional Planning Policy

The London Plan: Spatial Strategy for Greater London, 2008

- 11.10 The London Plan (Ref. 11.3) considers the potential noise effects of new development in Policy 4A.20. This policy provides guidance to the London Boroughs on policies for controlling noise. Policy 4A.20 states that noise levels should be reduced through:

“...separating new noise sensitive development from major noise sources wherever practicable...” and also “...reducing the impact of traffic noise through highway management and transport policies”.

The Mayor’s Ambient Noise Strategy, 2004

- 11.11 The Mayor’s Ambient Noise Strategy (Ref. 11.4) sets out policies to maintain and reduce ambient noise levels within London, with particular regard to roads, railways and aircraft. The Strategy acknowledges that the Mayor seeks to build a more sustainable city, which is more compact, thus requiring exemplary standards of acoustic design, including better sound insulation for new homes.
- 11.12 Policies 69 and 70 of the Strategy specifically relate to new development. The policies require a noise assessment to be carried out for sites where noise levels are above NEC A, as specified in PPG24. Such assessment must also demonstrate that potential noise issues are addressed to ensure a satisfactory standard of noise in and around the new development in question. Additionally, the Strategy stipulates that any adverse noise effects from a proposed development must be minimised both within, and in the vicinity of, the proposals.

Local Planning Policy

Westminster City Council Replacement Unitary Development Plan, 2007

- 11.13 Policies ENV6 and ENV7 of WCC’s Replacement Unitary Development Plan (UDP) (Ref.11.5) sets out Westminster’s policies for controlling noise. It aims to:
- Reduce noise levels to below levels set out in World Health Organisation (WHO) Guidelines;
 - Limit and contain noise from development;
 - Protect noise sensitive properties from noise disturbance; and
 - Reduce noise from transport.

Westminster City Council Supplementary Planning Guidance 'Sustainable Buildings', 2003

- 11.14 The WCC Supplementary Planning Guidance (SPG) 'Sustainable Buildings' (Ref. 11.6) sets out WCC's objectives to minimise noise from development and to ensure that noise effects on adjoining properties are avoided and/or mitigated.

Westminster City Council Victoria Area Planning Brief, 2006

- 11.15 The Victoria Area Planning Brief (VAPB) (Ref. 11.7) requires that proposed developments must not harm the residential amenity of the Victoria area. The VAPB also requires developers and their contractors to adhere to WCC's Code of Construction Practice (CoCP). The CoCP defines environmental standards and procedures to be undertaken in relation to construction works, including noise and vibration management.

Westminster City Council Code of Construction Practice, 2008

- 11.16 With regards to noise and vibration, WCC's CoCP (Ref. 11.8) stipulates that all contractors are required to:

"...control and limit noise and vibration levels, as far as is reasonably practicable, so that dwellings and other sensitive receptors are protected from excessive noise and vibration levels arising from construction activities".

- 11.17 Further details relating to the CoCP are provided within Chapter 6: Demolition and Construction.

Other Relevant Guidance**British Standard 5228 - Noise Control on Construction and Open Sites. Part 1:1997 and Part 4:1992**

- 11.18 Parts 1 and 4 of BS 5228 (Refs. 11.9 and 11.10) provide guidance on the assessment of noise and vibration effects during the redevelopment of a site. It includes procedures for estimating noise levels from construction activities and vibration attributable to piling activities. However, it comments that acceptable noise limits should be defined on a site-specific basis. BS 5228 also provides guidance on minimising potential effects through the use of mitigation and the adoption of Best Practicable Means (BPM).
- 11.19 In particular, Part 4 provides guidance on levels that can cause damage to structures from piling. In addition to the absolute vibration level, other factors to consider in assessing vibration are identified as being the nature of the vibration (transient or continuous), its frequency content and the type and condition of the exposed structures.

British Standard 8233 - Sound Insulation and Noise Reduction for Buildings, 1999

- 11.20 BS 8233 (Ref. 11.11) is a 'Code of Practice' providing guidelines for the control of noise in and around buildings. It recommends internal and external noise levels to provide both a 'good' and 'reasonable' acoustic environment for residential properties. A more detailed summary of the BS 8233 guidance for residential properties is presented within Section 4.2.3 of Technical Appendix 11a.

World Health Organisation - Guidelines for Community Noise, 2000

- 11.21 The World Health Organisation (WHO) Guidelines for Community Noise (Ref. 11.12) provides guidance of a similar nature to BS 8233. However, it places more emphasis on the potential health effects associated with noise. Specifically, the document recommends internal and external noise levels that would provide an acoustic environment that is conducive to uninterrupted speech and sleep. Again, a more detailed summary of the WHO guidance, including the recommended noise levels for residential properties, is presented within Section 4.2.3 of Technical Appendix 11a.

British Standard 4142 - Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas, 1997

- 11.22 PPG24 makes reference to BS 4142 (Ref. 11.13) as being the appropriate guidance for assessing new commercial operations and the related effects of new building services plant noise. As such, BS 4142 provides an objective method for rating the likelihood of complaint from industrial and commercial operations whilst also providing a means of determining noise levels from fixed building services plant installations, and prevailing background noise levels on, and around, proposed developments. A more detailed summary of the BS 4142 assessment method is presented within Section 4.2.2 of Technical Appendix 11a.

Institute of Acoustics Good Practice Guide on the Control of Noise from Pubs and Clubs, 2003

- 11.23 The Institute of Acoustics Good Practice Guide on the Control of Noise from Pubs and Clubs (Ref. 11.14) provides guidance for the assessment and control of noise affecting noise sensitive properties from pubs, clubs and other similar premises.

British Standard 6472 - Evaluation of Human Exposure to Vibration in Buildings (1Hz - 80Hz), 1992

- 11.24 BS 6472 (Ref. 11.15) provides guidance on the measurement and assessment of vibration within buildings that may cause adverse disturbance to human occupants.
- 11.25 BS 6472 introduces the concept of Vibration Dose Values (VDVs) for intermittent vibration assessment, together with reference curves for continuous vibration assessment. This document includes a series of permissible maximum vibration spectra for various types of buildings. These can be used to determine allowable levels of vibration from construction activities with respect to neighbouring developments. A more detailed summary of the guidance is presented within Section 4.1.2 of Technical Appendix 11a.

British Standard 7385 - Evaluation and Measurement for Vibration in Buildings, 1990

- 11.26 British Standard (BS) 7385 Part 1: 1990 and Part 2: 1993 (Refs. 11.16 and 11.17) establish the basic principles for carrying out vibration measurement and evaluating vibration effects on buildings. BS 7385 also gives guidance on the levels of vibration above which building structures could be damaged.

ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA**Assessment Methodology**

- 11.27 The methodology employed for the assessment of noise and vibration in relation to the four Development Scenarios has included the following:
- Consultation with WCC regarding noise and vibration issues including the scope of the assessment and agreement of the potentially sensitive noise and vibration receptors;
 - Confirmation of the potentially sensitive noise and vibration receptors through a detailed review of existing plans, plans of the four Development Scenarios and a walkover survey;
 - Establishment of baseline conditions currently existing at the application sites via unmanned and manned noise monitoring surveys carried out during November and December 2006. This monitoring was updated in June 2007 to take into account the extended Congestion Charging Zone (CCZ) which now encompass each of the application sites (refer to Chapter 9: Transportation and Access). A further monitoring survey was undertaken along Buckingham Palace Road for a PPG24 assessment in March 2008 (refer to Technical Appendix 11b);

- Establishment of existing London Underground Limited (LUL) train induced vibration levels at representative locations around the application sites via measurement surveys undertaken during November 2006 (refer to Technical Appendix 11c);
- Prediction and assessment of indicative noise and vibration levels likely to be associated with the demolition and construction of the four Development Scenarios at representative locations within and around each application site. Such effects have been established for each of the key construction phases ('Timeslices');
- Prediction and assessment of changes in noise levels associated with the completed and occupied Development Scenarios;
- Establishment of noise criteria for fixed plant associated with the four Development Scenarios;
- Assessment of the suitability of each of the application sites for residential accommodation;
- Formulation of mitigation measures where appropriate; and
- Assessment of residual noise and vibration effects.

11.28 Further technical details pertaining to the methodologies used are provided in Section 5 of Technical Appendix 11a.

Demolition and Construction

- 11.29 The prediction of the likely noise and vibration levels anticipated during the demolition and construction programme has been carried out based on the methodology contained within BS 5228, together with assumptions of the working practices likely to be employed during the demolition and construction works. However, it is acknowledged that vibration levels from construction activities are highly dependent on ground conditions, underlying geology and construction techniques.
- 11.30 Details regarding the types of construction methods and plant likely to be used for each development programme Timeslice are described in Chapter 6: Demolition and Construction. As such 'worst case' and 'typical-case' L_{Aeq} free-field noise levels have been calculated, based upon L_{Aeq} noise levels for each item of plant/machinery, obtained from:
- Defra's 'Update of noise database for prediction of noise on construction and open sites' (Ref. 11.18);
 - Hann Tucker Associates' in-house database; and/or
 - BS 5228 Part 1: 1997.
- 11.31 Demolition and construction noise and vibration predictions initially consider the potential effects at the nearest sensitive buildings for each Development Scenario. As such, the assessment of potential effects considers the worst case conditions for each Timeslice of the overall demolition and construction programme. Under these worst case conditions it is assumed, for example, that plant and machinery would be located close to noise-sensitive receptors without screening and that all plant and machinery would operate constantly during permitted construction hours.
- 11.32 In contrast to these worst case conditions, the typical case residual effects assume that mitigation measures such as locating plant and machinery away from noise-sensitive properties and installing screening attenuation would exist. Under the typical case conditions, all plant and machinery is assumed to operate for 4.5 hours out of every 9 hour working day, and the environmental management controls detailed later in this chapter and Chapter 6: Demolition and Construction are assumed to be successfully implemented. An assessment of these residual effects is then provided, assuming the mitigation measures have been implemented.
- 11.33 With respect to vibration, effects could occur to people, equipment within buildings, or buildings and other structures themselves. However, it should be noted that significant damage to buildings through vibration from construction works is comparatively rare and most demolition and construction activities do not give rise to vibration levels of a magnitude that would be damaging, as defined within BS 6472.

Completed Development

Suitability of the Application Sites for Residential Development

- 11.34 The assessment of existing and future levels of noise affecting the proposed residential elements of each of the four Development Scenarios has been undertaken in accordance with the methodology contained within PPG24.
- 11.35 As previously noted, PPG24 recommends the use of four NEC bands, designed to assist LPAs in evaluating the appropriateness of sites for residential development. Tables 11.1 and 11.2 show each NEC band together with relevant planning advice contained within PPG24.

Table 11.1: PPG24 NEC Advice

NEC	Planning Advice
A	Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.
B	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	Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.
D	Planning permission should normally be refused.

Table 11.2: Recommended Noise Levels for the Varying NEC Categories (for new Dwellings in Proximity to Existing Noise Sources)

Noise Source / Time of Day	Noise Levels Corresponding to NECs for New Dwellings $L_{Aeq,T}$ dB			
	NEC A	NEC B	NEC C	NEC D
Road Traffic				
07:00 – 23:00 hours	<55	55 – 63	63 – 72	>72
23:00 – 07:00 hours	<45	45 – 57	57 – 66	>66

- 11.36 A computer model was utilised to predict NEC categories for each residential façade within the proposed Development Scenarios. Where measured noise levels fall within NECs B to D, PPG24 suggests the LPA would require an appropriate noise assessment to identify the mitigation measures necessary to achieve suitable levels of noise. Therefore, this assessment has identified the NEC levels for the proposed residential elements each of the four Development Scenarios.
- 11.37 PPG24 states: “Guidance on suitable internal noise levels can be found in BS 8233: 1987”. However, BS 8233: 1987 has been withdrawn and replaced by BS 8233: 1999. This notes that reasonable resting and sleeping conditions in living rooms and bedrooms can be achieved by the target $L_{Aeq,T}$ internal noise levels shown in Table 11.3.

Table 11.3: BS 8233: 1999 Target $L_{Aeq,T}$ Internal Noise Levels

Room Type	$L_{Aeq,T}$	
	Good	Reasonable
Living Room	30dB	40dB
Bedrooms	30dB	35dB

- 11.38 BS 8233: 1999 also states: “For a reasonable standard in bedrooms at night, individual noise events (measure with F time-weighting) should not normally exceed 45dB L_{Amax} ”.
- 11.39 The aforementioned WHO document (Guidelines for Community Noise) provides guideline noise values as set out in Table 11.4 for community noise in specific environments.

Table 11.4: WHO Guideline Values for Community Noise in Specific Environments

Specific Environment	Critical Health Effect(s)	L_{Aeq}	$L_{Amax,fast}$
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35dB	-
Inside bedrooms	Sleep disturbance, night-time	30dB	45dB

- 11.40 The WHO document also notes: “For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dBA L_{Amax} more than 10-15 times per night”
- 11.42 WCC’s design requirement for new residential dwellings are:
- An indoor daytime noise level of no more than 35dB $L_{Aeq,16hours}$; and
 - An indoor night-time noise level of no more than 30dB $L_{Aeq,8hours}$ for bedrooms.
- 11.41 The formulation of appropriate noise mitigation for the residential components of the Development has given due consideration to the above design requirements.

Road Traffic Noise

- 11.42 Due to the nature of the application sites (in particular, their locations within an urban context and surrounded by a comprehensive road network), it is anticipated that the key noise effects to existing noise receptors would be associated with changes in road traffic noise on completion and operation of the Development Scenarios.
- 11.43 The assessment of road traffic noise has followed the noise prediction procedures as detailed in the Department of Transport and Welsh Office’s ‘The Calculation of Road Traffic Noise’ (CRTN) (Ref.11.19). This uses criteria to compare changes between the existing traffic noise levels and the future traffic noise levels (with and without any development) at nearby sensitive receptors.
- 11.44 In order to assess the worst case conditions for each Development Scenario the following periods have been considered (in accordance with CRTN guidance):
- Morning peak hour: 08:00 hours to 09:00 hours;
 - Evening peak hour: 18:00 hours to 19:00 hours;
 - Daytime 16-hours: 06:00 hours to 22:00 hours; and
 - Night time 8-hours: 22:00 hours to 06:00 hours.
- 11.45 The calculation of road traffic noise has been undertaken using traffic data provided by the project transport consultants, Steer Davies Gleave (SDG).

Road Traffic Vibration

- 11.46 The Design Manual for Roads and Bridges (DMRB) Volume 11 (Ref. 11.20) provides broad advice on the assessment of road traffic vibration, noting that ground-borne vibration resulting from road traffic is difficult to accurately predict and that it is extremely unlikely to cause damage to buildings. Notwithstanding this, the DMRB does recognise 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.

- 11.47 The DMRB provides guidance on ambient levels of vibration as Peak Particle Velocities (PPV), stating that for traffic vibration generally a PPV of 0.2 mm/s measured on a floor in the vertical direction is on the threshold of perceptibility, and a level of about 0.5 mm/s is perceptible and may become disturbing or annoying at higher levels. PPVs in the structure of buildings close to heavily trafficked roads rarely exceed 0.2 mm/s and are typically well below 0.1 mm/s. The DMRB also states that there is no firm evidence that structural damage to buildings can occur below 10 mm/s.
- 11.48 All roads surrounding the application sites would be new and in good condition and devoid of speed bumps. It is considered sufficient therefore to assume that vibration from road traffic affecting the residential Buildings 5 and 7b/c would not represent a significant issue. Furthermore, given that it is proposed to vibration-isolate the residential areas of the proposed Building 7b/c from train induced vibration, it is safe to assume that vibration from road traffic would not represent an issue within this building. As such, no further consideration is given to road vibration within this assessment.

Noise from Fixed Plant

- 11.49 Each of the four Development Scenarios would incorporate a range of building services plant which would have the potential to generate noise when operational. However, WCC stipulates acoustic requirements and standards for operational plant and these are routinely imposed by way of suitable planning conditions. These requirements and standards are provided later in this chapter.
- 11.50 This assessment calculates the level of noise attenuation required to achieve WCC's acoustic standards in respect of operational plant. It is also assumed that these standards would be met.

Servicing Noise

- 11.51 In the absence of guidelines for assessing the effects of noise generated by servicing (in this case of the proposed retail and office elements of the four Development Scenarios) professional judgement has been used following a review of the proposed service yard locations and layout, together with servicing traffic information (refer to Chapter 9: Transportation and Access). In addition, the servicing strategy (included within Technical Appendix 9a: Transport Assessment) has been reviewed

Noise Generated by Class A3 and A4 Retail Units

- 11.52 Noise generated by the proposed retail units including shops, restaurants, cafés and drinking establishments (i.e. land use classes A1, A2, A3, A4 and A5) would adhere to the standards and requirements routinely imposed by WCC by way of suitable planning conditions. Details are provided later in this chapter. The assessment therefore assumes that WCC's acoustic standards and requirements would be met.

Underground Train Induced Noise and Vibration

- 11.53 Due to the close proximity of the Underground train network to the application sites (refer to Chapter 3: Existing Land Uses and Activities), the proposed building superstructures are likely to modify the vibration levels produced by the movement of the underground trains. The analysis has assumed the following:
- i. Empirically researched floor amplification factors have been used, as given within 'A Prediction for Rail Transportation Ground-borne Noise and Vibration' (Ref. 11.21) and 'Handbook for Urban Noise and Vibration Control' (Ref. 11.22);
 - ii. The overall maximum recorded vibration levels for different train pass-bys during the survey in 2006 were used;
 - iii. A concrete substructure was assumed where the buildings would be generally supported on piles with the exception of Building 7b/c which would be located above the area safeguarded for the proposed Victoria Station Upgrade (VSU) works;

- iv. The superstructure of the predominantly residential Building 5 overlooking Buckingham Palace Road has been assumed to comprise a concrete frame with pre-stressed or reinforced concrete flat slabs;
- v. The superstructure of the Building 7b has been assumed to comprise lightweight bespoke timber floors and walls with lateral support from concrete cores; and
- vi. The commercial buildings (except Building 7b West) have been assumed to comprise a steel frame with composite beams and concrete slabs on metal decking.

Significance Criteria

- 11.54 In accordance with Chapter 2: EIA Methodology, the assessment of noise and vibration establishes the significance of potential and residual effects. Specific criteria have been devised and applied to each component of the assessment. Details are provided in the following sections.

Demolition and Construction Activities, Plant and Equipment Noise

- 11.55 The guidance contained in BS 5228 does not extend to providing criteria against which to assess construction noise. However, the Department of Environment (DoE) Advisory Leaflet (AL) 72 (1976) 'Noise Control on Building Sites', (Ref. 11.23) gives advice on the maximum levels of construction site noise at residential locations during daytime hours based on levels associated with speech interference. This publication states that during daytime hours (07:00 hours to 19:00 hours) the L_{Aeq} noise level at the building façade should not exceed:
- 75 dBA in urban areas near to main roads in heavy industrial areas; or
 - 70 dBA in rural, suburban and urban areas away from main road traffic and industrial noise.
- 11.56 Given the location of the application sites within central London, and the results of the noise surveys (described later in this chapter), a value of 75dB $L_{Aeq, 8hour}$ has been adopted as an appropriate assessment criterion. It should be noted that this criterion is not proposed as an absolute limit for demolition/construction noise. Rather, it should be considered as a level against which to assess the significance of noise effects associated with demolition and construction activities.
- 11.57 Draft 'Guidelines for Noise Impact Assessments' (Ref. 11.24), published by the Institute of Acoustics and Institute of Environmental Management and Assessment (IEMA), gives guidance on describing the effect of noise based on the change in noise level. This guidance has been adapted for use in this assessment. Accordingly, where the predicted noise due to demolition and construction activities is above the aforementioned assessment criterion, the significance of the excess is assessed as follows:
- **Negligible:** Assessment criterion (i.e. 75 dBA) is exceeded by 0 to 3 dBA;
 - **Minor adverse:** Assessment criterion is exceeded by 3 to 5 dBA;
 - **Moderate adverse:** Assessment criterion is exceeded by 5 to 10 dBA; and
 - **Substantial adverse:** Assessment criterion is exceeded by over 10 dBA.
- 11.58 Despite the above, consideration is also given to the duration of the noise generating activity. If the activity is for a short duration (e.g. a few weeks), the significance of the effect could be reduced by one level (for example an effect of moderate adverse significance be reduced to an effect of minor adverse significance).

Demolition and Construction Activities, Plant and Equipment Vibration

- 11.59 From BS 6472, it can be derived that the peak particle velocity (PPV) level of around 0.56mm/s for a single event for repeated impulsive vibration (such as that due to pneumatic breaking) is the lowest level normally perceptible by humans in buildings. A doubling of this level to 1.12mm/s is generally considered to be an appropriate level in relation to perceptible vibration. Accordingly, below this level, vibration disturbance to occupants of buildings would not be expected.

- 11.60 In addition to the above, BS 6472 gives multipliers corresponding to: “...satisfactory magnitudes of building vibration with respect to human response...”.
- 11.61 As set out in Table 11.5, these multipliers have been used to develop the significance criteria used to determine the relative significance of demolition and construction derived vibration effects upon human receptors.

Table 11.5: Significance Criteria for Demolition and Construction Vibration Effects upon Human Receptors for dwellings (daytime) and offices (based on BS 6472)

Multiplier from BS 6472	Corresponding PPV in mm/s	Significance
Up to 4	Up to 0.56	Negligible
> 4 - 8	> 0.56 - 1.12	Minor adverse
> 8 - 16	> 1.12 - 2.24	Moderate adverse
> 16	> 2.24	Substantial adverse

- 11.62 BS 7385: Part 2: 1993 provides guidance on acceptable values of transient vibration for the avoidance of cosmetic damage to buildings such as the formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces or the formation of hairline cracks in mortar joints of brick, concrete construction. The stated levels below which there is a minimal risk of cosmetic damage are 15mm/s at 4Hz, rising to 20mm/s at 15Hz, further increasing to 50mm/s at 40Hz and above. BS 7385 also suggests that building damage is highly unlikely at vibration levels less than 12.5mm/s.
- 11.63 In addition to the above, BS 7385 gives specific vibration limits that are judged to represent a minimal risk of vibration-induced damage. As shown in Table 11.6 these vibration limits can be applied to different types of buildings and structures. It should be noted that the damage threshold is taken as cosmetic damage not structural failure and that in most situations, although cosmetic damage may be possible to buildings located within approximately 20m of piling activities, at greater distances damage is much less likely to arise.

Table 11.6: Significance Criteria for Demolition and Construction Vibration Effects upon Buildings and Structures

Building or Structure Type	Intermittent vibration ppv (mm/s)	Continuous vibration ppv (mm/s)
Listed buildings or ancient monuments.	5	2.5
Houses or houses converted into flats.	5	2.5
Tower blocks, office blocks, steel framed factories, warehouse units and structures related to transport, power or water services.	20	10

Note: Impulsive piling is considered to give rise to intermittent vibration whereas vibratory piling is considered to give rise to continuous vibration.

- 11.64 The severity (and therefore significance) of the effect is assessed on an individual basis, taking into account the use of the property.

Demolition and Construction Traffic Noise

- 11.65 The Design Manual for Roads and Bridges (DMRB) Volume 11 (Ref. 11.25) gives advice on the assessment of noise effects due to changes in road traffic. The DMRB indicates that a sudden 1dB change in noise level is 'just' perceptible, and a change in noise level of less than 1dB is considered to be imperceptible. However, PPG24 states that a change in noise level of 3dB (equivalent to a doubling or halving of the total flow of traffic) is 'just' perceptible. PPG24 regards a change in the noise level of 1dB as being perceptible only under controlled conditions.
- 11.66 On the basis of the advice contained in the DMRB and PPG24, Table 11.7 details the subjective human response relating to the change in the level of road traffic noise and the significance criteria applied to the road traffic noise assessment.

Table 11.7: Significance Criteria for Changes in Road Traffic Noise

Change in Noise Level	Subjective Response	Significance (Beneficial or Adverse)
Up to 1 dBA	Imperceptible change in loudness	Negligible
1 to 3 dBA	Just perceptible change in loudness	Minor
4 to 5 dBA	Perceptible change in loudness	Moderate
6 to 10 dBA	Up to a doubling or halving of loudness	Substantial.
11 to 15 dBA	More than a doubling or halving of loudness	Severe

Completed Development

Road Traffic Noise

- 11.67 The significance of effects generated by road traffic noise associated with the completed and operational Development Scenarios uses the same criteria as outlined above within Table 11.7.

Underground Train Induced Re-radiated Noise

- 11.68 Currently no British Standards exist which recommend a method by which to assess intermittent ground-borne or structure-borne noise, such as that induced by trains.
- 11.69 Whilst there is no widely accepted method of evaluation of ground-borne noise, there is some consensus that for levels at and above 50dBA L_{smax} during daytime, there is likely to be significant adverse reaction. For residential situations, the L_{smax} noise levels for which there are likely to be very little adverse comment can be taken as around 30dBA during the daytime and around 25dBA during night time. These levels do not equate to the train pass-by being inaudible, but are considered to be reasonable.
- 11.70 Re-radiated noise is of greatest concern when it is the dominant noise, and also when the source cannot be seen, as in the case of trains in a tunnel. Criteria for re-radiated noise are therefore generally intended to apply to sources such as underground trains. In the UK a criterion of 40dBA (often used by LUL), measured in terms of L_{smax} , is considered unlikely to provoke adverse comment or complaint in a commercial environment. For residential premises we would advise in favour of a criterion of 35dBA, measured in terms of L_{smax} .
- 11.71 It should be noted that these guidance noise levels do not take into account high levels of incident environmental noise levels. The assessment of the potential effects has, therefore, taken into account the current dense, urban location of the application sites and the consequent relatively high levels of incident environmental noise (mainly due to vehicle movement) which often masks train induced re-radiated noise. Professional judgement has been used to assign significance criteria to potential effects, taking into account the above mentioned guidance noise levels and the existing noise climate around the application sites.

Underground Train Induced Vibration

- 11.72 Perceptible levels of vibration are deemed acceptable for intermittent events, such as train pass-bys. British Standard BS 6472 provides a methodology to assess such intermittent events by means of the eVDV. (estimated Vibration Dose Value).
- 11.73 This guidance indicates for a low probability of adverse comment the eVDV ($\text{m/s}^{1.75}$) should be:
- 0.2 to 0.4 $\text{m/s}^{1.75}$ during the daytime (07:00 – 23:00); and
 - 0.13 $\text{m/s}^{1.75}$ during the night-time (23:00 – 07:00)

Fixed Plant

- 11.74 For building services plant, reference is made to the methodology described in BS 4142 for determining the likelihood of complaints. The significance criteria are therefore based upon a comparison of the noise levels generated by the operation of the plant (L_{Aeq}), incorporating a 5dB(A) penalty should the noise be intermittent or tonal in nature (known as the Rating Level) compared to the existing background (L_{A90}) noise levels. BS 4142 is only relevant to assessment of noise increases above the existing background level. The significance criteria adopted are shown below:
- **Substantial beneficial:** Not applicable;
 - **Moderate beneficial:** Not applicable;
 - **Minor beneficial:** Not applicable;
 - **Negligible:** Rating Level of up to 3dB above background;
 - **Minor adverse:** Rating Level more than 3dB to less than 6dB above background;
 - **Moderate adverse:** Rating Level 6dB to less than 10dB above background; and
 - **Substantial adverse:** Rating Level 10dB or more above background.

BASELINE CONDITIONS

Identification of Existing and Future Sensitive Receptors

- 11.75 A desk based review of current maps, the Development Scenario proposals and a walkover survey of the application sites and their surrounds has identified a number of existing and proposed noise and vibration sensitive receptors for each Development Scenario. These have been agreed with WCC and are listed in Table 11.8, which should be read in conjunction with Figure 11.1. This figure shows the location of the receptors, with the exception of those which would be removed during the early stages of the demolition and construction programme. Table 11.8 is generally applicable to all four Development Scenarios although, where differences between Development Scenarios exist, this is noted.

Table 11.8: Noise and Vibration Sensitive Receptors (Development Scenarios 1, 2, 3 and 4)

Sensitive Receptor	Reference on Figure 11.1.
Existing Residences Within the Application Sites	
Allington Towers, 19 Allington Street (to be demolished during Timeslice 2)	1
Existing Residences Surrounding the Application Sites (to be Occupied During all Stages of the Demolition and Construction Programme)	
Flats above the Duke of York Pub	2
Flat above the Shakespeare Public House, 91-99 Buckingham Palace Road	3
Flat above Bureau de Change, 185 Victoria Street	4
8, 10, 12, 14, 16, 18, 20, 22 and 24 Buckingham Palace Road	5
26, 28, 30 and 40 Buckingham Palace Road	6
Evelyn Mansions, Vauxhall Bridge Road	7
Roebuck House, Palace Street	8
300-310 Vauxhall Bridge Road	9
Proposed Residences Within the Application Sites (to be Occupied During the Later Stages of the Demolition and Construction Programme)	
Residential units within Building 5 (to be occupied from Timeslice 7 onwards)	n/a
Residential units within Building 7b (to be occupied from Timeslice 10 within Development Scenarios 1 and 2 only)	n/a
Existing Non-Residential Receptors Surrounding the Application Sites (to be Occupied or Operational During all Stages of the Demolition and Construction Programme)	
Grade II listed Victoria Palace Theatre, Victoria Street.	A
Grade II* listed Apollo Victoria Theatre.	B
Hotel Rubens, Buckingham Palace Road.	C
Grade II listed Grosvenor Thistle Hotel.	D
Goring Hotel, Beeston Place.	E
Grade II listed Victoria Station Façade.	F ¹
Grade II listed Little Ben Clock	G ¹

Note 1: It is assumed that the façade of the Grade II listed Victoria Station and the Grade II Little Ben Clock would be sensitive to vibration only.

- 11.76 It should be noted that occupants of commercial (offices and retail) properties are generally considered to be less sensitive to noise, and have therefore been excluded from further consideration within this assessment. This approach has been agreed with WCC.

Existing Noise Levels and Sources

Noise Sources

- 11.77 As previously noted the existing baseline noise environment in and around the application sites has been established from manned and unmanned noise surveys undertaken between:
- 23-28 November 2006;
 - 8-13 December 2006;
 - 15 -19 December 2006;
 - 17-22 May 2007;
 - 29 May 2007; and
 - 7-14 March 2008.
- 11.78 Throughout the duration of the manned surveys the dominant source of noise was noted to be associated with traffic from the surrounding roads. This traffic included a significant number of buses and taxis passing through and setting down/picking up. Road traffic noise dominated the noise climate at the three main arterial roads surrounding the application sites (i.e. Buckingham Palace Road, Bressenden Place and Victoria Street). Noise was also generated from pedestrian movements, principally in the vicinity of Victoria Street.

Noise Levels

- 11.79 The surveys were undertaken at six unmanned and 13 manned representative locations in and around the application sites. The monitoring locations are shown on Figure 11.2. Full details of the noise monitoring surveys are provided within Technical Appendix 11b.
- 11.80 The noise monitoring surveys revealed that noise levels around the application sites vary significantly. The noisiest location was on Victoria Street, where the noise levels reached 82dB $L_{Aeq(15min)}$ during the daytime and did not fall below 67dB $L_{Aeq(15min)}$ during the night-time. The quietest location was on Allington Street, where the noise levels did not exceed 68dB $L_{Aeq(15min)}$ during the daytime and fell to 58dB $L_{Aeq(15min)}$ at night.
- 11.81 With regard to the proposed residences, Table 11.9 presents the arithmetic average of the daytime $L_{Aeq(16-hour)}$ and night-time $L_{Aeq(8-hour)}$ noise levels measured at the Royal Westminster Hotel and the flat above the Stag Public House. These survey positions are most representative of the proposed residential Buildings 5 and 7b/c respectively. Building 5 would be included within all four Development Scenarios; Building 7b/c would be included in Development Scenarios 1 and 2 only.

Table 11.9: Existing Free Field Daytime and Night Time Noise Levels at Survey Positions Located Closest to the Proposed Residential Elements of the Development

Position (refer to Figure 11.2)	Location	Daytime $L_{Aeq(16\text{ hour})}$	Night Time $L_{Aeq(8\text{ hour})}$
E	Royal Westminster Hotel, on Buckingham Palace Road.	72dB	68dB
F	Flat above the Stag Public House, on Bressenden Place.	71dB	68dB

Note: The above noise levels are averaged direct from measured levels. They have been corrected for façade reflections and distance attenuation.

Existing Vibration Sources and Levels

Vibration Sources

- 11.82 The District and Circle LUL Line runs east-west across the application sites (refer to Figure 3.4). Timetabled District Line train movements occur every few minutes from 05:20 hours to 00:40 hours Monday to Saturday, and 06:50 hours to 00:05 hours on Sundays and Bank Holidays.
- 11.83 The Victoria LUL Line runs approximately north-south under the eastern edge of the Application 1 site and directly under the Application 2 and 3 sites. Timetabled Victoria Line train movements occur every few minutes from 05:34 hours to 00:34 hours Monday to Friday, and 07:00 hours to 00:00 hours on Sundays and Bank Holidays.

Vibration Levels

- 11.84 The existing LUL train induced vibration levels within the application sites were established from surveys undertaken on 8th and 24th November 2006. Train movements were perceptible as surface vibration for the majority of pass-bys in the basement, ground floor and first floor of 124 Victoria Street (monitoring location 1) (within the Application 2 site) and Elliott House (monitoring location 2) (within all three application sites). Monitoring locations are shown on Figure 11.2. Full details of the surveys are provided within Technical Appendix 11c.
- 11.85 Re-radiated noise due to train induced vibration was clearly audible at every measurement position and consultation with the occupants of the Grade II listed Victoria Palace Theatre confirmed that train induced re-radiated noise is clearly audible within the theatre during speech deliveries.

POTENTIAL EFFECTS

Demolition and Construction

Development Scenarios 1, 2, 3 and 4

Demolition and Construction Activities, Plant and Equipment Noise

- 11.86 Based upon the predicted source noise levels associated with demolition and construction activities, calculations of noise levels for Development Scenario 1 have been made at the potentially most affected on-site and off-site noise-sensitive locations (refer to Figure 11.1) using the methodology described in BS 5228. Predicted worst-case $L_{Aeq(8hr)}$ noise levels for each Timeslice at the various noise sensitive receptors within and around the application sites are presented for Development Scenario 1 in Table 11.10. More detailed information is provided in Table L within Technical Appendix 11a.

Table 11.10: Predicted LAeq(8hr) Noise Levels at Sensitive Receptors during Demolition and Construction Timeslices (Development Scenario 1)

Sensitive Receptor	Predicted L _{Aeq(8hr)} per Timeslice (without mitigation measures)				
	Timeslice 1	Timeslice 2	Timeslice 3	Timeslices 4, 5 & 6	Timeslices 7, 8, 9 & 10
1 Allington Towers	90		n/a – demolished		
2 Flat above Duke of York Pub	89	88	87	91	85
3 Flat above Shakespeare Pub, 91-99 Buckingham Palace Road	80	81	77	80	77
4 Flat above Bureau de Change, 185 Victoria Street	84	81	78	83	77
5 8-24 (evens) Buckingham Palace Road	80	83	80	86	76
6 26-40 (evens) Buckingham Palace Road	85	86	83	82	78
7 Evelyn Mansions	82	83	78	75	76
8 Roebuck House	73	74	71	75	74
9 300-310 Vauxhall Bridge Road	72	72	69	62	63
A Victoria Palace Theatre, Victoria Street	82	88	90	89	90
B Apollo Victoria Theatre	74	75	72	77	78
C Hotel Rubens	81	76	74	86	80
D Grosvenor Hotel	72	73	70	66	70
E Goring Hotel, Beeston Place	74	76	72	77	73

11.87 More detailed consideration of the demolition and construction activities with respect to each of the four Development Scenarios is presented in Tables L, M, N and O in Technical Appendix 11a. It should be borne in mind that the following overall timescales have been assumed for each Development Scenario (refer to Chapter 6: Demolition and Construction for more detail):

- Development Scenario 1: Quarter 1 2010 to Quarter 1 2017;
- Development Scenario 2: Quarter 1 2010 to Quarter 1 2017;
- Development Scenario 3: Quarter 1 2010 to Quarter 4 2016; and
- Development Scenario 4: Quarter 1 2010 to Quarter 4 2014.

11.88 Table 11.10 indicates that the effects of demolition and construction noise for Development Scenario 1 would vary greatly according to the Timeslice and the location of the sensitive receptor. However, it can be seen that sensitive receptors 1, 2, 3, 4, 5, 6, 7, A and C would experience, in the absence of mitigation, **short to medium term, local** effects of **moderate to substantial adverse** significance during at least one Timeslice. Conversely, sensitive receptors 8, 9, B, D and E would not exceed the 75dBA assessment criterion by more than 3dBA in any Timeslice and, therefore, would experience effects of, at worst, **negligible** significance.

- 11.89 The assessments for Development Scenarios 2, 3 and 4 produce very similar results to Development Scenario 1. For Development Scenarios 2, 3 and 4, sensitive receptors 1, 2, 3, 4, 5, 6, 7, A and C would again experience, in the absence of mitigation, **short to medium term, local** effects of **moderate to substantial adverse** significance during at least one Timeslice. Sensitive receptors 8, 9, B, D and E would again experience effects of, at worst, **negligible** significance.
- 11.90 It should be re-iterated that the above assessments are absolute worst case assessments which assume the continuous operation of plant, close to noise-sensitive receptors, without screening and do not take account of any mitigation measures.

Demolition and Construction Activities, Plant and Equipment Vibration

- 11.91 There are no recognised standards presenting methodologies for predicting vibration levels due to demolition or construction. However, based upon the preliminary information on construction plant and machinery and associated activities, it is considered likely that there would be some localised and temporary adverse vibration effects during the demolition and construction phases at the properties surrounding the application sites. Effects would only be likely to occur at the closest sensitive receptors (refer to Figure 11.1). In the absence of mitigation measures, it is considered that any such effects would be, at worst, **short to medium term, local** and of **minor adverse** significance for each of the four Development Scenarios.

Demolition and Construction Traffic Noise

- 11.92 As shown in Figure 6.17, within and in proximity to the three application sites, the construction traffic routes would include Victoria Street, Bressenden Place, Allington Street and Buckingham Palace Road.
- 11.93 Although construction vehicles associated with the four Development Scenarios would have the potential to generate noise, the estimated numbers of vehicles would be a very small proportion of the existing road traffic movements. Reference to Chapter 9: Transportation and Access indicates that peak hour construction vehicles generated by each of the four Development Scenarios would amount to 1.7 – 1.8% of total peak hour traffic on the construction traffic routes noted above. Accordingly, the traffic noise generated by this increase in road traffic would be less than 1dB(A). Therefore, the potential effects upon surrounding receptors would be **negligible**.

Completed Development

Development Scenarios 1, 2, 3 and 4

Suitability of the Application Sites for Residential Development

- 11.94 Figure 11.3 presents three-dimensional noise maps of Building 5 (within all four Development Scenarios) and Building 7b/c (within Development Scenarios 1 and 2 only) with reference to the NEC criteria presented in Tables 11.1 and 11.2. Due to the small difference between the predicted daytime and night-time noise levels at the application sites, and the more stringent criteria for the latter, the night-time period has been taken as the 'worst case' situation. Figure 11.3 demonstrates that the proposed residential façades of Building 5 fall into the following NEC categories:
- **NEC D:** where façades have a direct line of sight of Buckingham Palace Road, Victoria Street and Bressenden Place (e.g. on the southern, western and northern façades);
 - **NEC C:** at the middle segments of Building 5 façades overlooking Buckingham Palace Road, (e.g. on most of the western façade);
 - **NEC B:** where façades are screened from Victoria Street, Buckingham Palace Road and Bressenden Place (e.g. on much of the eastern façade); and
 - **NEC A:** where the greatest amount of screening from traffic noise is experienced (e.g. parts of the eastern façade).

- 11.95 Reference to Figure 11.3 indicates that the residential façades of Building 7b/c fall into the following NEC categories:
- **NEC D:** where façades have a direct line of sight to both Bressenden Place and Allington Street (e.g. parts of the eastern and northern façades);
 - **NEC C:** where façades have a direct line of sight of Bressenden Place and Allington Street (e.g. parts of the eastern and northern façades);
 - **NEC B:** where façades are screened from Bressenden Place and Allington Street (e.g. the western façade).
 - **NEC A:** where the greatest amount of screening from traffic noise is experienced (e.g. small areas of the northern and western facades).
- 11.96 As noted above, in accordance with PPG24, where proposed residential dwellings fall into NEC B, it is necessary that: *“Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise”*.
- 11.97 With respect to NEC C, PPG 24 notes: *“Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise”*.
- 11.98 With respect to NEC D, PPG 24 notes: *“Planning permission should normally be refused”*.
- 11.99 Therefore, the noise levels on some façades of the proposed residential buildings within all four Development Scenarios would not be suitable for residential use in the absence of appropriate mitigation.

Road Traffic Noise

- 11.100 The predicted changes between existing traffic noise levels and the future traffic noise levels at nearby sensitive receptors are summarised for each of the four Development Scenarios in Table 11.11:

Table 11.11: Potential Effects of Road Traffic Noise

Sensitive Receptor	Dev'nt Scenario	Predicted Change in Noise Level (dB L _{eq,T})			
		Morning Peak Hour	Evening Peak Hour	Daytime 16 hour	Night-time 8 Hour
		08:00-09:00 hours	18:00-19:00 hours	06:00-22:00 hours	22:00-06:00 hours
2 Flat above Duke of York Pub	1	+0.1	+0.1	+0.1	+0.1
	2	+0.1	0.0	+0.1	+0.1
	3	+0.1	0.0	+0.1	+0.1
	4	+0.1	+0.1	+0.1	+0.1
3 Flat above Shakespeare Pub, 91-99 Buckingham Palace Road	1	+0.4	+0.1	+0.2	+0.2
	2	+0.3	+0.1	+0.2	+0.2
	3	0.0	+0.1	+0.1	+0.1
	4	+0.2	+0.2	+0.2	+0.2
4 Flat above Bureau de Change, 185 Victoria Street	1	+0.1	+0.1	+0.1	+0.1
	2	+0.1	0.0	+0.1	+0.1
	3	+0.1	0.0	+0.1	+0.1
	4	+0.1	+0.1	+0.1	+0.1
5 8-24 (evens) Buckingham Palace Road	1	+0.4	+0.1	+0.2	+0.2
	2	+0.3	+0.1	+0.2	+0.2
	3	0.0	+0.1	+0.1	+0.1
	4	+0.2	+0.2	+0.2	+0.2
6 26-40 (evens) Buckingham Palace Road	1	+0.4	+0.1	+0.2	+0.2
	2	+0.3	+0.1	+0.2	+0.2
	3	0.0	+0.1	+0.1	+0.1
	4	+0.2	+0.2	+0.2	+0.2
A Victoria Palace Theatre, Victoria Street	1	+0.1	+0.1	+0.1	+0.1
	2	+0.1	0.0	+0.1	+0.1
	3	+0.1	0.0	+0.1	+0.1
	4	+0.1	+0.1	+0.1	+0.1
C Hotel Rubens	1	+0.4	+0.1	+0.2	+0.2
	2	+0.3	+0.1	+0.2	+0.2
	3	0.0	+0.1	+0.1	+0.1
	4	+0.2	+0.2	+0.2	+0.2
D Grosvenor Hotel	1	+0.4	+0.1	+0.2	+0.2
	2	+0.3	+0.1	+0.2	+0.2
	3	0.0	+0.1	+0.1	+0.1
	4	+0.2	+0.2	+0.2	+0.2

- 11.101 It should be noted that it was considered unnecessary to assess Sensitive Receptors 7, 8, 9, B and E due to their large distance and/or extensive screening from the application sites. It is considered that any change in noise levels at these sensitive receptors due to the road traffic noise generated by any of the four Development Scenarios would be <0.1dB and, therefore, insignificant.
- 11.102 Table 11.11 demonstrates that the differences between levels of road traffic noise with and without any of the four Development Scenarios are minimal. The greatest increase is predicted to not exceed 0.4dB. Such increases would be imperceptible to the human ear and would result in effects of **negligible** significance.

Noise from Fixed Plant

- 11.103 All four Development Scenarios would incorporate fixed plant, which has the potential to generate noise, especially when operating at night when background noise levels are at their lowest. Selected plant within all four Development Scenarios is to be accommodated within the main basement, with the remainder at roof level on Buildings 5, 6b and 7a (within all four Development Scenarios), and Building 6a (within Development Scenarios 1 and 3 only).
- 11.104 All building plant would be designed to meet the requirements of WCC, who normally stipulate a planning condition requiring noise generated by plant to be 10dBA below the background L90 level outside nearby residences. With this design aim implemented as part of the further detailed design, the noise effects anticipated from building service plant would be **negligible** at all receptors for all four Development Scenarios.
- 11.105 Table C of Technical Appendix 11a presents the atmospheric noise emission criteria to be achieved for sensitive receptors surrounding the application sites.

Servicing Noise

- 11.106 The proposed shops, restaurants, cafés and drinking establishments within all four Development Scenarios would generally be serviced via service yards within the buildings. In the absence of mitigation, noise generated from servicing activities would, for example, include traffic movements, noise associated with general delivery activities and the use of reversing beepers. The service yards for all buildings with the exception of Building 7b/c (within Development Scenarios 1 and 2) are to be enclosed within the proposed main basement.
- 11.107 Servicing of Building 7b/c would be via street-level lay-bys and would not be undertaken during night-time hours. It is considered that the high levels of daytime traffic noise along Bressenden Place would mask the majority of the individual noise events from servicing from the on-street lay-bys of the retail premises of Building 7b/c.
- 11.108 Therefore, due to the enclosure of the proposed servicing yards for all buildings except Building 7b/c, the low levels of noise likely from on-street servicing activities for Building 7b/c, compared to existing traffic noise and the separation of servicing areas from residential receptors, it is anticipated that even in the worst case, servicing noise would result in effects of **negligible** significance for all four Development Scenarios.

Noise Generated by Class A3 and A4 Retail Units

- 11.109 The proposed retail (class A3 and A4) units within all four Development Scenarios would comprise cafés, restaurants and drinking establishments (public houses, wine bars or other drinking establishments but not night clubs).
- 11.110 Without mitigation measures, noise from the proposed retail units in Buildings 5 and 7b/c may adversely affect residential units directly above. However, it is anticipated that the proposed retail units would adhere to the following standards and requirements of WCC:

- “Where noise emitted from the proposed internal activity in the Development will not contain tones or will not be intermittent, the ‘A’ weighted sound pressure level from the internal activity shall not at any time exceed a value of 10dB below the minimum external background noise, at a point 1m outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council”; and
- “Where noise emitted from the proposed internal activity in the Development will contain tones or will be intermittent, the ‘A’ weighted sound pressure level from the internal activity shall not any time exceed a value of 15dB below the minimum external background noise, at a point 1m outside any window of any residential property, unless and until a fixed maximum noise level is approved by the City Council.”

11.111 It is also envisaged that the above would be secured by appropriate planning conditions.

11.112 In the absence of suitable mitigation measures, noise effects from the proposed retail uses within all four Development Scenarios would have **long term**, **local** effects of **minor adverse** significance upon the lowest levels of residential units.

Underground Train Induced Noise and Vibration

11.113 The results of a train-induced vibration assessment for the four Development Scenarios are presented in Technical Appendix 11c. VDV’s have been calculated for the proposed buildings in the vicinity of the District and Circle and Victoria Lines. These fall into the range defined within BS 6472 as being of ‘low probability of adverse comment’ for the daytime and night-time periods for Building 6a (within Development Scenarios 1 and 3), Building 7a (within all four Development Scenarios) and the non-residential blocks of Building 7b/c (within Development Scenarios 1 and 2).

11.114 The residential areas of Building 7b/c would be borderline or into the range of ‘adverse comment possible’ in the absence of mitigation measures. However, as noted above, the structure of the residential elements of Building 7b/c would be vibration-isolated.

11.115 It is considered, therefore, that effects of train induced vibration for all four Development Scenarios would be of **negligible** significance.

11.116 The results of a train-induced noise assessment for the four Development Scenarios are also presented in Technical Appendix 11c. Re-radiated train-induced noise is predicted to be below the guidance noise levels in Buildings 5 and 6b (both within all four Development Scenarios) but would exceed the guidance noise levels at Building 6a (within Development Scenarios 1 and 3), Building 7a (within all four Development Scenarios) and Building 7b/c (within Development Scenarios 1 and 2).

11.117 However, the guidance noise levels take no account of high incident noise levels at the application sites. The application sites are surrounded by a busy road network with constant heavy traffic movement (refer to Chapter 9: Transportation and Access) which would be likely to reduce the perception of train movement throughout the three application sites. The effects of masking are less evident at residential developments and when train noise levels are predicted to be of greatest magnitude and therefore the residential elements of Building 7b/c would be vibration-isolated.

11.118 Therefore, it is considered that the effects of train induced noise for all four Development Scenarios would be of **negligible** significance.

MITIGATION MEASURES**Demolition and Construction**

- 11.119 In accordance with modern working practices, the principles of 'best practicable means' (BPM), as defined in the Control of Pollution Act, 1974, (Ref. 11.26) would be used to reduce noise emissions throughout the demolition and construction works to a reasonable and practicable level.
- 11.120 As detailed in Chapter 6: Demolition and Construction, a site-specific Environmental Management Plan (EMP) would be prepared and implemented for whichever Development Scenario is taken forward. The EMP would be agreed in consultation with WCC and would give due regard to WCC's CoCP. With regard to noise and vibration, the EMP would include and/or specify the following routine noise and vibration management controls:
- Detailed programming of works to make maximum use of existing barriers to noise;
 - Retention of the outer walls of buildings for as long as possible before demolition is necessary;
 - Careful selection of demolition/construction methods and plant to be used;
 - Switching off of plant when not in use;
 - Regular maintenance and servicing of vehicles, equipment and plant;
 - Appropriate operational hours (to be agreed with WCC);
 - Enforcement of restricted working hours for excessively noisy activities;
 - Implementation of an appropriate traffic management strategy;
 - Use of temporary acoustic barriers where appropriate and other noise containment measures such as screens, sheeting and acoustic hoardings at the construction site boundary to minimise noise breakout and reduce noise levels at the potentially affected receptors; and
 - Breaking out of concrete structures would be undertaken, where possible, using low noise impact methods including bursting and splitting rather than percussive breaking.
- 11.121 To assist in controlling noise and vibration at specific receptor locations, provision would also be made for the setting of noise and vibration Site Action Values, in discussion with WCC. On-site monitoring of noise and/or vibration would also be undertaken as part of the EMP in order to ensure the Site Action Values are continuously achieved.
- 11.122 If the Site Action Values are exceeded, this would trigger a review of the working activities taking place at the time, and additional environmental management control options or suppression measures would be examined.
- 11.123 If a temporary source of noise or vibration cannot reasonably be prevented and the works being undertaken are crucial to progressing the particular project phase, then separate liaison with WCC and the appropriate neighbours would be held to reach an acceptable compromise.
- 11.124 A further environmental management control option would be for the Demolition and Construction Contractor to negotiate a formal Control of Pollution Act: 1974, Section 61 Agreement 'Prior consent in respect of Works on Construction sites', with WCC, prior to commencement of works. The Contractor would be assisted during their negotiations by acoustic consultants, in order to ensure adequately detailed information is included with the application, in the form of Program Method Statements and lists of plant to be used on a best practical means basis throughout the works.
- 11.125 In addition to the above, reasonable steps would be taken to keep the local community informed of proposed demolition and construction operations. Measures for community liaison would be dealt with by a dedicated Community Liaison Officer to co-ordinate the dissemination of information (for example, by means of a regular newsletter) and to program those operations at times that would minimise the potential for disturbance.

- 11.126 With respect to the potential effects of demolition and construction generated vibration upon the Grade II listed Victoria Palace Theatre and the Grade II listed Little Ben Clock as relevant, prior to commencement of demolition works a detailed condition survey would be carried by the main contractor at these listed buildings. An assessment would also be made to establish appropriate vibration limits that would not adversely affect these listed structures. As such, prior to each phase of works, assessments would be undertaken to predict the likely levels of vibration based upon the exact methodology of the works. If the predicted level of vibration is found to be unacceptable, the contractors would be required to alter their working method to bring operational vibration levels within acceptable limits. Particular attention would be given to vibration from piling and non-percussion techniques would be employed as appropriate.
- 11.127 The above range of environmental management controls represent measures that are regularly and successfully applied to large-scale construction projects in order to minimise noise effects on local communities. The application of similar control measures during the construction of the consented Development Scenario would likewise ensure that the works proceed with the minimum disturbance to local residents, commercial properties, and pedestrians.

Grade II Listed Victoria Palace Theatre

- 11.128 Based upon existing information, the evening performance at the Grade II listed Victoria Palace Theatre is at 19:30 hours Monday to Saturday. These performances, and weekend matinee performances, would therefore generally not be affected by demolition or construction noise as hours of works would be outside these times.
- 11.129 The only weekday matinee performance is currently 14:30 hours on Thursdays. It is anticipated that no noisy or percussive works would take place in the vicinity of the Theatre during the weekday matinee performance.
- 11.130 There should be close liaison with the occupants of the Victoria Palace Theatre regarding the timing of quiet periods in relation to the rehearsals, and the weekday matinee performances, wherever they coincide with site working hours in order to reduce potential noise effects.

Completed Development

Suitability of the Application Sites for Residential Development

- 11.131 Without mitigation, the assessment of potential effects has shown that the proposed residential elements of the four Development Scenarios would generally fall into NECs C or D. Most of the remaining residential facades would fall into NEC B with only small areas of residential façade being classed as NEC A. As such, and in accordance with PPG24, additional mitigation would be required to ensure the achievement of appropriate internal noise levels for residents throughout each of the four Development Scenarios.
- 11.132 At this point, it is important to note that PPG24 considers external noise levels. However, given the intensely urban nature of the application sites, it is considered appropriate that internal noise levels should be the overriding consideration in determining suitability for use. In this respect, PPG24 refers to further guidance provided in BS 8233 (refer to Table 11.3). Taking the guidance set out in BS 8233, together with additional guidance provided within the WHO's Guidelines for Community Noise (refer to Table 11.4), Table 11.12 sets out the internal noise criteria proposed for the residential elements of the four Development Scenarios.

Table 11.12: Proposed Internal Noise Criteria for Residential Elements of the Development

Room Type	Period	Criterion
Living Areas	Daytime (07:00-23:00 hours)	35dB L _{Aeq, 16hr}
Bedrooms	Night Time (23:00-07:00 hours)	30dB L _{Aeq, 8hr}

11.133 In accordance with the above criteria, the internal noise levels achievable in the ‘worst–case’ proposed dwellings (i.e. the northern, southern, north-western and south-western façades of Building 5) have been calculated. These are presented in Table 11.13 together with the proposed internal noise criteria as set out in Table 11.12. It can therefore be seen that even in the worst case, the appropriate internal noise levels as recommended by BS 8233 and WHO would be achievable.

Table 11.13: Predicted Achievable Internal Noise Levels

Location	Predicted Level	Proposed Criterion
Living Room $L_{Aeq,16hour}$	35dB	35dB
Bedroom $L_{Aeq,8hour}$	29dB	30dB
Bedroom $L_{Amax(fast)}$	45dB	45dB

Note: Predicted L_{Amax} levels are based upon a typical external L_{Amax} level

11.134 The residential units would be designed such that they can be naturally or mechanically ventilated depending on the specific requirements of each apartment. Where ventilation would be provided through the façade it would be suitably acoustically attenuated to ensure the achievement of the proposed internal noise conditions would not be compromised.

11.135 At this stage the precise acoustic performance specifications for the windows cladding and vents to be used within any of the Development Scenarios have not been determined. This information would be provided to WCC when available at the later stages of detailed design. However, it is envisaged that the requirement for such detail (which would not compromise the achievement of the proposed internal noise criteria) would be secured by a suitable planning condition.

Road Traffic Noise

11.136 No significant increases in road traffic noise are predicted at any sensitive receptor as a result of the completion and operation of any of the four Development Scenarios. Therefore, no mitigation would be required in respect of road traffic noise.

Noise from Fixed Plant

11.137 As stated earlier in this chapter, all building plant within all four Development Scenarios would be designed to meet WCC’s requirements. Accordingly, plant would be selected, located and silenced so that these emission criteria are satisfied. It is likely that a combination of the following environmental noise control techniques would be implemented:

- Enclosing noisy plant within the building envelope;
- Selecting suitably quiet ‘low noise’ plant;
- Positioning air intake/discharge louvres away from noise sensitive receptors;
- Orientating air intake/discharge louvres away from noise sensitive receptors;
- Attenuation of air intake/discharge louvres with duct mounted attenuators and/or acoustic louvres; and
- Sound insulating plant housings/enclosures/rooms.

11.138 Structure borne vibration transfer from fixed plant to residential buildings would be considered at the detailed design stage. Where necessary, anti-vibration mountings would be used.

Servicing Noise

11.139 A servicing management plan would be implemented to control service vehicles movements. As the proposed service yards for all buildings, other than Building 7b/c, are to be located within the basement and separated from residential receptors, no further mitigation would be required in respect of servicing noise. Street lay-bys for servicing at Building 7b/c would only be used during the daytime when the noise climate would be subject to high levels of background noise from existing vehicle traffic. Therefore, again, no further mitigation measures would be required.

Noise Generated by Class A3 and A4 Retail Units

11.140 It is anticipated that, in the absence of mitigation, there would be minor adverse effects at nearby residential receptors arising from the use of the proposed retail (class A3 and A4) land uses. Therefore, additional measures would be implemented to ensure the protection of residential amenity. Accordingly, further detailed design would make reference to the guidance set out within the Institute of Acoustics 'Good Practice Guide on the Control of Noise from Pubs and Clubs'. This document recommends the following control measures for cafés and restaurants:

- The determination of appropriate levels of sound insulation based on realistic source and reception levels;
- The construction of cavity masonry walls, including insulation where necessary;
- The provision of lobbies with automatic door-closures for entrances and exits to premises;
- The provision of well sealed acoustic doors at emergency exits;
- The provision of windows with appropriate sound insulating qualities;
- The provision of air conditioning or similar to negate the necessity to open windows;
- The control of music noise at source;
- The installation of sound level regulatory devices;
- Careful design of loudspeaker systems;
- Restricting delivery hours and/or limiting numbers where appropriate; and
- Using alternative side/rear exits for dispersal of patrons at the end of the evening.

11.141 Noise breakout from cafés, restaurants and drinking establishments would be controlled by means of a building envelope which would provide adequate sound insulation for most operations. Tenants would be responsible for controlling noise by limiting their activities and/or providing additional attenuation, where required.

11.142 Outdoor terraces would be subject to restrictions on music and operating hours. Additionally, entrances and exits to and from cafés, restaurants and drinking establishments would be generally be positioned away from openable windows of existing and proposed residences so as to minimise disturbance from patrons.

11.143 The above shall be enforced by a combination of WCC's planning restrictions, licensing restrictions, lease agreements and tenants' handbooks.

Underground Train Induced Noise and Vibration

11.144 The vibration isolation of Building 7b/c would serve to reduce the effects of train induced noise and vibration at these residential receptors. No further mitigation measures are considered necessary to control the potential effects of train induced noise and vibration for any of the four Development Scenarios.

RESIDUAL EFFECTS

Demolition and Construction

Development Scenarios 1, 2, 3 and 4

Demolition and Construction Activities, Plant and Equipment Noise

11.145 The implementation of mitigation measures as outlined earlier in this chapter would assist in the reduction of adverse noise effects generated from demolition and construction activities and the operation of associated plant and equipment. Demolition and construction noise levels for each Timeslice at the various noise sensitive receptors within and around the application sites are presented in Tables L, M, N and O within Technical Appendix 11a, together with their associated individual levels of significance. Table 11.14 summarises the predicted noise levels throughout the demolition and construction Timeslices at nearby sensitive receptors, with and without mitigation measures in place, for Development Scenario 1.

Table 11.14: Predicted $L_{Aeq(8hr)}$ Noise Levels at Sensitive Receptors during Demolition and Construction Timeslices Without Mitigation Measures (Development Scenario 1)

Sensitive Receptor	Predicted $L_{Aeq(8hr)}$ per Timeslice (without/with mitigation measures)									
	Timeslice 1		Timeslice 2		Timeslice 3		Timeslices 4, 5 & 6		Timeslices 7, 8, 9 & 10	
	Without	With	Without	With	Without	With	Without	With	Without	With
1 Allington Towers	90	83	n/a – demolished							
2 Flat above Duke of York Pub	89	79	88	80	87	82	91	87	85	82
3 Flat above Shakespeare Pub, 91-99 Buckingham Palace Road	80	71	81	74	77	73	80	76	77	72
4 Flat above Bureau de Change, 185 Victoria Street	84	76	81	74	78	73	83	80	77	71
5 8-24 (evens) Buckingham Palace Road	80	76	83	75	80	74	86	81	76	74
6 26-40 (evens) Buckingham Palace Road	85	79	86	81	83	80	82	78	78	76
7 Evelyn Mansions	82	75	83	77	78	76	75	76	76	76
8 Roebuck House	73	72	74	74	71	73	75	75	74	72
9 300-310 Vauxhall Bridge Road	72	70	72	72	69	71	62	64	63	63
A Victoria Palace Theatre, Victoria Street	82	79	88	82	90	89	89	86	90	86
B Apollo Victoria Theatre	74	72	75	74	72	73	77	77	78	76
C Hotel Rubens	81	74	76	69	74	68	86	80	80	73
D Grosvenor Hotel	72	70	73	72	70	70	66	65	70	67
E E: Goring Hotel, Beeston Place	74	72	76	74	72	73	77	76	73	71

- 11.146 As for the potential effects, the residual effects would vary with time according to the type of on-site processes operating and the distance of the affected receptor from the noise source. Table 11.14 indicates that with the implementation of appropriate mitigation measures within Development Scenario 1 all sensitive receptors would experience reductions in adverse noise effects throughout the demolition and construction programme. However, Table 11.9 does not take into account the mitigation strategies specifically proposed for the Victoria Palace Theatre (e.g. restriction of noisy activities during performances, rehearsals, etc.). These strategies have been considered within the assessment of residual effects on the theatre.
- 11.147 Accordingly, the greatest adverse effects would be at sensitive receptors 1, 2, 4, 5, 6, A and C, which would each experience, **short to medium term, local** effects of **moderate adverse** significance during at least one Timeslice. Conversely, sensitive receptors 3, 7, 8, 9, B, D and E would not exceed the 75dBA assessment criterion by more than 3dBA in any Timeslice and, therefore, would experience effects of, at worst, **negligible** significance.
- 11.148 The assessments for Development Scenarios 2, 3 and 4 produce very similar results to Development Scenario 1. Again, the greatest adverse effects would be at sensitive receptors 1, 2, 4, 5, 6, A and C, which would each experience, **short to medium term, local** effects of **moderate adverse** significance during at least one Timeslice. Sensitive receptors 3, 7, 8, 9, B, D and E would again experience effects of, at worst, **negligible** significance.

Demolition and Construction Activities, Plant and Equipment Vibration

- 11.149 Through vibration monitoring and the implementation of the environmental management controls, the potential vibration related effects of the demolition and construction works are expected to fall within acceptable limits for each Development Scenario. The overall residual effects would therefore be anticipated to be of **negligible** significance.

Demolition and Construction Traffic Noise

- 11.150 No mitigation measures were considered necessary to control noise effects from demolition and construction traffic for any of the four Development Scenarios. The negligible potential effects associated with demolition and construction generated traffic would not require any additional mitigation. As such, the residual effects would remain identical to the potential effects, i.e. of **negligible** significance.

Completed Development

Development Scenarios 1, 2, 3 and 4

Suitability of the Application Sites for Residential Development

- 11.151 Suitable internal noise levels, as recommended in BS 8233 and WHO, are achievable within the proposed residential buildings, i.e. Building 5 within all four Development Scenarios and Building 7b/c within Development Scenarios 1 and 2 only. This would be achieved via the use of suitable glazing and ventilation which would be secured through appropriate planning obligations.

Road Traffic Noise

- 11.152 As previously stated, no additional mitigation is required in respect of road traffic noise. Therefore, the residual effects would be of **negligible** significance.

Noise from Fixed Plant

- 11.153 The acoustic performance of operational plant would be designed to meet the requirements of WCC. This would be achieved and secured through appropriate planning obligations. As such, the residual effects of noise from fixed plant would be of **negligible** significance.

Servicing Noise

- 11.154 Use of open lay-bys for servicing vehicles for the retail premises in Building 7b/c would only be during the daytime and potential noise effects would be reduced due to the existing noise levels from vehicle movement on Victoria Street and Bressenden Place.
- 11.155 The basement location of the servicing areas for all the remaining buildings within the four Development Scenarios, together with the implementation of a servicing management plan, the residual noise effects from servicing activities would be of **negligible** significance.

Noise Generated by Class A3 and A4 Retail Units

- 11.156 Through a combination of appropriate design secured by planning obligations, additional planning restrictions, licensing restrictions, lease agreements and tenants' handbooks, the residual effects of noise breakout from cafés, restaurants and drinking establishments are anticipated to be of **negligible** significance.

Underground Train Induced Noise and Vibration

- 11.157 It is considered that re-radiated noise and vibration due to the movement of underground trains within all four Development Scenarios would be of **negligible** significance.

SUMMARY AND CONCLUSIONS

- 11.158 A noise and vibration assessment has been undertaken consisting of a visit to the application sites to identify potentially sensitive receptors and a comprehensive baseline noise survey undertaken on various dates in 2006, 2007 and 2008.
- 11.159 The baseline noise measurements revealed that the existing noise levels in the vicinity of the application sites are predominantly influenced by road traffic from the surrounding highway network. Sources of vibration are entirely associated with the operation of the District and Circle and Victoria LUL Lines which run in the vicinity of the application sites.
- 11.160 An assessment of the effects of the demolition and construction works, together with the completed and operational Development Scenarios was undertaken in relation to a number of existing and proposed noise and vibration sensitive receptors. There are predicted to be, at worst, occasional effects of moderate adverse significance at nearby sensitive receptors due to noise from demolition and construction activities for all four Development Scenarios. All other noise and vibration assessments predict residual effects of negligible significance at nearby sensitive receptors for all four Development Scenarios.