9. Noise and Vibration

Environmental Statement

Volume I

9 Noise and Vibration

Introduction

9.1 This chapter of the Environmental Statement (ES) reports the findings of an assessment of the likely significant effects on noise and vibration as a result of the proposed Peel Centre Hybrid Planning Application (hereafter referred to as the 'Proposed Development') in the London Borough of Barnet (LBB).

9.2 Described within this chapter are:

- The methods used to assess the noise and vibration impacts associated with the Proposed Development;
- The baseline conditions currently existing at the site and in the surrounding area;
- The mitigation measures required to prevent, reduce or offset any significant adverse noise and vibration impacts; and
- The likely residual impacts after these measures have been adopted.

9.3 Impacts are considered during the demolition and construction phase and on completion and occupation of the Proposed Development. In particular, the chapter considers potential impacts on identified receptors, in terms of:

- Predicted noise and vibration levels from the demolition and construction works;
- Noise from the Proposed Development during operation; and
- An increase in noise associated with increases to road traffic attributed to the Proposed Development.

9.4 This chapter also provides an assessment of the suitability of the Proposed Development for the proposed use, in terms of existing noise and vibration, and of the need to provide an adequate internal and external environment regarding noise and vibration.

9.5 The potential for noise and vibration effect interactions and combined effects ('Type 1' effects) and combined cumulative noise and vibration effects ('Type 2' effects) of the Proposed Development with other development schemes are discussed in **Chapter 18: Effect Interactions and Cumulative Effects**.

Noise and Vibration Terminology

9.6 For the purposes of this ES Chapter, the following terminology and abbreviations will be used:

- dB(A) – The unit of noise measurement that expresses the loudness in terms of decibels (dB) based upon a weighting factor that represents the human sensitivity to sound (A).
- Hz – Hertz;
- L_{A1}, L_{A5}, L_{A10}, L_{A50}, L_{A90}, L_{A99} – A-weighted sound pressure level exceeded for 1, 5, 10, 50, 90 or 99% of the measured time;
- L_{Aeq} – Equivalent continuous A-weighted sound pressure level over a given period of time;
- L_{Amax} – The maximum A-weighted sound pressure level over a given period of time;
- VDV – Vibration Dose Values in units of $ms^{-1.75}$. The vibration measurement parameter that is based upon acceleration weighted to reflect human sensitivity to various frequencies;
- PPV – Peak Particle Velocity in millimeters per second ($mm \cdot s^{-1}$). The vibration measurement parameter that is used to describe vibration in relation to sudden impulse events;
- SWL – Sound power level; and
- SPL – Sound pressure level.

9.7 Where decibel (dB(A)) levels are followed by a given noise indicator (e.g. L_{Aeq}), then the annotation will read as dB L_{Aeq}.

Planning Policy Context

National Planning Guidance

National Planning Policy Framework (2012)

9.8 The National Planning Policy Framework (NPPF) (Ref. 9-1) was introduced in March 2012. The document sets out the Government's planning policies for England and how these are expected to be applied. As a result of the NPPF, the following noise related policy and guidance has been replaced:

- Planning Policy Statement (PPS) 23: Planning and Pollution Control; and
- Planning Policy Guidance 24: Planning and Noise (PPG24) (Ref. 9-2).

9.9 The NPPF provides for the production of distinctive local and neighbourhood plans by Councils, in consultation with local people, which should be developed to reflect the needs and priorities of their communities. The paragraphs from the NPPF relating to noise are set out below:

- Paragraph 109: The planning system should contribute to and enhance the natural and local environment by:
  - Preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability.
- Paragraph 123: Planning policies and decisions should aim to:
  - avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development;
  - Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;
  - Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and
  - Identify and protect areas of tranquility which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.
- Paragraph 143: In preparing Local Plans, local planning authorities should:
  - Set out environmental criteria, in line with the policies in this Framework, against which planning applications will be assessed so as to ensure that permitted operations do not have unacceptable adverse impacts on the natural and historic environment or human health, including from noise, dust, visual intrusion, traffic, tip- and quarry-slope stability, differential settlement of quarry backfill, mining subsidence, increased flood risk, impacts on the flow and quantity of surface and groundwater and migration of contamination from the site; and take into account the cumulative effects of multiple impacts from individual sites and/or a number of sites in a locality; and
  - When developing noise limits, recognise that some noisy short-term activities, which may otherwise be regarded as unacceptable, are unavoidable to facilitate minerals extraction.
- Paragraph 144. When determining planning applications, local planning authorities should:

- Ensure that any unavoidable noise, dust and particle emissions and any blasting vibrations are controlled, mitigated or removed at source, and establish appropriate noise limits for extraction in proximity to noise sensitive properties.

9.10 Applications for planning permission must be determined in accordance with the Development Plan (which includes any local plan or neighbourhood plans which have been adopted for the area), unless material considerations indicate otherwise. The NPPF must be taken into account in the preparation of local and neighbourhood plans, and is a material consideration in the determination of planning applications. Planning policies and decision must reflect, and where appropriate, promote relevant EU obligations and statutory requirements.

9.11 The planning system is required to contribute to and enhance the natural and local environment. Consequently, the aim is to prevent both new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution or vibration.

9.12 Therefore planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse effects on health and quality of life as a result of new development;
- Mitigate and reduce to a minimum other adverse effects on quality of life arising from noise from new development (including through the use of conditions);
- Recognise that development will often create some noise, and balance the requirement to restrict the effects of the operational noise against the need for the development; and
- Identify and protect areas of tranquility which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

National Planning Practice Guidance

9.13 The National Planning Practice Guidance (NPPG) was launched on the 6 March 2014 (Ref. 9-3) and provides a web-based resource in support of the NPPF.

9.14 Following its launch, a number of previously published planning guidance documents have been cancelled and are detailed within the Written Ministerial Statement titled 'Making the planning system work more efficiently and effectively', also dated 6 March 2014

9.15 The NPPG on Noise "*advises on how planning can manage potential noise impacts in new development*" and provides a series of guidelines that are in line with the National Planning Policy Framework (Ref. 9-1) and the Noise Policy Statement for England (Ref. 9-4).

9.16 The NPPG states that local planning authorities should take account of the acoustic environment and in doing so consider:

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

Planning Policy Guidance Note 24 (withdrawn)

9.17 PPG24 provided guidance on planning and noise, and contained the criteria which were most widely used in the UK when determining the suitability of sites for development.

9.18 In addition to introducing Noise Exposure Categories (NEC), PPG24 outlined the considerations to be taken into account in determining planning applications both for noise sensitive development and for those activities that generate noise, and advised on the use of conditions to minimise the effect.

9.19 PPG24 guidance has been superseded by the NPPF. The NPPF makes general reference to noise and amenity but does not contain any methodology for the assessment of noise nor does its technical appendices. Therefore, the NPPF places impetus on the local authority to produce their local planning policy and make reference to guidance that should be followed. The PPG24 methodology remains a valid method when referenced in local planning policy for assessing noise effects from new developments. PPG24 is referenced in the current London Borough of Barnet (LBB) Supplementary Planning Document: Sustainable Design and Construction (see Paragraph 9.38) and is used in this chapter as it is widely accepted and reliable.

Noise Policy Statement for England (2010)

9.20 The Noise Policy Statement for England (NPSE) (Ref. 9-4) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

9.21 The statement sets out the long term vision of the government's noise policy, which is to "*promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development*".

9.22 The NPSE adopts established concepts from toxicology that are currently being applied to noise effects. The concept details noise levels, at which the effects of an exposure may be classified into a specific category. The classification categories as detailed within NPSE are as follows:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

9.23 It is recognised that SOAEL does not have a single objective noise-based level that is applicable to all sources of noise in all situations; therefore the SOAEL is likely to be different for different sources, receptors and at different times of the day.

9.24 The first aim of the NPSE is to avoid significant adverse effects on health and quality of life, taking into account the guiding principles of sustainable development. The second aim considers situations where effects are established between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However this does not mean that such adverse effects cannot occur. The third aim seeks to improve health and quality of life, where possible, through the pro-active management of noise, whilst also taking account of the guiding principles of sustainable development.

9.25 The Department for Environment, Food and Rural Affairs (DEFRA) have led a research contract to identify the SOAEL and LOAEL for a limited range of noise sources. However, no guidance from this research has been issued at this time.

Control of Pollution Act 1974

9.26 The Control of Pollution Act 1974 (CoPA) requires that 'Best Practicable Means' (as defined in section 72 of CoPA) (Ref. 9-19) are adopted to control construction noise on any given site. CoPA makes reference to BS 5228 as best practicable means.

9.27 Sections 60 and 61 of this Act provide the main legislation regarding demolition and construction site noise and vibration. If noise complaints are received, a Section 60 notice may be issued by the Local Authority with instructions to cease work until specific conditions to reduce noise have been adopted.

9.28 Section 61 of the Control of Pollution Act 1974 provides a means for applying for prior consent to carry out noise generating activities during construction. Once prior consent has been agreed under Section 61, a Section 60 notice cannot be served provided the agreed conditions are maintained on-site.

9 Noise and Vibration

Regional Planning Guidance

The London Plan – Spatial Development Strategy for Greater London (2011)

9.29 With specific reference to noise, the London Plan 2011 (Ref. 9-5) contains the following policy: Policy 7.15: Reducing Noise and Enhancing Soundscapes:

- *"Development proposals should seek to reduce noise by:*
  - *Minimising the existing and potential adverse impacts of noise on, from, within, or in the vicinity of, development proposals;*
  - *Separating new noise sensitive development from major noise sources wherever practicable through the use of distance, screening, or internal layout in preference to sole reliance on sound insulation; and*
  - *Promoting new technologies and improved practices to reduce noise at source."*

Draft Further Alterations to the London Plan (2014)

9.30 On 15th January 2014, the Mayor published Draft Further Alterations to the London Plan (Ref. 9-6) for a twelve week period of public consultation. The Draft Further Alterations are consolidated with the Revised Early Minor Alterations (October 2013) and the updated Policy 7.15 'Reducing and Managing Noise, Improving and Enhancing the Acoustic Environment and Promoting Appropriate Soundscape' contains the following text:

- *"Development proposals should seek to reduce noise by:*
  - *Avoiding significant adverse noise impacts on health and quality of life as a result of new development;*
  - *Mitigating and minimising the existing and potential adverse impacts of noise on, from, within, as a result of, or in the vicinity of new development without placing unreasonable restrictions on development or adding unduly to the costs and administrative burdens of business;*
  - *Improving and enhancing the acoustic environment and promoting appropriate soundscapes (including identifying and protecting Quiet Areas and spaces of relative tranquility);*
  - *Separating new noise sensitive development from major noise sources (such as road, rail, air transport and some types of industrial development) through the use of distance, screening or internal layout – in preference to sole reliance on sound insulation;*
  - *Where it is not possible to achieve separation of noise sensitive development and noise sources, without undue impact on other sustainable development objectives, then any potential adverse effects should be controlled and mitigated through the application of good acoustic design principles;*
  - *Having particular regard to the impact of aviation noise on noise sensitive development; and*
  - *Promoting new technologies and improved practices to reduce noise at source and on the transmission path from source to receiver."*

The Mayor's Supplementary Planning Guidance (SPG): Sustainable Design and Construction (2014)

9.31 The SPG (Ref. 9-7) provides guidance on noise related key areas and makes reference to the following London Plan Policies:

- London Plan Policies 3.2, 7.15 – *"Areas identified as having positive sound features or as being tranquil should be protected from noise*"; and
- London Plan Policies 3.2, 5.3, 7.6., 7.15 – ""*Noise should be reduced at source, then designed out of a scheme to reduce the need for mitigation measures*".

9.32 The SPG goes on to provide information on the following key areas relating to noise:

- *"the sources of noise;*
- *ways to mitigate noise emitted by developments;*
- *ways to mitigate the impact of noise on developments; and*
- *some detailed design considerations."*

City Soundings: The Mayor's London Ambient Noise Strategy (2004)

9.33 The London Ambient Noise Strategy (Ref. 9-8) aims to minimise the adverse effects of noise on people living, working in and visiting London by using the best available practices and technologies within a sustainable development framework.

9.34 The Strategy aims to work towards more compact city development, while minimising noise. This requires careful consideration of the adverse effect of noise on, from, within or in proximity to a development.

Local Planning Guidance

Local Plan Core Strategy Development Plan Document (2012)

9.35 With reference to noise, 18.11 Air and noise pollution of the LBB Local Plan Core Strategy (Ref. 9-9) states the following:

- *"18.11.3 Persistent and intermittent noises such as those made by industrial activities, transport, construction and congregations of people can undermine quality of life. We will take into account noise considerations when assessing development proposals. Regard will be made to the Mayor's Ambient Noise Strategy as a reference source for understanding noise and identifying best practice. We will require Noise Impact Assessments for developments likely to generate or be exposed to significant noise. Further guidance on noise quality and when assessments will be required is provided in our SPD on Sustainable Design and Construction."*

London Borough of Barnet Local Plan Development Management Policies (2012)

9.36 With reference to noise, the LBB Local Plan Development Management Policies (Ref. 9-10) recommends that noise is a key consideration when planning housing, day centres, schools and libraries and in areas of high population density. Proposals for noise sensitive developments that are affected by significant noise sources will not be permitted unless suitable noise mitigation measures are provided.

9.37 The layout of buildings should be considered in terms of reducing noise effects through screening. Further mitigating measures are set out in LBB's Sustainable Design and Construction Supplementary Planning Document (SPD). The four noise exposure categories set out in the Sustainable Design and Construction SPD will be used to assess proposed residential properties that are located near a source of noise.

Supplementary Planning Document: Sustainable Design and Construction (2013)

9.38 Guidance contained within LBB's Sustainable Design and Construction Supplementary Planning Document (SPD) (Ref. 9-11) reflects the NEC procedure which forms part of PPG24, which has since been withdrawn.

9.39 In addition, the SPD provides the following Noise Design Principals which should be considered in the design of a new development:

A. Ensure that development reduces the effect of noise on occupants and existing properties – Proposed developments subject to high levels of noise will require very high design criteria to ensure acceptable levels of internal noise and vibration are achieved. Buildings can be used to screen outdoor amenity areas from sources of noise.

B. Mixing of land uses and Internal layout – Consideration should be given to the use of a proposed building and how proposed noise generating units (e.g. leisure, retail, industrial etc.) may affect neighbouring sensitive units. Building design should try to limit transmission of noise through internal

noise and external breakout of noise. It is recommended that this may be achieved through the following measures:

- *"Locate rooms that are sensitive to loud noise (i.e. bedrooms/living rooms) away from areas of the site that are most prone to loud or continuous noise.*
- *Stacking rooms with similar uses on top of each other (i.e. living rooms, kitchens) to avoid unnecessary noise disturbance.*
- *Non-residential uses should be placed closer to noise sources than residential accommodation."*

C. **Provide appropriate noise insulation given the external and internal noise environment** – Appropriate mitigation (glazing and ventilation) should be provided to achieve suitable internal noise levels in new developments. Building services should be suitably located and mitigated.

D. **Establish the impact of new development on the noise environment** – building systems should be suitably mitigated that they do not contribute to increasing background noise levels.

9.40 The SPD also makes reference to fixed plant noise levels which should achieve a level of 5dB(A) below the background noise level.

Supplementary Planning Document: Residential Design Guidance (2013)

9.41 Contained in the LBB SPD: Residential Design Guidance (Ref. 9-12) principles is reference to noise which states that new development must:

- *"Ensure the design and layout of developments (including balconies, stacking of rooms, windows) minimise the potential for noise transfer between new homes"*

9.42 The document makes reference to Sustainable Design and Construction SPD for guidance and requirements on how to reduce disturbance from noise.

British Standards (BS)

9.43 British Standards are the standards produced by BSI Group which is incorporated under a Royal Charter. British Standards that contain guidance for the assessment of noise and vibration that may affect new developments or existing noise sensitive receivers are covered in this section.

British Standard 7445

9.44 British Standard (BS) 7445 'Description and Measurement of Environmental Noise' (Ref. 9-13) defines parameters, procedures and instrumentation required for noise measurement and analysis.

British Standard 8233

9.45 British Standard 8233 'Guidance on Sound Insulation and Noise Reduction for Buildings' (Ref. 9-14) provides criteria for the assessment of internal noise levels for various uses including dwellings and commercial properties.

British Standard 6472

9.46 British Standard 6472-1 'Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting' (Ref. 9-15) presents recommended frequency weighted vibration spectra (for continuous vibration) and vibration dose values (VDV) (for intermittent vibration) above which adverse comment is likely to occur in residential properties.

British Standard 5228

9.47 British Standard 5228 'Noise and Vibration Control on Construction and Open sites' (Ref. 9-16) provides a 'best practice' guide for noise and vibration control, and includes sound power level (SWL) data for individual plant as well as a calculation method for noise from construction activities.

British Standard 7385

9.48 British Standard 7385 'Evaluation and measurement for vibration in buildings' (Ref. 9-17) presents guide values or limits for transient vibration, above which there is a likelihood of cosmetic damage.

British Standard 4142

9.49 British Standard 4142 'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas' (Ref. 9-18) can be used for assessing the impact of noise from mechanical services plant. The method compares the difference between 'rating level' of the new noise, with the 'background level' at the receptor position.

Other Standards and Guidance

Calculation of Road Traffic Noise

9.50 Department of Transport/Welsh Office Memorandum 'Calculation of Road Traffic Noise (CRTN)' (Ref. 9-20) describes procedures for traffic noise calculation, and is suitable for environmental assessments of schemes where road traffic noise may have an impact.

Calculation of Railway Noise

9.51 Department of Transport document 'Calculation of Railway Noise (CRN)' (Ref. 9-21) describes procedures for railway noise calculation, and is suitable for environmental assessments of schemes where railway noise may have an impact.

Design Manual for Roads and Bridges

9.52 The Highways Agency 'Design Manual for Road and Bridges Volume 11 Section 3 Part 7-Traffic Noise and Vibration' (DMRB) (Ref. 9-22) provides guidance on the appropriate level of assessment to be used when assessing the noise and vibration impacts arising from all road projects, including new construction, improvements and maintenance.

World Health Organisation (WHO) Guidelines for Community Noise

9.53 The WHO 'Guidelines for Community Noise' (Ref. 9-23) provides guidelines based on scientific knowledge about the health impacts of community noise.

Building Bulletin 93

9.54 Building Bulletin 93 (Ref. 9-24) provides guidance on suitable noise levels for schools and associated teaching and leisure areas to ensure that any issues likely to prevent compliance, due to basic planning and design are addressed.

Assessment Methodology and Effect Significance Criteria

9.55 This section of this ES chapter presents the following:

- Identification of the information sources that have been consulted throughout preparation this chapter;
- Details of the consultation undertaken with respect to noise and vibration;
- The methodology behind the assessment of noise and vibration effects, including the criteria for the determination of sensitivity of receptor/importance of resource noise and vibration and magnitude of change from the existing or 'baseline' condition;
- An explanation as to how the identification and assessment of potential noise and vibration effects has been reached; and
- The significance criteria and terminology for assessment of the residual effects to noise and vibration.

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9.56 The assessment methodology will be considered in the context of the Detailed Components of the Proposed Development and the Outline Components of the Proposed Development. Where noise effects may occur simultaneously due to both Detailed and Outline Components of the Proposed Development, these have been assessed cumulatively.

9.57 The following sources of information that define the Proposed Development have been reviewed and form the basis of the assessment of likely significant effects on noise and vibration:

- Parameter Plans;
- Detailed elevations and sections;
- Road traffic flow data (construction and operational); and
- Demolition and construction programme and phasing.

Assessment Methodology

9.58 This section presents the methodology used to assess each type of noise and vibration impact, in terms of the Application of relevant standards and guidance (as detailed above), the types of data and analysis carried out, and the derivation of the presented significance or compliance criteria used in the assessments.

Methodology for Determining Baseline Conditions and Sensitive Receptors

Baseline Noise and Vibration Methodology

9.59 Baseline noise surveys were undertaken to establish the baseline noise environment around the site in accordance with the measurement methodology agreed with the Scientific Officer LBB and best practice as specified in BS 7445: Part 2.

9.60 Unattended long term noise measurements were undertaken at the Site on 23 May to 30 May 2014 using a Rion NL-52 and Norsonic 140 Type 1 sound level meters and a B&K 4230 Type 1 field calibrator. The calibration levels were checked before and after measurements and no significant calibration drift was detected. The sound level meters log environmental noise measurement parameters including average ambient (L_{Aeq}), maximum (L_{Amax}) and background (L_{A90}) noise levels.

9.61 The long-term noise monitoring equipment located at position MP4a (see Figure 9-1) was removed by police approximately 5 hours after it was left on site. Consequently, only a short term sample of noise was logged at this location. To supplement this measurement, an additional short-term measurement was logged on 6 June 2014 to ensure noise data was representative of current noise conditions.

9.62 Vibration measurements were undertaken using a Svantek 959 vibration meter. Monitoring locations were selected to be representative of the Proposed Development in close proximity to the Edgware branch of the Northern Line which runs adjacent to the south Site boundary and the Midland Main Line which runs adjacent to the east Site boundary. The monitoring locations were considered to be representative of locations on-site that may experience high levels of vibration due to train movements.

9.63 Full details of noise and vibration measurements are presented in ***ES Volume III, Appendix E: Noise and Vibration***.

Methodology for Determining Sensitive Receptors

9.64 Potential sensitive receptors, both those in proximity to the Site and those on-site (i.e. new residents/site users as the phasing of the Proposed Development progresses), which have been taken into consideration when assessing the impacts associated with noise and vibration levels from the demolition/construction and operational phases of the Proposed Development, are listed in Table 9-1. A plan showing the locations of the receptors described within Table 9-1 is presented in Figure 9-1.

9.65 These receptors are considered to be representative of the nearest noise sensitive receptors to the Proposed Development. It is considered that if noise levels are suitably controlled at the key receptors listed in Table 9-1, noise levels will be suitably controlled at all receptors in the proximity of the Site.

9.66 Each receptor location has been assigned a long-term measurement location for the purposes of the assessment. Although the measurement location may not be directly associated with the physical receptor locations, the intention is to provide appropriate noise level data at each receptor location for assessment purposes.

Figure 9-1 Noise and Vibration Sensitive Receptor and Monitoring Locations

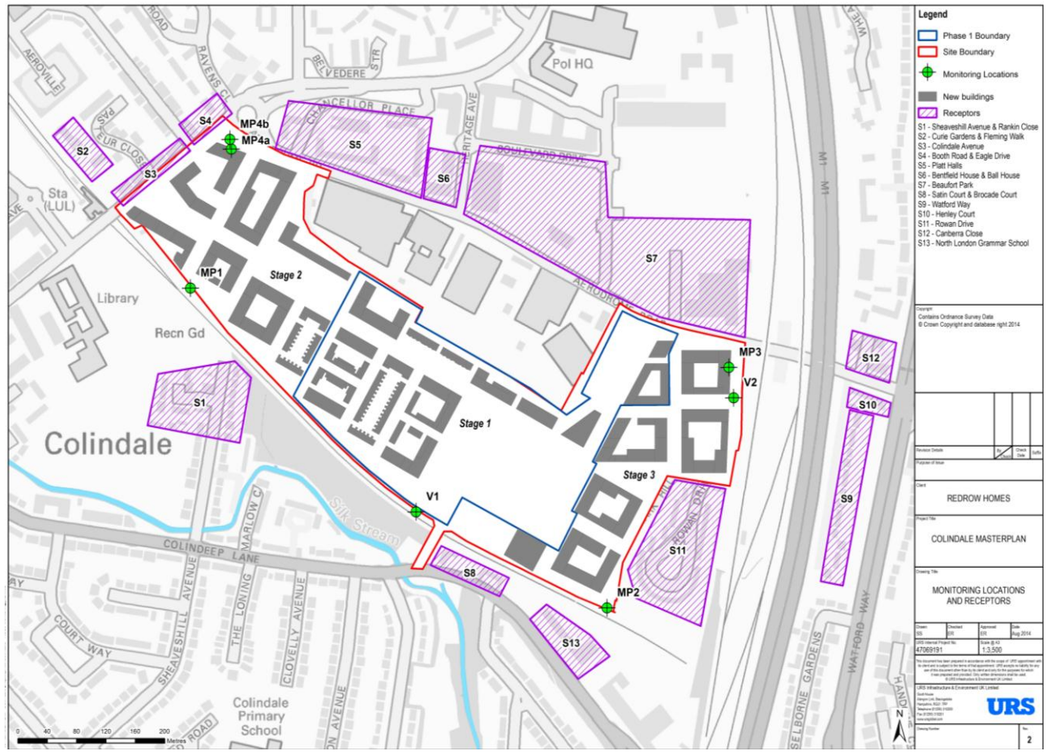

Table 9-1 Noise Sensitive Receptors

Receptor Group	Addresses in Receptor Group	Representative Measurement Location	Distance to Closest Construction Site (m)	Receptor Type
S1	Sheaveshill Avenue & Rankin Close	MP2	45	Residential
S2	Curie Gardens & Fleming Walk	MP2	70	Residential
S3	Colindale Avenue	MP4	20	Residential
S4	Booth Road & Eagle Drive	MP4	20	Residential
S5	Platt Halls	MP4	30	Residential
S6	Bentfield House & Ball House	MP4	140	Residential
S7	Beaufort Park	MP4	40	Residential

Receptor Group	Addresses in Receptor Group	Representative Measurement Location	Distance to Closest Construction Site (m)	Receptor Type
S8	Satin Court & Brocade Court	MP2	25	Residential
S9	Watford Way	MP1	150	Residential
S10	Henley Court	MP1	160	Residential
S11	Rowan Drive	MP3	10	Residential
S12	Canberra Close	MP1	160	Residential
S13	North London Grammar School	MP2	35	School
S14	New Development Stage 1 receptors	MP3	10	Residential
S15	New school receptor	MP3	20	School
S16	New Development Stage 3 receptors	MP3	400	Residential

Methodology for Determining Site Suitability

9.67 Although PPG24 has been withdrawn, it is still considered to be useful by the LBB for understanding the suitability of a site for its intended use.

9.68 PPG24 defines Noise Exposure Categories (NECs) for day and night-time external noise. The categories relate to different noise bands depending on the source of noise (i.e. road, rail, air or mixed noise sources). Table 9-2 details the planning guidance associated with each NEC classification.

Table 9-2 Descriptive Guidance in Relation to NECs as presented in PPG24

NEC	PPG 24 Guidance
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.

9.69 Table 9-3 details the classification of NECs covering daytime and night-time periods for different noise sources. The values refer to the average (L_{Aeq}) noise level throughout the day or night-time periods respectively.

Table 9-3 Noise Exposure Categories for New Dwellings

Noise Source	Noise Exposure Category $L_{Aeq,T}$ (dB)			
	A	B	C	D
Road Traffic 07:00 – 23:00 23:00 – 07:00	 <55 <45	 55 – 63 45 – 57	 63 – 72 57 – 66	 >72 >66
Rail Traffic 07:00 – 23:00 23:00 – 07:00	 <55 <45	 55 – 66 45 – 59	 66 – 74 59 – 66	 >74 >66
Air Traffic 07:00 – 23:00 23:00 – 07:00	 <57 <47	 57 – 66 47 – 59	 66 – 72 59 – 68	 >72 >68
Mixed Sources 07:00 – 23:00 23:00 – 07:00	 <55 <45	 55 – 63 45 – 57	 63 – 72 57 – 66	 >72 >66

9.70 PPG24 advises that where individual night-time noise events regularly exceed 82dB L_{Amax} it should be treated as NEC C, unless already in NEC D.

Facade Insulation

9.71 Providing a facade is traditionally constructed (i.e. predominantly masonry), windows are the main path for external noise to enter rooms.

9.72 The sound insulation of a window is usually measured over a wide range of frequencies from 125 Hz to 4 KHz in accordance with BS EN ISO 140-3. Conventionally in the UK, three single figure indices have been used:

- Rm, the mean reduction, is the arithmetic average across the noise spectrum, and is not commonly used;
- Rw, the weighted reduction, which is more useful, as it incorporates a correction for the response of the human ear; and
- RTRA, the weighted reduction against typical low speed urban road traffic noise.

9.73 BS EN ISO 717-1: 1997 'Acoustics – Rating of sound insulation in buildings and building elements Part 1' introduced the term Ctr, the A-weighted noise spectrum adaptation term for urban traffic noise and low speed

9.74 rail traffic. Ctr is usually a negative number, so Rw + Ctr will be less than Rw alone. For urban situations

Ambient Noise – Noise within the Proposed Development

9.75 Criteria for provision of suitable living conditions inside dwellings are provided in BS 8233: 2014. Table 9-4 presents the desirable internal noise levels for dwellings that should not be exceeded in new developments.

Table 9-4 Indoor ambient noise levels in dwellings (BS 8233)

Activity	Location	Daytime (07:00 to 23:00)	Night-time (23:00 to 07:00)
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$
Study and work requiring concentration	Meeting room, executive office	35-40 dB $L_{Aeq,T}$	-

9.76 Regular individual noise events at night have the potential to disturb the sleep of inhabitants in dwellings. BS 8233 states that: "*A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night*".

9.77 The WHO Guidelines for Community Noise provide guidance on noise levels of single noise events that may cause sleep disturbance by stating: "*To avoid sleep disturbance, indoor guideline values for bedrooms are … 45 dB L_{Amax} for single sound events*". Consequently, a noise level of 45 dB $L_{Amax,F}$ has been adopted as a suitable internal noise level for impulse noise events that should not normally be exceeded at night.

9.78 BS 8233 provides guidance on suitable noise levels for external spaces that are used for amenity areas (e.g. gardens and patios). An upper guideline value of 55 dB $L_{Aeq,T}$ is considered to be acceptable for outdoor amenity areas.

9 Noise and Vibration

9.79 BS 8233 acknowledges that this guideline value may not be achievable in higher noise areas such as city centres or urban areas adjoining the strategic transport network. In these situations, developments should aim to achieve the lowest practicable noise levels in outdoor amenity areas.

Building Bulletin 93

9.80 Section 1 of Building Bulletin 93 defines the recommended internal noise levels for school classrooms. Noise limits are specified in terms of the $L_{Aeq.30mins}$ (the highest average noise level over any 30 minute period). Achieving these levels is based on the existing external noise levels, the type of external noise insulation and the level of noise from ventilation systems. The two most critical noise limits are summarised in Table 9-5.

Table 9-5 BB93 Recommended Internal Noise Levels

Application	Recommended Noise Level, dB $L_{Aeq.30mins}$
General Classroom Limit.	35
Music Performance and Recording Rooms. Large Lecture Rooms, Special Rooms for Teaching. Hearing Impaired Children (including speech therapy).	30

9.81 BB 93 defines criteria for outdoor noise levels, which are given in Table 9-6 below. These criteria relate to the use of outdoor spaces for teaching and sport activities. Noise limits are again specified in terms of the $L_{Aeq.30mins}$.

Table 9-6 BB93 Recommended External Noise Levels

Application	Recommended Noise Level, dB $L_{Aeq.30mins}$
No special measures required to control noise.	45 or less
External teaching areas.	50
Playgrounds, playing fields and recreational areas.	55
Recommended upper limit for external areas.	60

Ground-Borne Vibration Assessment Criteria

9.82 The assessment of vibration affecting humans in buildings due to train movements is made in accordance with BS 6472-1:2008 by considering the Vibration Dose Value (VDV) in $ms^{-1.75}$. The VDV levels take into account both the level and duration of vibration events, allowing both continuous and intermittent vibration events to be assessed using the same assessment metric.

9.83 The significance of vibration has been derived from BS 6472-1:2008, which rates vibration in terms of varying degrees of adverse comment, ranging from 'adverse comment not expected' to 'adverse comment very likely'. This range of varying degrees of adverse comment has been translated into the significance criteria presented in Table 9-7.

Table 9-7 Criteria for Assessing Human Response to Vibration in Buildings

Period	Adverse Comment Not Expected ($mms^{-1.75}$)	Low Probability of Adverse Comment ($mms^{-1.75}$)	Adverse Comment Possible ($mms^{-1.75}$)	Adverse Comment Probable ($mms^{-1.75}$)	Adverse Comment very likely ($mms^{-1.75}$)
Residential 16 Hour Daytime	< 0.2	0.2 - 0.4	0.4 – 0.8	0.8 – 1.6	> 1.6
Residential 8 Hour Night-time	< 0.1	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8	> 0.8
Offices (daytime)	< 0.4	0.4 – 0.8	0.8 – 1.6	1.6 – 3.2	> 3.2
Magnitude of Impact	Negligible/No change	Small	Medium	Large	Large

9.84 The values shown in BS 6472-1:2008 to residential accommodation. Where the assessment concerns the impacts on commercial premises, the values shown in Table 9-7 are doubled, as advised by BS 6472-1:2008.

Methodology for Determining Demolition and Construction Effects

9.85 The demolition of the existing building and construction of the Proposed Development have been assessed based on a 11 year (continuous) programme of works (refer to ***Chapter 5: Demolition and Construction*** of this ES for further detail).

9.86 As described within ***Chapter 2: EIA Methodology*** of this ES, the 10 year demolition and construction programme has been divided into time slices to allow for a comprehensive and robust assessment. Timeslice 1, 2, 3 and 4 represent the worst case scenario for construction noise impacts due to the activities taking place, simultaneous construction phases and their location in relation to the identified receptors. Additionally it also represents the period of time when the buildings on Development Stages 1 and 3 sites have been completed and are occupied providing an indication of the worst case impact to the future on site residential receptors. Table 9-8 identifies the activities included within the assessed time slices.

Table 9-8 Activities Included within the Assessed Timeslices

Timeslice (TS)	Year	Construction Activity / Completed Elements
TS1	2017	Development Stage 1 (detailed) construction of Blocks H, M, P, Q, R, S, T and U. Occupation of Development Stage 1 Blocks L and N Development Stage 1a, 1b and 2 demolition. Stage 2 excavation
TS2	2019	Development Stage 1 (detailed) and the School completed and occupied Development Stage 2 (outline) construction and part occupation
TS3	2021	Development Stage 1 (detailed) and the School completed and occupied Development Stage 2 (outline) construction and part occupation Development Stage 3 (outline) excavation and construction
TS4	2023	Development Stage 1 (detailed) and the School completed and occupied Development Stage 2 (outline) construction and part occupation Development Stage 3 (outline) construction and part occupation

Demolition and Construction Works Noise

9.87 BS 5228 'Noise and Vibration Control on Construction and Open Sites' provides practical information on demolition and construction noise and vibration reduction measures, and promotes a 'Best Practice Means' approach to control noise and vibration. BS 5228 provides further guidance on acceptable levels of construction noise within Annex E and provides example criteria for the assessment of significance of construction noise effects. One of the potential suggested sets of criteria within BS 5228 refers to the Department of the Environment (DoE) Leaflet AL72: Noise Control on Building Sites from 1976.

9.88 The leaflet states that during the daytime period (defined as 07:00 to 19:00 hours weekdays, and 07:00 to 13:00 hours on Saturdays), the noise level outside the nearest occupied room of a residential property or office should not exceed the values in Table 9-9.

Table 9-9 AL72 - Construction noise limits

Environment	Recommended daytime (07:00 to19:00) façade noise level $L_{Aeq,12h}$ dB
Urban areas close to main roads	75
Rural, suburban and urban areas away from main traffic and industrial noise sources areas	70

9 Noise and Vibration

9.89 Due to the temporary and transient nature of construction noise, BS 5228 advises that some receptors may be more sensitive to high levels of construction noise, for example hospitals and educational establishments, and a reduction of noise limits by 10dB(A) may often be appropriate.

9.90 Considering the proposed works are within urban locations and taking account of the advice presented in AL72, noise limits for demolition and construction activities have been defined in Table 9-10.

Table 9-10 Construction Noise Limits

Environment	Recommended daytime (07:00 to 19:00 Mon-Fri and 07:00-13:00 Sat) façade noise level $L_{Aeq,T}$ dB
Residential and offices	75
Schools and place of worship	65

9.91 A semantic scale for the description of the construction noise impacts as measured outside the nearest identified receptor is presented in Table 9-11.

Table 9-11 Magnitude of Construction Noise Effects

Description	Magnitude of impact
Daytime noise levels not exceeding the dB $L_{Aeq,T}$ ambient noise level	Very low
Daytime noise levels exceeding $L_{Aeq,T}$ ambient noise level but not exceeding the dB $L_{Aeq,T}$ noise limit	Low
Daytime noise levels not exceeding the $L_{Aeq,T}$ dB noise limit by more than 5 dB	Medium
Daytime noise levels exceeding the $L_{Aeq,T}$ dB noise limit by more than 5 dB	High/very high

Demolition and Construction Works Vibration

9.92 Vibration from construction activities, in particular piling, may impact on the occupants of adjacent buildings in terms of causing annoyance. Likely levels of vibration at given distances can be predicted from existing piling vibration data - examples of which are included in Annex D of BS 5228 Part 2.

9.93 Table 9-12 details potential vibration levels measured in terms of Peak Particle Velocity (PPV) and provides a semantic scale for description of construction vibration impacts on human receptors (all considered to be of high sensitivity) based on guidance contained in BS 5228.

Table 9-12 Guidance on the Impacts of Vibration (PPV) Levels

Vibration level PPV mm/s	Description of effect	Magnitude of impact
<0.3	Vibration is unlikely to be perceptible in even the most sensitive situations for most vibration frequencies associated with construction.	Very low
0.3 to 1	Increasing likelihood of perceptible vibration in residential environments.	Low
1 to 10	Increasing likelihood of complaint in residential environments, but can be tolerated at the lower end of the scale if prior warning and explanation has been given to residents.	Medium
>10	Vibration is likely to be intolerable for any more than a very brief exposure to a level of 10mms-1.	High/very high

Underground Services

9.94 BS 5228 Part 2 contains information on vibration levels that are considered to be the limits of tolerability for underground services. The following noise PPV vibration limits are recommended in BS 5228:

- Maximum PPV for intermittent or transient vibrations 30 mms^{-1}; and
- Maximum PPV for continuous vibrations 15 mms^{-1}.

9.95 Criteria should be applied at the nearest point to the source or activity. In the event of encountering elderly and dilapidated brickwork sewers, the base data should be reduced by 20% to 50%. For most metal and reinforced concrete service pipes, however, the values are expected to be quite tolerable.

Construction Traffic Noise

9.96 Road traffic noise levels have been calculated with reference to methodology within the CRTN which contains an equation for the calculation of the Basic Noise Level (BNL) from a road in terms of the 18-hour traffic flow from 06:00 to 24:00.

9.97 The magnitude of a noise impact due to changes in road traffic noise levels has been assessed with reference to the procedure outlined in the DMRB. The DMRB describes the relationships between road traffic noise and the magnitude of impact due to road projects. This is corroborated within the DMRB by the statement that:

"The purpose of this document is to provide guidance for those undertaking noise and vibration assessments of impacts from road projects…"

9.98 As the Proposed Development does not include enhancements to the road network, it is not considered to be a road project. Consequently, a full DMRB assessment has not been undertaken. However, it is considered that, for the purposes of identifying significant impacts due to changes in road traffic flows, reference to criteria within the DMRB shall be made.

9.99 The criteria for the assessment of changes in road traffic noise levels arising from construction works have been taken from Table 3.1 of DMRB and are provided in Table 9-13 below.

Table 9-13 Road Traffic Noise Assessment Criteria

Noise Change Band	Magnitude of Impact
0 dB(A)	No change
0.1 – 0.9 dB(A)	Negligible
1.0 – 2.9 dB(A)	Small
3.0 – 4.9 dB(A)	Medium
5.0 dB(A) or more	Large

Methodology for Determining Operational Effects

Operational Road Traffic Noise

9.100 Operational road traffic noise has been assessed by considering the change in traffic flows following completion of the Proposed Development, with reference to both the CRTN and DMRB. Road traffic flows for the following scenarios were provided by WSP:

- Scenario 1 – Existing baseline 2014;
- Scenario 2 – Future baseline 2026 (Existing + Committed Developments);
- Scenario 3 – Future baseline 2026 + The Proposed Development; and
- Scenario 4 – Future baseline 2026 + The Proposed Development + Area Action Plan (AAP) developments.

9.101 Calculation of road traffic noise for 'with development' and 'without development' scenarios allows the change in noise level due to road traffic associated with the Proposed Development to be derived.

9.102 To obtain road traffic flows associated with the Proposed Development only, Scenario 2 was subtracted from Scenario 3. This calculated road traffic flow data for the operational development was added to Scenario 1

flows to provide an indication of how baseline road traffic flows may change only as a result of the Proposed Development. Natural traffic growth may occur between the baseline year and the opening year; however, this is not accounted for in London as road links tend to be operating at maximum density. Consequently, baseline traffic flows are considered to representative of baseline opening year traffic flows.

9.103 The criteria for the assessment changes in road traffic noise due to the Proposed Development are detailed in Table 9-13 above.

Building Services and Plant Noise

9.104 BS 4142 is frequently used by Local Authorities for assessing mechanical services noise. The standard compares the 'rating level' of the new noise source with the existing 'background level'. The greater this difference the greater the likelihood of complaints. BS 4142 requires separate analysis for day and night time periods.

9.105 LBB require that fixed plant should achieve a level of 5 dB(A) below the background noise level. Consequently, the significance criteria presented in Table 9-14 has been derived with reference to LBB and BS 4142 guidance.

Table 9-14 BS 4142 Noise Rating

Difference between Rating Level* and Background Level#	Rating	Magnitude of Impact
-5dB(A) or less	Below LBB criteria	Negligible
Between -5 and +5dB(A)	Less than marginal significance.	Small
Between +5 and +10dB(A)	Greater than Marginal significance.	Medium
+10 dB(A) or more	Indicates complaints are likely.	Large

**The Rating Level is the noise level attributable to the new source(s), plus a 5 dB(A) penalty if the new source has tonal or intermittent characteristics;*

#The Background Noise Level is taken as the L_{A90}; this is the ambient noise level in the absence of the source which is exceeded for 90% of the time.

Noise Model

9.106 To predict the noise levels at the facades of the proposed buildings within the site, a noise model of the Proposed Development has been created using Cadna-A© noise modelling software. The methodology used to create the noise models is outlined in ***ES Volume III, Appendix E: Noise and Vibration***.

9.107 Road traffic noise data for the cumulative scenario (see ***ES Chapter 18: Effect Interactions and Cumulative Effects*** of this ES) has been used to predict noise levels at the Proposed Development. This is considered to be representative of a worst case future scenario. Where predicted noise levels were lower than measured noise levels, road traffic data has been amended based on measured noise levels so under-predictions of noise levels are unlikely.

Significance Criteria

9.108 The following terminology has been used in the assessment to define residual effects:

- **Adverse** – detrimental or negative effects to an environmental resource or receptor;
- **Negligible** – imperceptible effects to an environmental resource or receptor; or
- **Beneficial** – advantageous or positive impact to an environmental resource or receptor.

9.109 Where adverse or beneficial impacts have been identified, these have been assessed against the following significance scale:

- **Minor** – slight, very short or highly localised effect of no significant consequence;
- **Moderate** – limited effect (by extent, duration or magnitude), which may be considered significant; or
- **Major** – considerable effect (by extent, duration or magnitude) of more than local significance or in breach of recognised acceptability, legislation, policy or standards.

9.110 Effects classed from negligible to minor adverse are considered to be insignificant, whereas effects classed from moderate adverse to major adverse are considered to be significant.

9.111 Duration of effects are defined as follows:

- **Short term** – period lasting for no longer than 1 month;
- **Medium term** – period lasting for no longer than 1 year; or
- **Long term** – period lasting for longer than 1 year.

9.112 Table 9-15 provides a matrix showing the significance of impacts depending on the sensitivity of receptors. Noise sensitive receptors (e.g. residential properties, hospitals, schools, etc.) are considered to be of high sensitivity. All other receptors (e.g. offices, warehouses, etc.) are considered to be of low sensitivity.

Table 9-15 Significance of Effect Matrix Relating Magnitude of Impact and Sensitivity of Receptor

Magnitude of Impact	Significance of Effect Based on Sensitivity of Receptor	
	High	**Low**
Large	Major	Minor
Medium	Moderate	Negligible
Small	Minor	Negligible
Negligible / No change	Negligible	Negligible

Consultation

9.113 Consultation was held with LBB through submission of an EIA Scoping Report issued on 24 March 2014 and a response from LBB through an EIA Scoping Opinion received on 16 June 2014 (see ***ES Volume III, Appendix A: EIA Scoping Report and LBB Scoping Opinion)***.

9.114 Consultation has also been undertaken with LBB's Scientific Officer regarding the number and location of noise and vibration monitors in April 2014.

9.115 In terms of noise and vibration, LBB have confirmed the suitability of the approach detailed in the Scoping Report. The LBB requested in the Scoping Opinion that properties in Beaufort Park and Rowan Drive should be identified as sensitive receptors. Noise and vibration effects due to demolition and construction phases should take into account duration of activities.

Limitations and Assumptions

9.116 A series of assumptions were made regarding some elements of existing noise sources that have the potential to affect noise levels on the Site. These assumptions are described in the noise monitoring methodology described in ***ES Volume III, Appendix E: Noise and Vibration*** and are considered standard industry practice when modelling the propagation of noise.

9.117 To assess the potential impact of the Proposed Development, it was necessary to determine the baseline conditions. It is considered that the baseline noise and vibration measurements, which were undertaken at the Site in May and June 2014, are representative of the typical noise and vibration environment of the Site.

9 Noise and Vibration

9.118 Construction noise predictions were undertaken using typical items of plant that are used in such developments. These items of plant may not be fully representative of the plant that will be used during the construction process, which at this stage, are not yet known with any certainty. Noise predictions were carried out to represent a worst case scenario where all plant is operational on-site. Consequently, noise predictions may overestimate construction noise levels and can therefore be considered as worst case.

Baseline Conditions

9.119 The existing noise environment of the Site and surrounding area is influenced by several sources, these are described below:

- Road traffic on the surrounding road network (Colindale Avenue, Aerodrome Road, M1 and A41); and
- Trains on the railway to the south of the Site.

Baseline Noise Survey

9.120 The noise monitoring locations are presented in Figure 9-1. A summary of measured noise levels are presented in Table 9-16 and Table 9-17. Full details of the baseline surveys can be found in ***ES Volume III, Appendix E: Noise and Vibration***.

Table 9-16 Long-Term Noise Survey Results (23 May to 30 May 2014)

Position	Date	Average Free-Field Ambient Level dB L_{Aeq}		Typical Highest Night-time Maximum Level dB L_{Amax}	Lowest Background Level dB L_{A90}	
		Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)		Daytime (07:00 – 23:00)	Night-time (23:00 – 07:00)
MP1	23/5/14 to 30/5/14	67	60	84	51	42
MP2	23/5/14 to 30/5/14	67	61	85	45	36
MP3	23/5/14 to 30/5/14	60	52	74	41	38

Table 9-17 Short-Term Noise Survey Results

Position	Time/Date	dB $L_{Aeq,T}$	dB $L_{A10,T}$	dB $L_{A90,T}$	dB L_{Amax}
MP4a	23/05/14 13:50-16:50	63	65	57	86
MP4b	06/06/15 10:15-13:15	66	68	59	89

Baseline Vibration Survey

9.121 The highest measured VDV values (on the z-axis) were measured during vibration monitoring at each location (see Figure 9-1). A summary of the highest logged levels of vibration from an individual train movement on the Northern Line and the Midland Main Line are presented in Table 9-18.

Table 9-18 Summary of VDV Vibration Measurements

Position	Train Line Measured	Period	Maximum Measured VDV $ms^{-1.75}$
V1 (long term)	Northern Line	30/0514/13 09:40 to 10:40	0.048
V2 (short term)	Midland Main Line	30/0514/13 12:20 to 13:20	0.015

Suitability of Use

9.122 This section assess the suitability of the site for development in terms of noise and vibration. Where internal noise and vibration levels (as specified in relevant British Standards) that are desirable for new developments are not achievable through a typical building construction, mitigation measures have been recommended.

PPG24 Assessment

9.123 PPG24 Noise contours have been calculated across the Proposed Development site and are presented in ***ES Volume III, Appendix E: Noise and Vibration***. These noise contours show the propagation of noise across the site without any buildings.

9.124 The PPG24 noise contours are worst case during the night and indicate that the majority (approximately 75%) of the Site is within NEC B. Areas of the Site directly adjacent to adjacent roads and rail lines (approximately 25% of the Site) are within NEC C.

9.125 Although the PPG24 assessment indicates that the vast majority of the Site is within NEC B, further assessment was required at different heights to identify how noise levels change as building heights increase (see below).

Assessment of Internal Noise Environments in the Proposed Development

9.126 Noise predictions have been used to derive glazing requirements which will achieve the required $L_{Aeq,T}$ (as stated in BS8233) of the 35dB threshold noise level for habitable rooms during the daytime and 30dB for suitable sleeping conditions during the night.

9.127 To achieve the internal noise levels specified above, external noise ingress must be controlled by the building facade. Glazing recommendations are given using the R_w+C_{tr} index (see Paragraphs 9.71 to 9.74), a commonly used single figure term used to specify the sound insulation requirements of facades affected by traffic noise (urban road traffic and low speed rail noise), and are provided as three numerical values, for example 4-16-6. These values relate to the: glazing thickness - air gap - glazing thickness, each in millimetres (mm).

9.128 Noise contour plots showing the predicted daytime and night-time noise levels incident on the façades of proposed buildings are presented in ***ES Volume III, Appendix E: Noise and Vibration.***

9.129 ***: Noise and Vibration***.

9.130 Noise predictions have been carried out to provide the highest predicted noise level incident on each building façade. Predicted daytime and night-time noise levels incident on the building facades can be seen on the in ***ES Volume III, Appendix E: Noise and Vibration***. Noise predictions have been carried out every two floors (starting at 1st floor level which typically experience highest noise levels) for each of the proposed Development Stage 1 Blocks to provide an indication of how noise levels change as the building height increases. Noise plots are colour coded to provide an indication of mitigation requirements along each proposed building façade. The mitigation colour coding assumes that:

- A partially open window provides an R_w+C_{tr} of approximately 15dB;
- Thermal double glazing provides an R_w+C_{tr} of approximately 30dB;
- Acoustic laminate double glazing can provide an R_w+C_{tr} of up to 40dB; and
- Secondary glazing can provide an R_w+C_{tr} of up to 50dB.

9.131 In addition to glazing, all residential properties with a requirement for glazing with an R_w+C_{tr} of 15dB would be required to be fitted with ventilation that was capable of performing to the same acoustic specification to remove the need to ventilate the building using open windows. A whole house ventilation system will be

incorporated into the residential units which must be capable of performing to the same acoustic specification as the glazing recommendations so the sound insulation performance of the building façade is not compromised.

Detailed Components of the Proposed Development

9.132 Noise predictions have been carried out to provide the highest predicted noise level incident on each building façade. The highest predicted noise levels incident on the Development Stage 1 building facades are presented in Table 9-19 to Table 9-30. Figures showing the predicted noise levels incident on Development Stage 1 building facades can be seen in ***ES Volume III, Appendix E: Noise and Vibration***.

Table 9-19 Block H – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	44	47	44	46	17	4-16-6 mm Thermal double glazing
	Night	39	40	39	40	10	
3rd	Day	46	48	46	47	13	
	Night	40	40	41	41	11	
5th	Day	47	48	47	47	13	
	Night	42	40	43	42	13	
7th	Day	48	49	48	48	14	
	Night	43	41	44	43	14	

Table 9-20 Block J – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	42	54	50	53	19	4-16-6 mm Thermal double glazing
	Night	38	47	44	46	17	
3rd	Day	44	52	49	49	17	
	Night	40	45	43	43	15	
5th	Day	45	52	50	53	17	
	Night	42	46	44	46	16	

Table 9-21 Block K – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	52	65	62	66	31	4-12-6.8 mm Acoustic laminate glazing
	Night	45	58	55	59	29	4-16-6 mm Thermal double glazing
3rd	Day	52	65	62	66	30	
	Night	46	58	55	59	29	
5th	Day	53	64	62	65	30	
	Night	46	57	55	59	29	

Table 9-22 Block L – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	44	40	46	44	11	4-16-6 mm Thermal double glazing
	Night	39	31	40	38	10	
3rd	Day	46	42	47	46	12	
	Night	41	35	42	40	12	

Table 9-23 Block M – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	54	64	62	65	30	4-16-6 mm Thermal double glazing
	Night	47	57	55	58	27	
3rd	Day	44	49	48	48	14	
	Night	41	42	42	42	12	
5th	Day	46	50	49	50	15	
	Night	43	44	44	44	14	

Table 9-24 Block N – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	45	42	49	49	14	4-16-6 mm Thermal double glazing
	Night	40	34	42	43	13	
3rd	Day	47	43	50	50	15	
	Night	42	37	44	44	14	

Table 9-25 Block P – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	43	51	56	56	21	4-16-6 mm Thermal double glazing
	Night	40	44	49	49	19	
3rd	Day	45	52	57	56	22	
	Night	42	45	50	50	20	
5th	Day	47	50	57	57	22	
	Night	43	43	51	50	21	
7th	Day	49	49	58	57	23	
	Night	45	44	51	51	21	

Table 9-26 Block Q – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	47	63	62	64	28	4-16-6 mm Thermal double glazing
	Night	43	56	55	57	27	
3rd	Day	50	63	62	64	29	
	Night	44	56	55	57	27	
5th	Day	49	62	62	64	27	
	Night	46	55	55	57	27	

Table 9-27 Block R – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	47	52	54	54	19	4-16-6 mm Thermal double glazing
	Night	42	45	48	48	18	
3rd	Day	48	53	55	55	20	
	Night	44	46	49	49	19	

Table 9-28 Block S – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	47	54	54	54	19	4-16-6 mm Thermal double glazing
	Night	42	47	47	48	18	
3rd	Day	49	54	54	55	20	
	Night	44	48	48	49	19	

Table 9-29 Block T – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		NE	NW	SE	SW		
1st	Day	50	53	53	54	19	4-16-6 mm Thermal double glazing
	Night	45	46	49	49	19	
3rd	Day	53	54	54	55	20	
	Night	49	47	50	50	20	
5th	Day	55	54	55	56	21	
	Night	51	48	51	51	21	

Table 9-30 Block U – Highest Predicted Noise Levels

Floor	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation						Highest Required R_w+C_{tr} Glazing Rating	Example Glazing Specification
		N	NW	E	S	SE	W		
1st	Day	65	61	54	49	62	47	30	4-16-6 mm Thermal double glazing
	Night	49	45	46	45	48	43	19	

9.133 Noise predictions indicate that suitable internal noise levels as stated in BS 8233 (see Table 9-4) are achievable through provision of standard thermal double glazing with the exception of bedrooms and living rooms on south-west facing properties at 1st floor level of Block K which will require acoustic laminate glazing. Once this mitigation is in place the acceptable internal levels will be reached.

Outline Components of the Proposed Development

School Outline Component

9.134 Noise predictions have been carried out to provide the highest predicted noise level incident on each façade of the proposed school building. Predicted worst case daytime noise levels incident on the building facades are summarised in Table 9-32 and are presented graphically in ***ES Volume III, Appendix E: Noise and Vibration*****.**

Table 9-31 School – Highest Predicted Noise Levels

Room	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Worse Case Example Glazing Specification
	N	S	E	W		
General classroom	48	70	68	67	35	6-16-10.8 mm Acoustic laminate glazing
Specialist classroom					40	8.8-16-12.8 mm Acoustic laminate glazing

9.135 The proposed school will require acoustic laminate glazing to satisfy internal noise requirements set out in BB93 (see Table 9-5) for both general classrooms and specialist classrooms.

9.136 Noise predictions showing the propagation of noise across outdoor spaces within the school boundaries are presented in ***ES Volume III, Appendix E: Noise and Vibration*****.** Noise predictions indicate that noise levels

range from approximately 45 dB $L_{Aeq,T}$ to 60 dB $L_{Aeq,T}$, depending on the separation distance to the Northern Line (adjacent to the south site boundary) and screening of train noise provided by the school building.

9.137 Outdoor space within the school boundaries should be utilised in accordance with recommended external noise levels for schools in BB93 (see Table 9-6). Areas that are suitable for outdoor teaching should be located directly north of the school (thus benefitting from screening of train noise) or in the northern area of the Site (thus increasing the separation distance from train movements). The rest of the outdoor space would be suitable for playgrounds, playing fields and recreational areas.

Development Stage 2 Outline Components

9.138 Noise predictions have been carried out to provide the highest predicted noise level incident on each building façade. Predicted worst case daytime noise levels incident on the building facades are summarised in Table 9-32 and are presented graphically in ***ES Volume III, Appendix E: Noise and Vibration*.**

Table 9-32 Development Stage 2 Outline Blocks – Highest Predicted Noise Levels

Block	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Worse Case Example Glazing Specification
		N	S	E	W		
A	Day	67	63	64	64	32	6-12-6.8 mm Acoustic laminate glazing
	Night	58	53	55	55	28	4-16-6 mm Thermal double glazing
B	Day	70	68	70	64	35	6-16-10.8 mm Acoustic laminate glazing
	Night	62	61	62	57	32	6-12-6.8 mm Acoustic laminate glazing
D	Day	66	56	63	63	31	4-12-6.8 mm Acoustic laminate glazing
	Night	52	50	51	51	22	4-16-6 mm Thermal double glazing
E	Day	54	64	63	61	29	4-16-6 mm Thermal double glazing
	Night	48	57	56	54	22	4-16-6 mm Thermal double glazing
F	Day	52	47	52	49	17	4-16-6 mm Thermal double glazing
	Night	44	42	44	42	14	4-16-6 mm Thermal double glazing
G	Day	50	67	66	60	32	6-12-6.8 mm Acoustic laminate glazing
	Night	46	60	59	54	30	4-16-6 mm Thermal double glazing

9.139 Noise predictions indicate that suitable internal noise levels as stated in BS 8233 (see Table 9-4) are achievable through provision of standard thermal double glazing with the exception of Blocks A, B, D and G buildings which will require acoustic laminate glazing in order to achieve the suitable noise levels. Once this mitigation is in place the acceptable internal levels will be reached.

Development Stage 3 Outline Component

9.140 Noise predictions have been carried out to provide the highest predicted noise level incident on each building façade. Predicted worst case daytime noise levels incident on the building facades are summarised in Table 9-32 and are presented graphically in ***ES Volume III, Appendix E: Noise and Vibration*.**

Table 9-33 Development Stage 3 Outline Blocks – Highest Predicted Noise Levels

Block	Period	Highest Predicted dB $L_{Aeq,T}$ Incident on Building Façade of Orientation				Highest Required R_w+C_{tr} Glazing Rating	Worse Case Example Glazing Specification
		N	S	E	W		
V	Day	49	55	55	53	20	4-16-6 mm Thermal double glazing
	Night	45	51	51	47	21	4-16-6 mm Thermal double glazing
W	Day	56	59	59	56	24	4-16-6 mm Thermal double glazing
	Night	53	54	54	50	24	4-16-6 mm Thermal double glazing
X	Day	56	65	66	64	31	4-12-6.8 mm Acoustic laminate glazing
	Night	52	58	60	58	30	4-16-6 mm Thermal double glazing
Y	Day	66	64	52	58	31	4-12-6.8 mm Acoustic laminate glazing
	Night	52	53	48	45	23	4-16-6 mm Thermal double glazing
Z	Day	56	59	59	55	29	4-16-6 mm Thermal double glazing
	Night	51	55	55	50	20	4-16-6 mm Thermal double glazing

9.141 Noise predictions indicate that suitable internal noise levels as stated in BS 8233 (see Table 9-4) are achievable through provision of standard thermal double glazing with the exception of Block X and Y buildings which will require acoustic laminate glazing in order to meet suitable internal noise levels.

Ground-Borne Vibration

9.142 This assessment covers new buildings in both the Detailed and Outline Components of the Proposed Development. Vibration levels due to train movements have been logged at two locations on the Site which are considered to be representative of typical worst case levels of vibration from train movements on the Northern Line (adjacent to the south Site boundary) and the Midland Main Line (adjacent to the east Site boundary). Results of the vibration survey are presented in Table 9-18.

9.143 The number of train movements during daytime and night-time periods was estimated for the weekday period using the TfL Northern Line timetable (Ref. 9-25) and East Midlands timetable (Ref. 9-26). The estimated number of train movements on each along with the calculated day and night VDV levels at each monitoring location are presented in Table 9-18.

9 Noise and Vibration

Table 9-34 Calculated Day and Night VDV Levels for Train Movements

Location	Highest Logged VDV $mms^{-1.75}$	Period	Estimated Train Movements	VDV $mms^{-1.75}$
V1	0.048	Day	136	0.16
		Night	10	0.09
V2	0.015	Day	584	0.07
		Night	74	0.04

9.144 The levels of vibration logged at the on-site measurement locations that were considered to be representative of locations at which high levels of vibration due to train movements may be experienced are of a magnitude that adverse comments are not expected. Consequently, the site is considered to be suitable for development in terms of vibration from train movements.

Assessment of Effects and Significance

9.145 This section discusses effects to sensitive receptors associated with noise and vibration arising from the Proposed Development during the demolition and construction phase and on completion and occupation of the Proposed Development.

9.146 Where significant adverse effects are predicted to occur, outline mitigation measures have been identified in order to demonstrate the feasibility of reducing the significance of these impacts to an acceptable level.

Effects during Demolition and Construction

9.147 This section identifies potential noise and vibration effects on sensitive receptors arising during the demolition and construction phase of the Outline Components of the Proposed Development.

9.148 The Outline Components of the Proposed Development is planned to be constructed over an ten year period which have been summarised as four timeslices (see Table 9-8). As the timeslices for the demolition and construction programme include overlapping works on both the Detailed and Outline Components of the Proposed Development, the demolition and construction noise assessment covered in this section includes potential noise impacts arising from works on Detailed and Outline Components.

Demolition and Construction Works Noise

9.149 Details on construction and demolition calculation methodology are presented in ***ES Volume III, Appendix E: Noise and Vibration***. The results of noise predictions for each construction phase at the receptors identified in Table 9-1 are presented in Table 9-35.

9.150 The significance of predicted construction and demolition noise levels has been assessed using the methodology presented in Table 9-11. Noise contour plots showing the predicted propagation of noise during each stage are presented in ***ES Volume III, Appendix E: Noise and Vibration***.

Table 9-35 Demolition and Construction Noise Assessment

Receptor	Measured Daytime $L_{Aeq,16h}$ dB	Noise Limit dB $L_{Aeq,T}$	Predicted dB $L_{Aeq,1h}$ Noise Level for Timeslice							
			TS1	Potential Effect	TS2	Potential Effect	TS3	Potential Effect	TS4	Potential Effect
Off-site receptors										
S1	67	75	77	Moderate adverse	65	Negligible	74	Minor adverse	74	Minor adverse
S2	67	75	71	Minor adverse	55	Negligible	68	Minor adverse	68	Minor adverse
S3	63	75	78	Moderate adverse	57	Negligible	74	Minor adverse	74	Minor adverse
S4	63	75	77	Moderate adverse	56	Negligible	74	Minor adverse	74	Minor adverse
S5	63	75	77	Moderate adverse	58	Negligible	74	Minor adverse	74	Minor adverse
S6	63	75	68	Minor adverse	57	Negligible	64	Negligible	64	Negligible
S7	63	75	76	Moderate adverse	72	Minor adverse	72	Minor adverse	56	Negligible
S8	67	75	74	Minor adverse	68	Minor adverse	68	Minor adverse	58	Negligible
S9	67	75	67	Negligible	63	Negligible	63	Negligible	50	Negligible
S10	67	75	66	Minor adverse	62	Negligible	63	Negligible	51	Negligible
S11	60	75	79	Moderate adverse	75	Minor adverse	75	Minor adverse	53	Negligible
S12	67	75	68	Minor adverse	63	Negligible	63	Negligible	51	Negligible
S13	67	70*	78	Major adverse	75	Moderate adverse	75	Moderate adverse	54	Negligible
On-site receptors										
S14	60	75	81	Major Adverse	76	Moderate adverse	77	Moderate adverse	77	Moderate adverse
S15	60	65	-	-	75	Major adverse	75	Major adverse	54	Negligible
S16	60	75	-	-	-	-	-		57	Negligible

*As ambient noise levels logged at the North London Grammar School (S13) exceed the demolition and construction $L_{Aeq,T}$ noise limit of 65dB for schools (as stated in Table 9-10), the noise limit for this receptor has been revised by rounding up the ambient noise level of 67dB to 70dB so magnitude of effects can be identified as per Table 9-11.

9.151 Noise predictions presented in Table 9-35 indicate that noise effects at noise sensitive receptors due to construction and demolition activities are predicted to range from **negligible** to **major adverse** significance, with major adverse noise effects only occurring at new on-site receptors during timeslices 1, 2, and 3 due to their close proximity to work sites. It is likely that major adverse noise effects may occur at receptors directly adjacent to sites where demolition and construction works are taking place. Noise mitigation measures and noise management plans should be put into place to minimise noise effects due to demolition and construction.

9.152 It should be noted that construction noise predictions are based on a worst case scenario where, over the course of a working day, all plant are operational at all areas of all worksites during each timeslice. According to the demolition and construction schedule, a Block will take between 15 and 24 months to construct. In reality, it is likely that the worst case noise levels predicted will only occur for limited periods of time when plant are operational at the closest approach to sensitive receptors.

Vibration due to Construction Works

9.153 BS 5228 indicates that construction activities (particularly piling) usually only generate significant vibration impacts when they are located within 20m from sensitive locations. The impact depends on the type of piling, ground conditions, and receptor distance, which are outlined in the table below.

9.154 Table 9-36 provides PPV levels for different piling activities at various plan distances sourced from BS 5228 Part 2.

Table 9-36 Example Piling Vibration Levels

BS 5228 Reference No.	Soil Conditions	Piling Mode	Plan Distance (m)	PPV (mm/s)
101	Fill / dense ballast / London Clay	Augering	20	0.05
		Auger hitting base of hole	20	0.23
103	Fill clay	Augering	20	0.30
		Dollying casing	20	0.55
		Spinning off	20	0.44
104	Fill / sand / clay	Augering	15	0.10
		Auger hitting base of hole	14	0.30
		Mudding in	14	0.20
		Dollying casing	14	0.80

9.155 The nearest existing sensitive residential receptors are located approximately 10m from a proposed building location. Additionally, new on-site Development Stage 1 receptors are located approximately 10m Development Stage 1 receptors scheduled for completion at a later date. All other receptors are located at least 20m from potential piling locations.

9.156 Based on the separation distance between piling and receptor, the example vibration levels in Table 9-36, and the construction works vibration criteria (see Table 9-12); potential vibration levels from piling affecting sensitive receptors are unlikely to exceed a PPV of 1 mm/s (the level at which significant vibration effects are likely) with the exception of properties on Rowan Drive and new Development Stage 1 receptors. Consequently, construction vibration effects may, for limited periods of time, be of **moderate adverse** significance at properties on Rowan Drive and new Development Stage 1 receptors; however, for the majority of the construction period, vibration effects are likely to be no worse than **minor adverse** (in accordance with the criteria set out in Table 9-12), without mitigation, depending upon the type of piling method used.

9.157 There are underground utilities on-site which may be sensitive to high levels of vibration. Although it is unlikely that piling will result in high enough levels of vibration to damage pipework unless piling occurs in close proximity, due care should be taken by the contractors if pipework is located in close proximity to piling activities so threshold vibration limits (see Paragraph 9.94) are not exceeded.

Demolition and Construction Traffic Noise

9.158 Noise impacts that may arise due to demolition and construction traffic flows have been assessed based on information in ***Chapter 5: Demolition and Construction*** of this ES.

9.159 CRTN equations have been applied to the construction road traffic flow data in ***ES Volume III, Appendix E: Noise and Vibration*****.** A summary of the highest change in noise level on each road link affected by construction traffic are presented in Table 9-37. Full details of BNL calculations for each timeslice are presented in ***ES Volume III, Appendix E: Noise and Vibration*****.** The resultant change in noise level is considered to be representative of the change in noise level that may be experienced at nearby noise sensitive receptors.

Table 9-37 Summary of Construction Road Traffic Calculation Results

Road Link	Description	Worst Affected Timeslice	Difference (dB)	Significance
1	Edgware Road (north of Colindale Avenue)	3	+0.1	negligible
3	Colindale Avenue (north)	4	+0.2	negligible
5	Aerodrome Road	1, 3	+0.4	negligible
6	Greyhound Hill	3, 4	+0.1	negligible
7	Watford Way	1, 3	+0.1	negligible
9	Colindeep Lane	4	+0.1	negligible

9.160 The calculated BNLs indicate that, with the inclusion of construction traffic, road traffic noise levels will increase by a worst case of approximately 0.4 dB at all noise sensitive receptors that may be affected by road traffic noise. According to guidance within Table 9-13, a change in road traffic noise of this magnitude is considered to have a **negligible** effect.

Effects Once the Proposed Development is Complete and Occupied

Operational Road Traffic Noise

9.161 CRTN equations have been applied to the operational road traffic flow data in ***ES Volume III, Appendix E: Noise and Vibration*****.** Calculated BNLs and the change in noise level between the baseline scenario and full occupation of the Proposed Development are presented in Table 9-38. The change in road traffic noise level has been calculated for each road link that may be affected by changes in road traffic flows. The resultant change in noise level is considered to be representative of the change in noise level that may be experienced at nearby noise sensitive receptors.

Table 9-38 Changes in Road Traffic Noise due to Operational Development Road Traffic Flows

Road Link	Description	Baseline BNL $L_{A10,18h}$ dB	Future Operational BNL $L_{A10,18h}$ dB	Difference (dB)	Significance
1	Edgware Road (north of Colindale Avenue)	72.9	72.9	0.0	Negligible
2	Colindale Avenue (south)	66.4	66.4	0.0	Negligible
3	Colindale Avenue (north)	67.2	67.5	+0.3	Negligible
4	Grahame Park Way	68.4	68.4	0.0	Negligible
5	Aerodrome Road	68.5	68.7	+0.2	Negligible
6	Greyhound Hill	64.4	64.5	+0.1	Negligible
7	Watford Way	76.1	76.1	0.0	Negligible
8	Edgware Road (south of Colindale Avenue)	70.7	70.7	0.0	Negligible
9	Colindeep Lane	67.5	67.5	0.0	Negligible

9.162 Comparison of calculated baseline BNLs with future BNLs calculated from road traffic flows indicates that the noise effect due to changes in road traffic flows as a result of the Proposed Development will be of **negligible** significance at all receptors.

Building Services Plant Noise

9.163 Table 9-39 presents recommended operational noise limits for proposed building services plant experienced at nearby sensitive receptors and the on-site receptors. These operational noise limits were derived from background noise measurements presented in Table 9-16 and Table 9-17 and noise criteria presented in Table 9-14 which defines fixed plant noise as having a negligible effect at a rating noise level of 5dB below the measured background noise level, as required by LBB. It should be noted that the L_{A90} background noise

level at MP4 has been estimated by taking the biggest difference between daytime and night-time background noise levels (9dB at MP1 and MP2 to provide the lowest estimated night-time L_{A90} noise level) and subtracting from the daytime L_{A90} logged at MP4a.

9.164 It is assumed that the plant will operate as intended and will not be tonal or impulsive in nature. Should the noise exhibit any acoustic features such as a continuous note (whine, hiss, screech, hum, etc.) or contain distinct impulses (bangs, clicks, clatters or thumps) then a 5 dB penalty should be imposed as described in BS 4142. Noise limits have been capped to a minimum rating noise level of 35 dB $L_{Aeq,T}$, which is described as 'very low' in BS 4142.

Table 9-39 Recommended Operational Noise Limits for Noise Sensitive Properties

Receptor Group	Daytime (07:00-23:00) Operational Noise Limit $L_{Aeq,1h}$ dB	Night-time (23:00-07:00) Operational Noise Limit $L_{Aeq,5min}$ dB
S1	40	35*
S2	40	35*
S3	52	43
S4	52	43
S5	52	43
S6	52	43
S7	52	43
S8	40	35*
S9	46	37
S10	46	37
S11	36	33
S12	46	37
S13	40	35*

*capped to a minimum noise limit of 35 dB

9.165 As the building services plant will be designed to achieve the recommended limits shown in Table 9-39; operational building services noise effects are considered to be **negligible** at all receptors.

Additional Mitigation Measures

9.166 Significant noise effects at sensitive receptors have been identified during demolition and construction activities. Mitigation measures should be implemented across the Site to minimise the magnitude and duration adverse noise effects wherever possible.

Additional Mitigation during Demolition and Construction

9.167 Mitigation measures should be employed to ensure that potential noise impacts at nearby sensitive receptors due to demolition and construction activities are minimised.

9.168 The preferred approach for controlling construction noise is to reduce source levels where possible, but with due regard to practicality. Sometimes a greater noise level may be acceptable if the overall demolition/construction time, and therefore length of disruption, is reduced.

9.169 Noise and vibration will be managed to reduce impacts, and mitigation measures will be documented within a Demolition and Construction Method Statement (DCMS) and a Construction and Environmental Management Plan (CEMP). On-site, good practice procedures will be followed in order to mitigate noise and vibration impacts. Measures that should be adopted to minimise construction and demolition noise impacts include:

- Noisy plant or equipment shall be situated as far as possible from noise sensitive buildings; and
- Barriers (e.g. site huts, acoustic sheds or partitions) to reduce noise reaching noise sensitive buildings.

9.170 In addition to the mitigation measures listed above, the following provisions should be adhered to wherever practicable:

- The contractor shall ensure that all plant complies with the relevant statutory requirements;
- Machines in intermittent use should be shut down or throttled down to a minimum when not in use;
- Compressors should be fitted with properly lined and sealed acoustic covers which should be kept closed whenever in use. Pneumatic percussive tools should be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Equipment which breaks concrete, brickwork or masonry by bending or bursting or "nibbling" shall be used in preference to percussive tools. Avoid the use of impact tools where the site is close to occupied premises;
- Rotary drills and bursters activated by hydraulic, chemical or electrical power shall be used for excavating hard or extrusive material;
- Equipment powered by mains electricity shall be used in preference to equipment powered by internal combustion engine or locally generated electricity;
- Neither any part of the works nor any maintenance of plant shall be carried out in such a manner as to cause unnecessary noise except in the case of an emergency when the work is absolutely necessary for the saving of life or property or the safety of the works;
- Plant shall be maintained in good working order so that extraneous noise from mechanical vibration, creaking and squeaking is kept to a minimum; and
- Noise emitting machinery which is required to run continuously shall be housed in a suitable acoustically lined enclosure.

9.171 Following incorporation of the above mitigation measures, the residual demolition and construction noise effect is assessed, based upon professional judgement, as ranging from **moderate adverse** to **negligible** significance.

Demolition and Construction Vibration Mitigation

9.172 To ensure that potential adverse vibration effects due to piling are minimised when piling in close proximity to sensitive receptors, it is recommended that the contractor use a piling technique that is least likely to cause adverse vibration effects (e.g. auger piling), to ensure that the effect of vibration is controlled to a **negligible/minor adverse** significance at nearby receptors. Additionally, care should be taken when piling close to underground services to ensure that levels of vibration that may cause damage are not generated.

Demolition and Construction Traffic Noise Mitigation

9.173 Although construction traffic has been predicted as having an effect of **negligible** significance, it is recommended that the following measures are employed as best practice to ensure that noise effects due to construction traffic remain insignificant:

- Vehicles employed for any activity associated with the construction works will, where reasonably practicable, be fitted with effective exhaust silencers and shall be maintained in good working order and operated in a manner such that noise emissions are controlled and limited as far as reasonably practicable;
- Time slots are adopted for deliveries to ensure that convoys of vehicles do not arrive simultaneously and to avoid unnecessary idling on site;

- Strict control to prevent temporary parking on kerbside in the vicinity of noise sensitive receptors near the site; and
- The use of sufficient clear signage to ensure that construction vehicles use only designated routes.

Residual Effects and Conclusions

9.174 This section addresses residual effects which cannot be eliminated through the Application of standard mitigation measures.

Proposed Development

9.175 Identified residual noise effects resulting from the Detailed and Outline Components of the Proposed Development are summarised in Table 9-40.

Table 9-40 Proposed Development – Summary of Residual Effects

Description of Effect	Residual Effect Significance	Nature of Effect	Geographic Scale
Demolition and Construction			
Demolition and Construction Noise	Negligible to Moderate Adverse	Temporary (medium term)	Local
Construction Vibration	Negligible to Minor Adverse	Temporary (medium term)	Local
Construction Traffic Noise	Negligible	Temporary (long term)	Local
Completed and Occupied Development			
Ambient Noise	Negligible	Permanent	Local
Groundborne Vibration	Negligible	Permanent	Local
Operational Road Traffic Noise	Negligible	Permanent	Local
Fixed Plant Noise	Negligible	Permanent	Local

9.176 Significant noise effects are only likely to occur during the construction phase of the Proposed Development. After mitigation measures are implemented, demolition and construction moderate adverse noise effects may occur at receptor groups S13, S14 and S15 during the construction phase. Through implementation of mitigation measures, construction noise effects can be controlled to moderate adverse at worst. These predictions cover a worst case scenario so, in reality, it is likely that adverse construction noise effects will occur for limited periods at specific receptors.

Overall Hybrid Planning Application Residual Effects Summary and Conclusions

9.177 It has been shown that suitable mitigation can be implemented in the fabric of proposed buildings to provide suitable levels of internal noise and vibration for their intended uses.

9.178 With the implementation of suitable noise mitigation procedures, construction noise effects are identified as ranging from negligible to moderate adverse.

9.179 Increases in road traffic flows due to the Proposed Development would result in a noise effect of negligible significance.

9.180 Noise limits at nearby receptors have been derived from existing ambient noise levels which fixed plant associated with the Proposed Development should not exceed.

9.181 It can be concluded that potential noise effects due to the Proposed Development can be suitably controlled and the Site can be considered as suitable in terms of noise and vibration for the Proposed Development.

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