



Grand Union House, London NW1

Acoustic Report

December 2018



Camden Mixed Developments Limited

GRAND UNION HOUSE

Acoustic Report





Camden Mixed Developments Limited

GRAND UNION HOUSE

Acoustic Report

TYPE OF DOCUMENT (VERSION) CONFIDENTIAL

PROJECT NO. 70009120

OUR REF. NO. AC-PL-001

DATE: DECEMBER 2018

WSP

4th Floor
6 Devonshire Square
London
EC2M 4YE

Phone: +44 20 7337 1700

Fax: +44 20 7337 1701

WSP.com



QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	First issue	GE Comments	CMS Comments	
Date	16 November 2018	23 November 2018	06 December 2018	
Prepared by	Chris Holmes	Chris Holmes	Chris Holmes	
Signature				
Checked by	Andrew Jarvis	Andrew Jarvis	Andrew Jarvis	
Signature				
Authorised by	Andrew Jarvis	Chris Wood	Andrew Jarvis	
Signature				
Project number	70009120	70009120	70009120	
Report number	70009120-AC-PL	70009120-AC-PL	70009120-AC-PL	
File reference	70009120/C/Report s/ AC/PL	70009120/C/Report s/ AC/PL	70009120/C/Report s/ AC/PL	



CONTENTS

1	INTRODUCTION	1
2	SITE DESCRIPTION	2
3	PLANNING POLICY AND GUIDANCE	4
4	ACOUSTIC SURVEY	13
5	SITE SUITABILITY ASSESSMENT	16
6	FIXED PLANT NOISE EMISSIONS LIMITS	22
7	CONCLUSION	24

1 INTRODUCTION

- 1.1.1. WSP has been appointed by Camden Mixed Developments Limited ('the Applicant'). to undertake an acoustic assessment for the proposed mixed-use development at Grand Union House, Camden ('the Site').
- 1.1.2. The development consists of partial demolition and redevelopment of the existing building, to provide a new office (Class B1) building with associated roof terraces, ground floor flexible town centre uses (Class A1 and/or A3 and/or D2), and 6 affordable housing units, along with associated landscaping works.
- 1.1.3. This report presents the results of an acoustic survey undertaken at the existing Site in order to establish the existing noise and vibration conditions.
- 1.1.4. An outline mitigation and ventilation strategy is presented to demonstrate suitable internal and external sound conditions can be achieved with respect to external sources.
- 1.1.5. The effects of vibration on proposed dwellings is discussed.
- 1.1.6. This report also presents noise emission limits applicable to external fixed plant items associated with the proposed development (both residential and commercial elements). These have been determined in accordance with relevant policy and guidance, and in conjunction with the results of the acoustic survey.
- 1.1.7. This report is necessarily technical in nature and a glossary of acoustic terms is presented in Appendix A.

2 SITE DESCRIPTION

2.1 LOCATION

- 2.1.1. The proposed development is located in the London Borough of Camden, to the east of Kentish Town Road, approximately 120 m north of Camden Town Station.
- 2.1.2. The northern part of the Site is occupied by one storey of double-height office space, atop a ground/mezzanine level used for car parking. Some retail uses are located at ground floor level.
- 2.1.3. The Site is in an area that is mixed, with commercial use premises at ground floor and residential dwellings at upper floors on Kentish Town Road. The Devonshire Arms public house is located to the north west of the Site, and a Sainsbury's supermarket and St Michael's Church are located to the east. The basement of the northern half of the Site is occupied by Sainsbury's car park.
- 2.1.4. The London Underground Northern Line runs beneath Kentish Town Road at a depth of approximately 12 - 14 m.
- 2.1.5. Figure 2-1 presents the Site location, with an approximate red line boundary. Also included are the nearest noise-sensitive receptors (blue), to which building services noise emissions should be assessed.

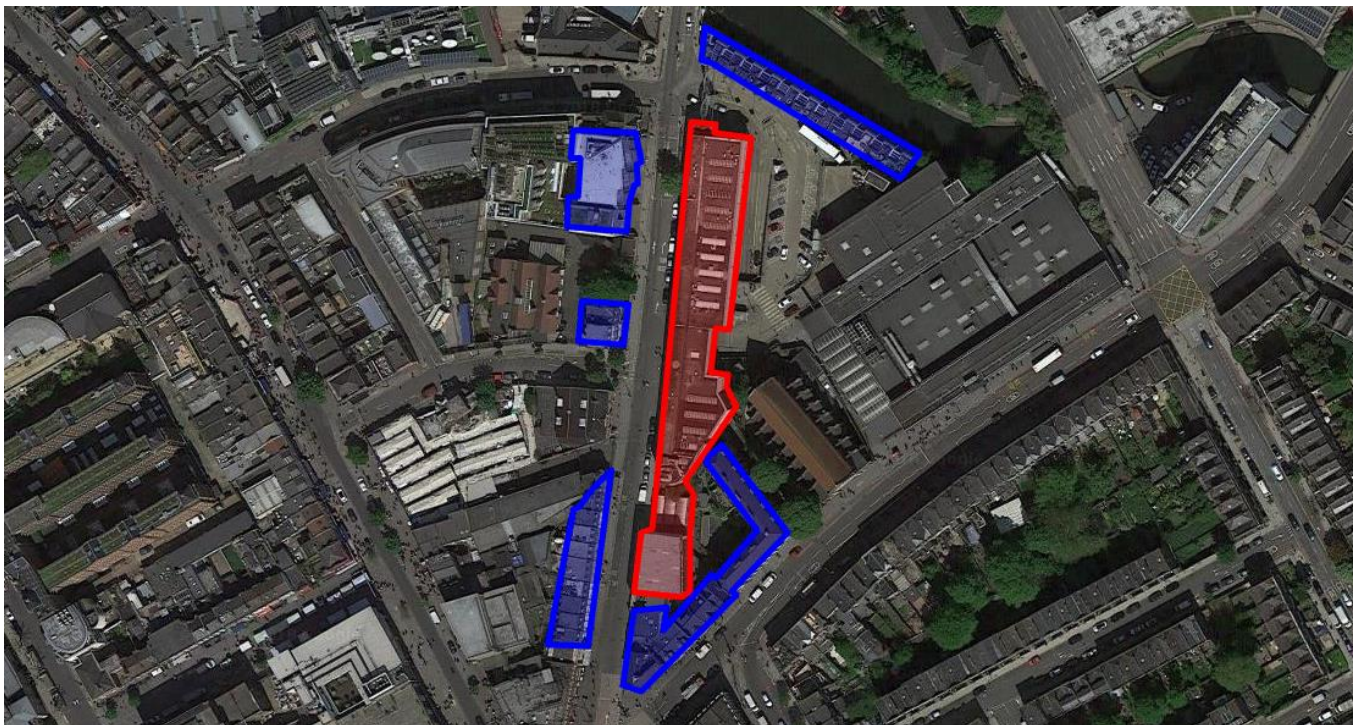


Figure 2-1: Site location (red) and nearest residential receptors (blue)

2.2 THE PROPOSED DEVELOPMENT

2.2.1. The proposed development consists of:

- **Ground Level:** Retention of parking for residents of Grand Union Walk and new, flexible retail and leisure spaces;
- **Ground Mezzanine:** Cycle parking and associated facilities and plant serving the office to the north and residential units to the south;
- **Level 01:** Open plan office with residential units to the south;
- **Level 02:** Open plan office with residential units to the south;
- **Level 03:** Open plan office with terrace and residential units to the south;
- **Level 04:** Open plan office and office terrace.

2.2.2. The respective use areas are summarised in Table 2-1 follows:

Table 2-1 – Proposed development use area summary

Land Use	Proposed (GIA)	Proposed (GEA)
Office (Class B1)	5,254 sqm	5,550 sqm
Residential (Class C3)	476 sqm	548 sqm
Flexible Retail and Restaurant/Café (Class A1/A3)	275 sqm	311 sqm
Flexible Retail, Restaurant/Café and Leisure (Class A1, A3 and/or D2)	263 sqm	289 sqm
Total	6,268 sqm	6,698 sqm

3 PLANNING POLICY AND GUIDANCE

3.1 CONSULTATION WITH THE LOCAL AUTHORITY

3.1.1. Prior to the undertaking of the assessment the London Borough of Camden (LBC) were consulted in order to establish their assessment criteria.

3.1.2. The following was confirmed:

- Internal noise level targets should be derived from British Standard 8233:2014 (summarised in Section 3.3 of this report).
- Limits for noise emissions from fixed plant items associated with the operation of the development (both residential and commercial) should be assessed in accordance with BS 4142:2014 and meet the following levels (when measured at 1 metre external to a sensitive façade during any time of the day, evening or night):
 - Noise without distinguishable features: $5 \text{ dB(A)} < L_{A90}$
 - Noise that has a distinguishable discrete continuous noise (whine, hiss, screech, hum): $10 \text{ dB(A)} < L_{A90}$
 - Noise that has distinct impulses (bangs, clicks, clatters, thumps): $10 \text{ dB(A)} < L_{A90}$

3.1.3. While not discussed, the effects of vibration (from the nearby London Underground Northern Line trains) will be assessed in accordance with the limits set in Appendix 3 of Camden's Local Plan (July 2017), as follows:

Vibration inside dwellings

- Day and evening (0700-2300) $0.2 \text{ to } 0.4 \text{ ms}^{-1.75} \text{ VDV}$
- Night (2300-0700) $0.13 \text{ ms}^{-1.75} \text{ VDV}$

Vibration inside offices

- Day, evening and night (0000-2400) $0.4 \text{ ms}^{-1.75} \text{ VDV}$

3.1.4. In addition Camden's (now superseded) Development Policies (2010) recommends that ground-borne regenerated noise within dwellings should not exceed 35 dB(A)max.

3.2 NATIONAL PLANNING POLICY

NATIONAL PLANNING POLICY FRAMEWORK (NPPF), 2018

3.2.1. First published in 2012 and most recently updated in July 2018, the NPPF sets out the Government's planning policies for England and how these are expected to be applied. The NPPF replaced Planning Policy Guidance Note (PPG) 24: Planning and Noise amongst other PPG's and Planning Policy Statements (PPS's). The sections of the NPPF which are relevant to noise and vibration are as follows:

- *"170. Planning policies and decisions should contribute to and enhance the natural and local environment by: ...[a number of points including]...*
 - e) *preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local*

environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;”

- *“180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. in doing so they should:*
A) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life⁶⁰;
B) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;...”
- *“182. Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”*

3.2.2. Reference number 60 of the above quotation points to the Explanatory Note to the Noise Policy Statement for England (NPSE).

NOISE POLICY STATEMENT FOR ENGLAND (NPSE), 2010

3.2.3. The NPSE seeks to ensure that noise issues are considered at the right time during the development of policy and decision making, and not in isolation. It highlights the underlying principles on noise management already found in existing legislation and guidance.

3.2.4. The NPSE sets out the long-term vision of Government noise policy as follows:

- *“Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.”*

3.2.5. This long-term vision is supported by the following aims:

- *“Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:*
 - avoid significant adverse impacts on health and quality of life;
 - mitigate and minimise adverse impacts on health and quality of life; and
 - where possible, contribute to the improvement of health and quality of life.”

3.2.6. To assist in the understanding of the terms ‘significant adverse’ and ‘adverse’, the NPSE acknowledges that there are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation (WHO). They are:

- NOEL - No Observed Effect Level - This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

- LOAEL - Lowest Observable Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected.

The NPSE extends these concepts to that of a SOAEL:

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

3.2.7. However, the NPSE goes on to state that:

- *“it is acknowledged within the NPSE that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.”*

3.2.8. The guidance does not present any values (i.e. decibel thresholds) that could be ascribed to the above effect levels. Guidance on doing so is provided in the form of the document by AECOM Limited for the Department for Environment, Food and Rural Affairs (Defra), entitled Possible Options for the Identification of SOAEL and LOAEL in Support of the NPSE (January 2013, Minor revisions 2014, but only released for use in December 2015).

3.2.9. In Table 1.1 of the above document, “Possible values or range of values for LOAEL and SOAEL for a given source/effect...” are given. For road traffic and rail noise, as most relevant to this assessment, the values presented in Table 3-1 were suggested.

Table 3-1 – Possible values or range of values for LOAEL and SOAEL

Source	Annoyance/ Stress, L _{Aeq,16h} (outside), dB		Sleep, L _{Aeq,8h} (outside), dB		Cardiovascular, L _{Aeq,16h} (outside), dB	
	LOAEL	SOAEL	LOAEL	SOAEL	LOAEL	SOAEL
Road	53-59	64-68	43-52	51-64	58	67
Rail	61-66	70-74	52-63	61-77	-	-

3.2.10. It should be noted that no values are suggested for indoor environments. However, the above values may be applicable in the assessment of external amenity areas and as general indicators of the appropriateness of a site for residential development.

3.2.11. Accordingly, and in line with LBC’s requirements, it is proposed to consider the results of the baseline noise survey primarily against quantitative assessment methods detailed in the following British Standards and associated guidance documents to determine the suitability of the Site for residential use.

3.3 LOCAL PLANNING POLICY

CAMDEN LOCAL PLAN (2017)

- 3.3.1. Camden's Local Plan was released in 2017 and has replaced Camden Development Policies and Core Strategy documents as the basis for planning decisions and future development in the borough.
- 3.3.2. Policy A4 *Noise and Vibration* of the document describes the LA's approach to controlling the effects noise and vibration throughout the design stage by considering both:
- The effect of proposed developments, that may produce noise, on the existing noise climate; and
 - The effect on proposed noise-sensitive developments of existing noise generating uses.
- 3.3.3. It acknowledges that, due to the high density and mixed-use nature of The Borough, the need for detailed control of noise emissions from development, both in operation and construction, is of high importance to protect local amenity.
- 3.3.4. Camden sets out its own strategy for judging the suitability of a site for noise-sensitive development, and relates this to the NOEL, LOAEL and SOAEL system of the NPPF, based on a traffic light system as follows:
- **Green:** *where noise is considered to be at an acceptable level.*
 - **Amber:** *where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.*
 - **Red:** *where noise is observed to have a significant adverse effect.*

Proposed Development Likely to be Sensitive to Noise

- 3.3.5. Relating to noise from general anonymous noise sources (road traffic, rail traffic), the document proposes the following quantitative guidelines for assessing the threshold of acceptability of noise as presented in Table 3-2.
- 3.3.6. Separate guidance is presented for industrial and commercial noise sources, discussed below, and entertainment noise sources, which is not discussed as it is not considered applicable to the proposed development.

Table 3-2 – Thresholds of sensitivity relating to noise-sensitive residential development from the Camden Local Plan

Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Noise at 1 metre from noise sensitive façade	Day	< 50 dB $L_{Aeq,16hr}^1$	50 dB to 72 dB $L_{Aeq,16hr}^1$	> 72 dB $L_{Aeq,16hr}^1$
	Night	< 45 dB $L_{Aeq,8hr}^1$ < 40 dB L_{night}^2	45 dB to 62 dB $L_{Aeq,16hr}^1$ > 40 dB L_{night}^2	> 62 dB $L_{Aeq,8hr}^1$
Inside a bedroom	Day	< 35 dB $L_{Aeq,16hr}$	35 dB to 45 dB $L_{Aeq,16hr}$	> 45 dB $L_{Aeq,16hr}$
	Night	< 30 dB $L_{Aeq,8hr}$ < 42 dB $L_{Amax,fast}$	30 dB to 40 dB $L_{Aeq,16hr}$ 40 dB to 73 dB $L_{Amax,fast}$	> 40 dB $L_{Aeq,8hr}$ > 73 dB $L_{Amax,fast}$
Outdoor living space (free-field)	Day	< 50 dB $L_{Aeq,16hr}$	50 dB to 55 dB $L_{Aeq,16hr}$	> 55 dB $L_{Aeq,16hr}$

- 3.3.7. It should be noted, and LBC acknowledge this within the Local Plan, that while the external levels may not be met internal levels may still be appropriate with appropriate mitigation strategies (such as glazing and building envelope specification).

Industrial and Commercial Noise Sources

- 3.3.8. The Camden Local Plan refers to BS 4142:2014 for guidance on the assessment of noise from industrial and commercial sources.
- 3.3.9. It also presents a similar traffic light strategy for the design of industrial and commercial noise sources as repeated in Table 3-3.

Table 3-3 – Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Garden used for main amenity (free-field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10 dB ¹ below background	'Rating level' between 9 dB below and 5 dB above background	'Rating level' greater than 5 dB above background
Outside bedroom window (façade)	Night	'Rating level' 10 dB ¹ below background and no events exceeding 57 dB L_{Amax}	'Rating level' between 9 dB below and 5 dB above background or noise events between 57 dB and 88 dB L_{Amax}	'Rating level' between 9 dB below and 5 dB above background and/or events between exceeding 88 dB L_{Amax}

¹ Where plant contains audible tonal elements this should be increased to 15 dB.

3.4 GUIDANCE DOCUMENTS – RESIDENTIAL USE

BRITISH STANDARD 8233:2014

- 3.4.1. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings provides guidance for the control of noise in and around buildings. Through providing appropriate criteria and limits for internal and external noise levels it can be used to guide the design of new buildings (or refurbished buildings undergoing a change of use).
- 3.4.2. Guidance pertaining to indoor noise levels for residential spaces is summarised in Table 3-4 below. These levels refer to the overall internal noise resulting from steady external environmental sound, such as road traffic, and are not applicable for sources of sound with specific character.

Table 3-4 – Indoor ambient noise levels in spaces when unoccupied

Activity	Location	Daytime 07:00 – 23:00 hours	Night-time 23:00 – 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

- 3.4.3. BS 8233:2014 states that, “Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$ depending on the character and number of events per night.” However, the document does not recommend any specific criterion.
- 3.4.4. In terms of design criteria for “...traditional external areas that are used for amenity space, such as gardens and patios...” BS 8233:2014 states that:

“...it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.”

- 3.4.5. In relation to other external amenity areas it states:

“Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still

appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.”

- 3.4.6. The sound level criteria specified in BS 8233:2014 are broadly in line with those specified by the World Health Organization (WHO) in its Guidelines for Community Noise (1999), as described below.

WHO GUIDELINES FOR COMMUNITY NOISE

- 3.4.7. The WHO Guidelines consolidate scientific knowledge on the health effects of community noise and provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments. The main sources of community noise are identified as road, rail and air traffic; industries; construction and public work; and neighbours.
- 3.4.8. The effects of noise in dwellings are, typically, sleep disturbance, speech interference and annoyance. Suggested guideline limitations, and the time periods to which they relate, are presented in Table 3-5.

Table 3-5 – WHO guideline values for community noise in specific environments

Specific environment	Critical health effect(s)	$L_{Aeq,t}$	Time base, t (hours)*	L_{Amax}
Outdoor living area	Serious annoyance, daytime and evening	55 dB	16	-
	Moderate annoyance, daytime and evening	50 dB	16	-
Dwellings indoors	Speech intelligibility and moderate annoyance, daytime and evening	35 dB	16	-
Inside bedrooms	Sleep disturbance, night-time	30 dB	8	45 dB **
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45 dB	8	60 dB

* These periods are usually taken to be 07:00 – 23:00 (16 hour day) and 23:00 – 07:00 (8 hour night)

** The document states that, “For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10-15 times per night...”

- 3.4.9. It is noted that the WHO guidance relating to night-time maximum noise levels is based on a study of sleep disturbance due to aircraft movements, which are not a prominent feature here. However, in the absence of similar guidance relevant to road traffic, together with aircraft noise typically being considered more annoying, it is considered appropriate to apply the guidance for the purposes of the assessment.

3.5 GUIDANCE DOCUMENTS – OFFICE USE

BRITISH STANDARD 8233:2014

- 3.5.1. BS 8233:2014 Guidance on sound insulation and noise reduction for buildings provides guidance on the control of noise in and around buildings. It suggests guideline indoor noise level criteria for new buildings.
- 3.5.2. The indoor noise level guideline values for office spaces are presented in Table 3-6.

Table 3-6 – BS8233 indoor ambient noise level criteria in offices

Room	Requirement	Indoor ambient noise level design range
Meeting room, training room	Office environment appropriate for study and work requiring concentration.	35-45 dB $L_{Aeq,T}$
Cellular office		35-40 dB $L_{Aeq,T}$
Open plan office	Office environment where a level of privacy is important.	45-50 dB $L_{Aeq,T}$

- 3.5.3. The indoor noise level guideline values apply only to steady sources of noise without specific character (i.e. anonymous noise) such road traffic noise and apply during the normal hours of occupation. The guideline values exclude any noise produced by the occupant activities in these spaces.
- 3.5.4. For offices, BS 8233:2014 also refers to guidance produced by BCO, as described in the following section.

BRITISH COUNCIL FOR OFFICES (2014): GUIDE TO SPECIFICATION (THE BCO GUIDE)

- 3.5.5. Criteria for indoor noise levels from both external noise and from building services are presented in the BCO specification guidance documents. The relevant indoor noise level criteria to the Proposed Development are reproduced in Table 3-7.
- 3.5.6. It should be noted that these criteria, conversely to those presented in BS 8233, relate to noise ingress alone and do not include the noise generated by internal building services.

Table 3-7 – BCO guideline indoor noise level criteria for office spaces

Location	Indoor ambient noise level due to external noise ingress	Normal maximum noise level due to noise ingress (db $L_{af,max}$)
Open plan office	NR 40 ($L_{eq,T}$)	55 dB
Speculative office ¹	NR 38 ($L_{eq,T}$)	55 dB
Cellular offices/meeting rooms	NR 35 ($L_{eq,T}$)	50 dB

¹ The speculative office criterion is a compromise between the ideals for open plan and cellular rooms.

- 3.5.7. On the use of natural ventilation, the BCO guide states that “it may be appropriate to accept higher external noise intrusion levels than shown above in maximum ventilation mode, provided occupants have the choice to open or close windows or ventilation openings. For example, +5 dB relaxation of $L_{eq,T}$ levels and/or +5 to 10 dB relaxation of $L_{A_{fmax}}$ levels depending on frequency of occurrence and character of noise.”

3.6 GUIDANCE DOCUMENTS – CONTROL OF NOISE FROM FIXED PLANT

BRITISH STANDARD 4142:2014

- 3.6.1. British Standard (BS) 4142:2014 Methods for rating and assessing industrial and commercial sound contains pertinent guidance relating to the assessment of sounds of an industrial and commercial nature, including sound from fixed installations (such as mechanical and electrical plant). It provides a method of determining noise rating levels for sources of industrial or commercial sound for the purposes of investigating complaints, assessing sound from new, modified, or additional sources of sound, and assessing sound at new residential premises.
- 3.6.2. The assessor is required to estimate the impact by subtracting the measured background sound level from a rating level, considering the following:
- Typically, the greater the difference, the greater the magnitude of the impact, and the lower the rating level is relative to the background sound level, the less likely it is that the specific sound source will have an adverse impact.
 - A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on context.
 - A difference of around +5 dB is likely to be an indication of an adverse impact, depending on context.
 - Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.
- 3.6.3. The rating level is determined by ‘rating’ the source by correcting for any acoustic characteristics that the specific sound may exhibit, such as:
- Tonality; + 2dB just perceptible, +4 dB clearly perceptible, +6 dB highly perceptible.
 - Impulsivity; +3 dB just perceptible, +6 dB clearly perceptible, +9 dB highly perceptible.
 - Intermittency; +3 dB if readily distinctive.
 - Other characteristics; +3 dB if readily distinctive.
- 3.6.4. On the determination of a background sound level, the Standard states that the goal is to present a background sound level, over a suitable time period, which is representative of the typical noise environment, and considers the context of the noise sources effecting that environment. The statistical analysis provided as an example in BS 4142 presents the lowest most commonly occurring $L_{A90,15m}$ value as the typical background sound level. This approach has been adopted in this assessment.
- 3.6.5. The importance of ‘context’ is highlighted in the Standard, as is interpretation by a qualified and experienced assessor. The interpretation of the rating level(s) as quantified above needs to be informed by an understanding of the context within which the noise is experienced.

4 ACOUSTIC SURVEY

4.1 INTRODUCTION

- 4.1.1. To inform the design, surveys of the existing external noise climate and vibration from the LU Northern line have been undertaken.
- 4.1.2. This section discusses the measurement methodology and summarises the results

4.2 NOISE SURVEY METHOD

- 4.2.1. An unattended environmental noise survey was undertaken between 20 September and 26 September 2017 at the following locations:
 - Monitoring Position 1 (MP1): Cantilevered from the roof of the existing building overlooking Kentish Town Road.
 - Monitoring Position 2 (MP2): Cantilevered from the roof of the existing building overlooking the rear of Sainsburys and St Michael's Church (to the south east).
- 4.2.2. The locations were chosen to minimise the influence from building services plant serving the existing development and to best capture the most significant sources of noise likely to effect the proposed development (those being road traffic on Kentish Town Road, noise from Sainsbury's and noise from road traffic on the more distant Camden Street).
- 4.2.3. Considering its location, and the relative locations of the sources affecting the microphone (primarily road traffic at street level), ambient noise levels and maximum noise levels measured at MP1 are considered to be effected by reflections from the façade and have been corrected as such.

NOISE SURVEY RESULTS

- 4.2.4. The results of the noise survey are presented for periods commensurate with those that apply to the assessments for the differing uses of the development. These being:

Office Use:

- Daytime: 12-hour L_{Aeq} (0900 – 1700, in accordance with the BCO guide), with the arithmetic average of the daily levels presented at each monitoring location.
- Typical daytime maximum levels in terms of the level that is not exceeded by more than 10 events between 0900 and 1700, with the arithmetic average of the daily levels presented at each monitoring location.

Residential Use:

- Daytime: 16-hour L_{Aeq} (0700 – 2300), with the arithmetic average of the daily levels presented at each monitoring location.
- Night-time: 8-hour L_{Aeq} (2300 – 0700), with the arithmetic average of the night-time levels presented at each monitoring location.
- Typical night-time maximum (L_{AFmax}) noise levels in terms of the level that is not exceeded by more than 10 events between 2300 and 0700, with the arithmetic average of the daily levels presented at each monitoring location.

Retail Use:

- Daytime: 10-hour L_{Aeq} (0800 – 1800), with the arithmetic average of the daily levels presented at each monitoring location.

Background Sound Levels

- Periods have been chosen to represent occupied hours (0700 – 1900), evening hours (1900 – 2300) and night-time hours (2300 – 0700), in order for appropriate limits to be set at each time of day.
- The daytime and night-time $L_{AF90,15min}$ background sound levels presented at each location have been determined from analysis of the statistical distribution of the measured 15-minute levels during the respective periods in accordance with the guidance presented in BS 4142:2014.

Table 4-1 presents the results of the unattended noise survey.

Table 4-1 – Results of the unattended environmental noise survey

Monitoring Position	Period	Ambient Noise Level ($L_{Aeq,T}$ free-field)	Typical Maximum Noise Level (L_{AFmax} , event, free-field)	Typical Background Sound Level ($L_{AF90, 15min}$, free-field)
MP1 (West)	0900 - 1700	62 ¹	81 ¹	56
	0700 - 2300	63 ¹	-	-
	0800 - 1800	63 ¹	-	-
	1900 - 2300	-	-	56
	2300 - 0700	61 ¹	81 ¹	47
MP2 (East)	0900 - 1700	59	80	55
	0700 - 2300	59	-	-
	0800 - 1800	59	-	-
	1900 - 2300	-	-	53
	2300 - 0700	56	76	49

¹ Measurements have been corrected by -3 dB to account for the effect of reflections from the façade.

- 4.2.5. Full long-term monitoring data, in graphical format, is included in Appendix B, with a mark-up illustrating the measurement locations in Appendix C.

VIBRATION SURVEY METHOD

- 4.2.6. Measurements of vibration from the LU Northern line were taken in the basement of the existing building on 4 December 2017 during an evening rush hour.
- 4.2.7. Since this survey the scheme has changed in that the residential units have been moved to the south of their original location and, therefore, further from the measurement location.

- 4.2.8. Nevertheless, given the proposed residential building is a similar distance from the tube line to the original scheme, this measurement location is considered representative of what may be experienced at basement level in the location of the proposed residential units.
- 4.2.9. As such, it is appropriate to use this data for the prediction of noise and vibration arising from the LU line in the proposed dwellings.

4.3 VIBRATION SURVEY RESULTS

- 4.3.1. Measurements were taken of several train pass-bys during an evening rush hour, with an average of the five events with the highest signal-to-noise ratio averaged to form a representative acceleration spectrum in third-octave bands.
- 4.3.2. A peak acceleration of approximately 2 mms^{-2} was recorded in the 63 Hz octave band. The average of the measured spectra is presented in Appendix C. Also presented is a maximum “background” vibration curve, which represents the level of continuous vibration from ongoing sources such as road traffic.

5 SITE SUITABILITY ASSESSMENT

5.1 INTRODUCTION

- 5.1.1. This section assesses the suitability of the Site for the proposed uses with respect to the existing noise and vibration climate.
- 5.1.2. An appraisal of the performance requirements of the external building envelope has been undertaken. An outline scheme of glazing is presented that would be appropriate to achieve the internal noise level criteria presented in Section 3.
- 5.1.3. These glazing performances are presented should not form a specification and, rather, should be used to inform a decision on the suitability of the Site for its proposed uses.
- 5.1.4. Where relevant, the appropriateness of using natural ventilation for provision of fresh air is also discussed.

IMPACT OF SAINSBURY'S COMMERCIAL OPERATION ON RESIDENTIAL ELEMENTS OF THE PROPOSED DEVELOPMENT

- 5.1.5. The operations of commercial premises' can have adverse impacts on proposed residential developments. Commonly these could be: noise from deliveries; noise emitted from fixed building services plant; or noise from patrons.
- 5.1.6. Appendix C illustrates the relative location of the current proposed residential units; the commercial deliveries yard; and the measurement location on this side of the development (at roof level).
- 5.1.7. As the plan shows, the residential units are approximately 85 m from the main deliveries loading yard, and approximately 55 m from the service road. The east facing windows to the residential units are also well screened from these sources of noise by the buildings between.
- 5.1.8. The noise data from Monitoring Position 2, which overlooked the Sainsbury's service yard has been reviewed to assess the impact of the operations of Sainsburys, and these were not considered to have a significant effect on the overall noise climate at the monitoring location.
- 5.1.9. On this basis, the activities of Sainsbury's have no significant effect on the noise climate experienced at the residential units, and do not require further assessment.

5.2 RESIDENTIAL USE

BUILDING ENVELOPE SOUND INSULATION

- 5.2.1. Noise levels vary across the facades of the development, with the most onerous requirements being to dwellings overlooking Kentish Town Road (to the west).
- 5.2.2. It is acknowledged that the noise levels measured at monitoring position 2 (to the east) are likely to be higher than would actually be experienced at the proposed residential units on this façade, due to them being more screened from Camden Street and traffic associated with Sainsbury's.
- 5.2.3. Nonetheless, the data measured at this position has been used to present a pessimistic assessment of the sound insulation performance requirements of the east façade.
- 5.2.4. Table 5-1 presents outline requirements for glazing to the residential elements of the development in order to achieve the internal noise levels targets summarised in Section 3.

- 5.2.5. Calculations to determine the degree of sound insulation required from a building façade have been undertaken in accordance with the rigorous calculation method in BS 8233. Calculations assume that the non-glazed elements of the façade are of adequate construction such that they are significantly more resistant to the passage of sound than the glazed elements.

Table 5-1 – Glazing sound insulation performance requirements

Façade	Period	External Noise Level (Free-Field, dB)	Internal Acoustic Criteria	Sound Reduction (dB $R_w + C_{tr}$)
West (overlooking Kentish Town Road)	Daytime $L_{Aeq,16h}$	63	35	32
	Night-time $L_{Aeq,8h}$	61	30	
	Night-time L_{AFmax}	81	45	
East (overlooking residential gardens to the east of the Site)	Daytime $L_{Aeq,16h}$	59	35	30
	Night-time $L_{Aeq,8h}$	56	30	
	Night-time L_{AFmax}	76	45	

- 5.2.6. To achieve the above sound reductions, it is likely that glazing would be an acoustically laminated double-glazed system.
- 5.2.7. The above recommended glazing performances represent an outline scheme that is considered suitable at this stage. Revised calculations should be undertaken at the appropriate time during the detailed design process when internal layouts and fenestration arrangements are confirmed.

VENTILATION AND COOLING

- 5.2.8. The provision of ventilation utilising openings in the façade is likely to, if not carefully considered, undermine the overall sound insulation performance of the façade.
- 5.2.9. It is necessary to consider how adequate ventilation would be provided, while maintaining appropriate internal noise levels.

BACKGROUND VENTILATION

- 5.2.10. BS 8233:2014 advises, *“The Building Regulations’ supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice.”*
- 5.2.11. Noise levels are such that open windows should not be relied upon for the provision of background ventilation to habitable rooms.

- 5.2.12. Trickle ventilators may be used, but are likely to need to be high performing specialist units on the noisiest façades (overlooking Kentish Town Road).

PURGE VENTILATION

- 5.2.13. While trickle ventilators can meet the requirements for background air changes and circulation (to provide fresh air and prevent damp/mould), these cannot be relied upon to provide ample volume of air change when cooling or rapid/purge ventilation is required.
- 5.2.14. Section 4.15 of Approved Document Part F Ventilation of the Building Regulations suggests that purge ventilation is required to “...aid removal of high concentrations of pollutants and water vapour released from occasional activities such as painting and decorating or accidental releases such as smoke from burnt food or spillage of water.” It is also “...intermittent, i.e required only when such occasional activities occur.”
- 5.2.15. Regarding purge ventilation, therefore, external noise levels should not prevent the opening of windows to provide intermittent, occasional ventilation in cases such as those described above.

PREVENTION OF OVERHEATING

- 5.2.16. Approved Document Part F goes on to note that, “*Purge ventilation provisions may also be used to improve thermal comfort, although this is not controlled under the Building Regulations.*” It is expected that, if dwellings are to rely on open windows for cooling, windows would be open for longer periods than for purge ventilation.
- 5.2.17. BS 8233 advises that partially open windows may provide a maximum sound reduction of 15 dB. Table 5-2 below provides an assessment of the predicted internal sound levels if a partially open window is to be relied upon throughout the day for cooling, based on the noise levels measured during the environmental noise survey.
- 5.2.18. It should be noted that the noise levels experienced at the proposed residential façades on the east of the development are likely to be lower than those measured, as these will be in a more screened location – overlooking the courtyard to the rear of a residential development to the east of the Site.

Table 5-2 – Internal noise levels with a partially open window

Façade	Period	External Noise Level (Free-Field, dB)	Internal Level (Partially Open Window)	Internal Acoustic Criteria	Exceedance
West (overlooking Kentish Town Road)	Daytime L _{Aeq,16h}	63	48	35	13
	Night-time L _{Aeq,8h}	61	46	30	16
	Night-time L _{AFmax}	81	66	45	21
East (overlooking residential gardens to the east of the Site)	Daytime L _{Aeq,16h}	59	44	35	9
	Night-time L _{Aeq,8h}	56	41	30	11
	Night-time L _{AFmax}	76	61	45	16

- 5.2.19. Internal criteria are exceeded by up to 21 dB if partially open windows are to be relied on for cooling. Exceedances of internal noise criteria of these magnitudes would be inappropriate, interfering with speech communication and the normal use of the dwellings.
- 5.2.20. The exceedances presented above for rooms on the east facade are based on measurements from Monitoring Position 2, which was more exposed to noise than would be expected at the east facing windows of the proposed residential units. It is considered likely that these noise levels would be somewhat lower and it would be possible to open windows on this façade without causing unreasonable disturbance to occupants.
- 5.2.21. As such, it is recommended that the opening of windows on the façade overlooking Kentish Town Road are not relied on to prevent overheating.
- 5.2.22. It is, however, noted that all flats are dual aspect. It may be demonstrated by the mechanical engineer that appropriate airflow can be achieved through opening windows on the east façade to cool dwellings without the need for mechanical cooling.
- 5.2.23. The method adopted to prevent overheating without opening windows of occupied rooms overlooking Kentish Town Road will be developed at a later stage of the design.

NOISE LEVELS IN EXTERNAL AREAS (BALCONY/TERRACES)

- 5.2.24. Noise levels on the second-floor terrace are likely to exceed the guideline of 55 dB L_{Aeq,16h} for external amenity space as set out in BS 8233:2014 and, therefore, fall into the red category in Camden's Local Policy. However, it should be noted that these spaces are generally relatively small, with the largest terrace being around 18 m².

- 5.2.25. As set out in BS 8233, noise limits for smaller balconies may not be appropriate as they would typically not be used as amenity space in the same way that a larger roof garden or terrace may be, with the space being used at the discretion of the occupant.
- 5.2.26. Reference may also be made to the guideline values for the LOAEL (lowest observed adverse effect level) and SOAEL (significant observed adverse effect level) presented in Section 3 of this report.
- 5.2.27. The noise levels measured on the worst-affected (west) façade exceed the guideline values for the LOAEL relating to road noise during the daytime (when balconies or terraces are likely to be occupied), but do not reach the SOAEL values.
- 5.2.28. Accordingly, an exceedance of the external criterion on balconies and terraces should not be considered unacceptable.
- 5.2.29. The inclusion of an imperforate balustrade to the terrace with an absorptive soffit above will reduce noise levels both on the terrace and to the living room behind it by up to 3 dB.

EFFECTS OF VIBRATION

- 5.2.30. Vibration Dose Values (VDV) and re-radiated noise from the LU Northern Line have been calculated in the first-floor residential units using empirical transfer functions to predict the attenuation or amplification of vibration as it travels into, and through, the building.
- 5.2.31. The calculation of vibration dose values (VDV) assumes 30 to 36 trains per hour and that the duration of vibration exposure is 10 seconds per train event. The W_b frequency weighting is used for vibration in the vertical direction (as specified in British Standard 6472-1).
- 5.2.32. BS 6472-1 advises that vibration exposure to human within buildings should be assessed in terms of the Vibration Dose Value (VDV). The vibration 'dose' is evaluated over a 16-hour daytime period (with the example hours given as 07:00 to 23:00) or 8-hour night-time period (e.g. 23:00 to 07:00).
- 5.2.33. The predicted VDV (night) range given above considers extra trains ran during the night tube service on Friday and Saturday.

Table 5-3 – Predicted levels of vibration in first-floor dwellings

Location	Predicted Daytime VDV ($\text{ms}^{-1.75}$)	Predicted Night-time VDV ($\text{ms}^{-1.75}$)	Predicted Re-radiated Noise Level ($L_{A\text{Smax}}$)
First Floor Dwelling	0.028 – 0.034 $\text{ms}^{-1.75}$	0.016 – 0.024 $\text{ms}^{-1.75}$	32 dB(A)

- 5.2.34. The above fall below the limits stipulated by the London Borough of Camden in their Local Policy.

5.3 OFFICE USE

BUILDING ENVELOPE SOUND INSULATION

- 5.3.1. Standard thermal double glazing will be appropriate to achieve the target internal noise criteria for open plan offices on all façades of the development, assuming there is not significant contribution through the non-glazed elements of the façade (the construction of which is not confirmed).
- 5.3.2. These requirements may be higher for cellular offices or meeting rooms located on the west façade (overlooking Kentish Town Road). These spaces require a lower internal noise level.

VENTILATION AND COOLING

- 5.3.3. It is understood that office units will have mechanical ventilation and cooling systems and, therefore, the provision of ventilation and prevention of overheating is not discussed.

5.4 GROUND FLOOR USES

BUILDING ENVELOPE SOUND INSULATION

- 5.4.1. The units at ground floor are proposed to be flexible retail and leisure uses (Class A1, A3 and/or D2), albeit that the precise uses and layouts of the units is not known at this stage and will not be known until the units are let in the future.
- 5.4.2. Acceptable internal noise levels will vary depending on the sensitivity of the space (i.e a noisy kitchen may be more tolerant to the ingress of noise than a quiet café).
- 5.4.3. BS 8233:2014 suggests a guideline design range of 50 – 55 dB $L_{Aeq,T}$ for a space where speech or telephone communications may be undertaken (such as a café, kitchen or department store).
- 5.4.4. Standard thermal double glazing is likely to provide adequate levels of sound insulation for use to flexible retail and leisure fronts throughout the development.

VENTILATION AND COOLING

- 5.4.5. It is understood that ground floor units will have mechanical ventilation and cooling systems and, therefore, the provision of ventilation and prevention of overheating is not discussed.

6 FIXED PLANT NOISE EMISSIONS LIMITS

6.1 INTRODUCTION

- 6.1.1. The proposed development includes commercial uses on lower floors, and offices on the upper floors. These elements of the development will be served by mechanical building services to provide cooling and ventilation.
- 6.1.2. At this stage, full details of any such plant are unavailable. However, to limit disturbance to residents of the proposed development, and also to any nearby existing noise-sensitive receptors, cumulative noise limits have been set for all external sources associated with the proposed development that fall within the scope of BS 4142 (as summarised in Section 3).

6.2 NOISE LIMITS

- 6.2.1. The noise limits have been set in line with guidance presented in BS 4142, and taking into account comments from the Local Authority as summarised in Section 3. The nearest existing residential receptors are indicated on the plan in Figure 2-1.
- 6.2.2. Table 6-1 presents noise limits at the key receptor locations that may be affected by noise from mechanical services and other operations serving the development. These noise limits apply to the cumulative level of noise from all sources that fall within the scope of BS 4142:2014. As such, individual plant items may need to be designed to achieve lower levels such that the overall noise limit(s) are achieved.
- 6.2.3. Typical background sound levels have been derived following the methodology in BS 4142 for the following periods:
- Daytime: 0900 – 1700: When the development is likely to be occupied
 - Evening: 1900 – 2300: To derive limits for any plant that runs into the evening
 - Night-time: 2300 – 0700: To derive limits for any plant that runs at any time of day or night.

Table 6-1 – Noise limits for plant and operations within the scope of BS 4142

Location	Representative Measurement Location (see Section 4)	Period	Typical Background Sound Level (dB L _{AF90,15m})	Free-field Cumulative Plant Noise Limit at the Receptor Location (dB L _{Ar,Tr})
Residential receptors to the south-east of the development (screened from Kentish Town Road)	MP2	Daytime (0900 – 1700)	56	51
		Evening (1900 – 2300)	56	51
		Night-time (2300 – 0700)	47	42

Location	Representative Measurement Location (see Section 4)	Period	Typical Background Sound Level (dB $L_{AF90,15m}$)	Free-field Cumulative Plant Noise Limit at the Receptor Location (dB $L_{Ar,Tr}$)
All other receptors	MP1	Daytime (0900 – 1700)	55	50
		Evening (1900 – 2300)	53	48
		Night-time (2300 – 0700)	49	44

- 6.2.4. The above noise limits are expressed in terms of $L_{Ar,Tr}$ (i.e rating levels), as defined in BS 4142:2014 and explained in Section 3 of this report. These limits should be used to inform plant selections. At later design stages the building services strategy will need to be reviewed to ensure the above cumulative noise limits are not exceeded.

7 CONCLUSION

- 7.1.1. WSP has been appointed by the Applicant to undertake an acoustic impact assessment to support the detailed planning application for the proposed development at Grand Union House, Camden.
- 7.1.2. An environmental noise survey has been carried out to establish the existing baseline noise and vibration conditions at the Site.
- 7.1.3. Recommendations have been made for mitigation required, in terms of the external building fabric of the Proposed Development, to provide appropriate internal ambient noise levels. It is demonstrated that the most onerous glazing requirement (on façades Kentish Town Road) would be achieved by a glazing unit achieving 32 dB $R_w + C_{tr}$.
- 7.1.4. A high-level discussion regarding the potential for use of natural ventilation options has been presented, and is summarised as follows:
- Trickle ventilators should be selected to provide background ventilation such that the overall sound insulation performance of the external building fabric is not undermined.
 - External sound levels should not preclude the use of open windows for circumstantial purge ventilation.
 - Opening windows on the Kentish Town Road façade to provide thermal regulation would be expected to lead to exceedances of the internal acoustic criteria. This may influence the strategy employed to prevent overheating.
- 7.1.5. Noise emission limits for fixed plant associated with the operation of the Proposed Development have been established with respect to the existing noise climate at the nearest noise-sensitive receptors, and guidance provided by the London Borough of Camden.
- 7.1.6. The limitations to this report are detailed in Appendix E.

Appendix A

GLOSSARY OF ACOUSTIC TERMINOLOGY

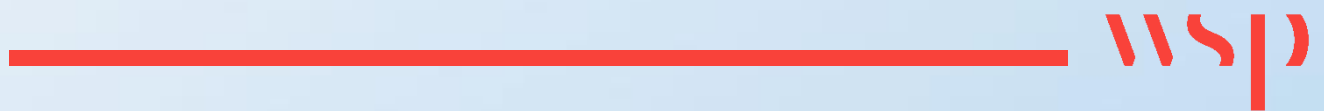


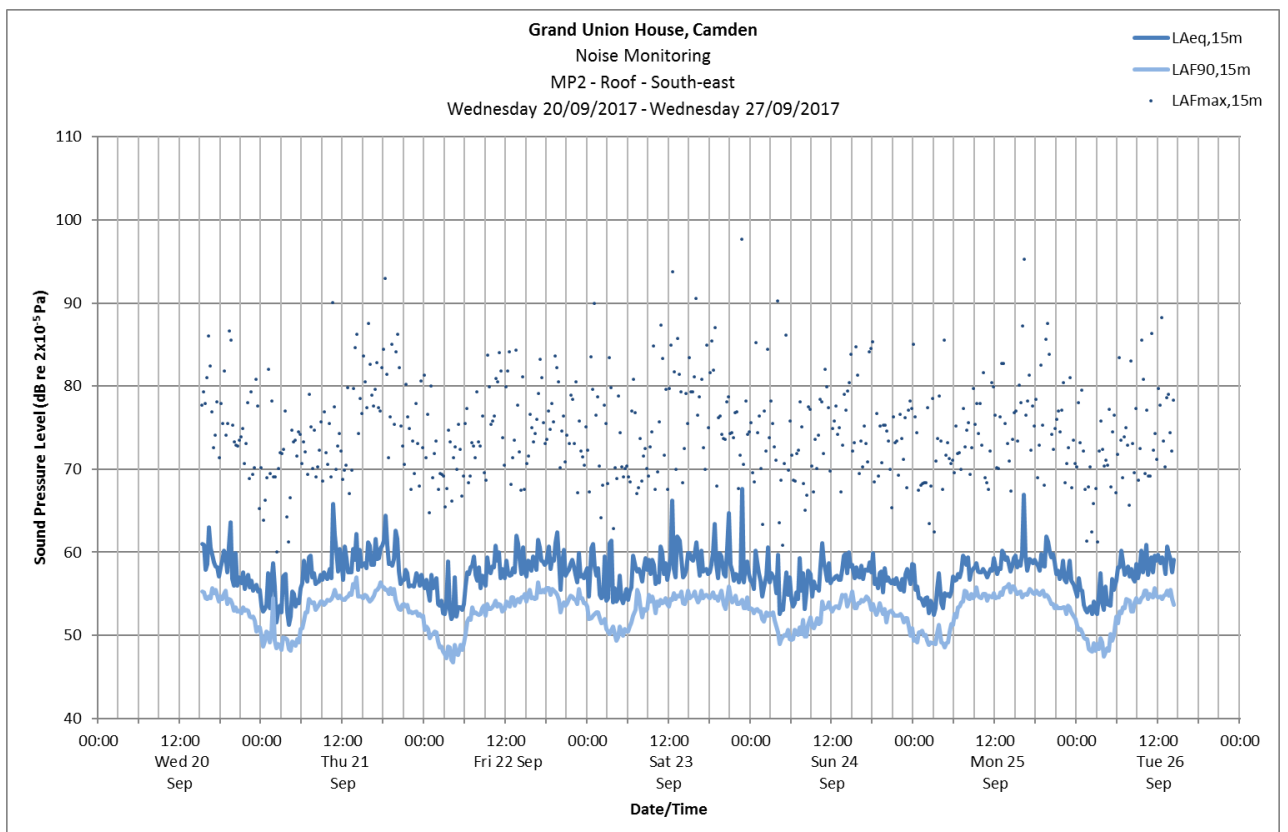
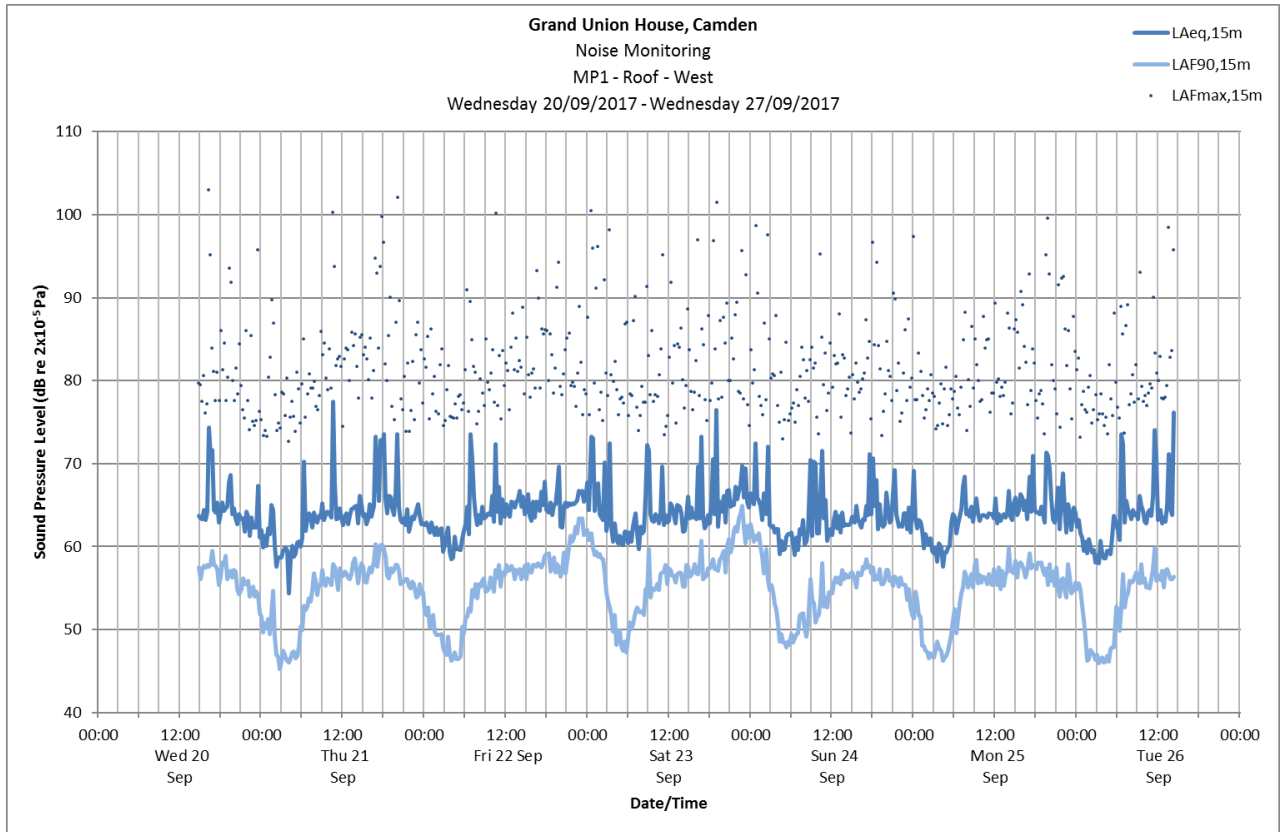
TECHNICAL GLOSSARY

Terminology	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20µPa (20x10 ⁻⁶ Pascals) on a decibel scale.
Sound Power Level	The sound power level is the sound power relative to a standard reference power of 10 ⁻¹² Watts on a decibel scale.
Decibel (dB)	<p>A scale for comparing the ratios of two quantities, including sound pressure. The difference in sound pressure level between two sounds s₁ and s₂ is given by:</p> $20 \log_{10} (s_1 / s_2)$ <p>The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20µPa.</p>
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
L _{eq,T}	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
L _{max,T}	A noise level index defined as the maximum noise level during the period T. L _{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L _{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L _{90,T}	A noise level index. The noise level exceeded for 90% of the time over the period T. L ₉₀ can be considered to be the "average minimum" noise level and is often used to describe the background noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5 m.
Façade	At a distance of 1 m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	Averaging time used in sound level meters.

Appendix B

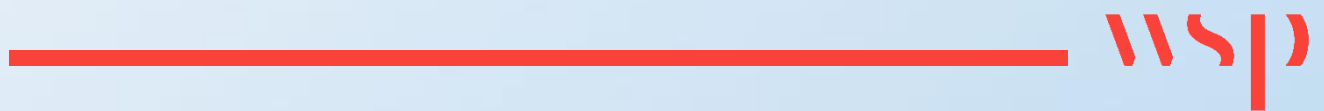
NOISE SURVEY RESULTS

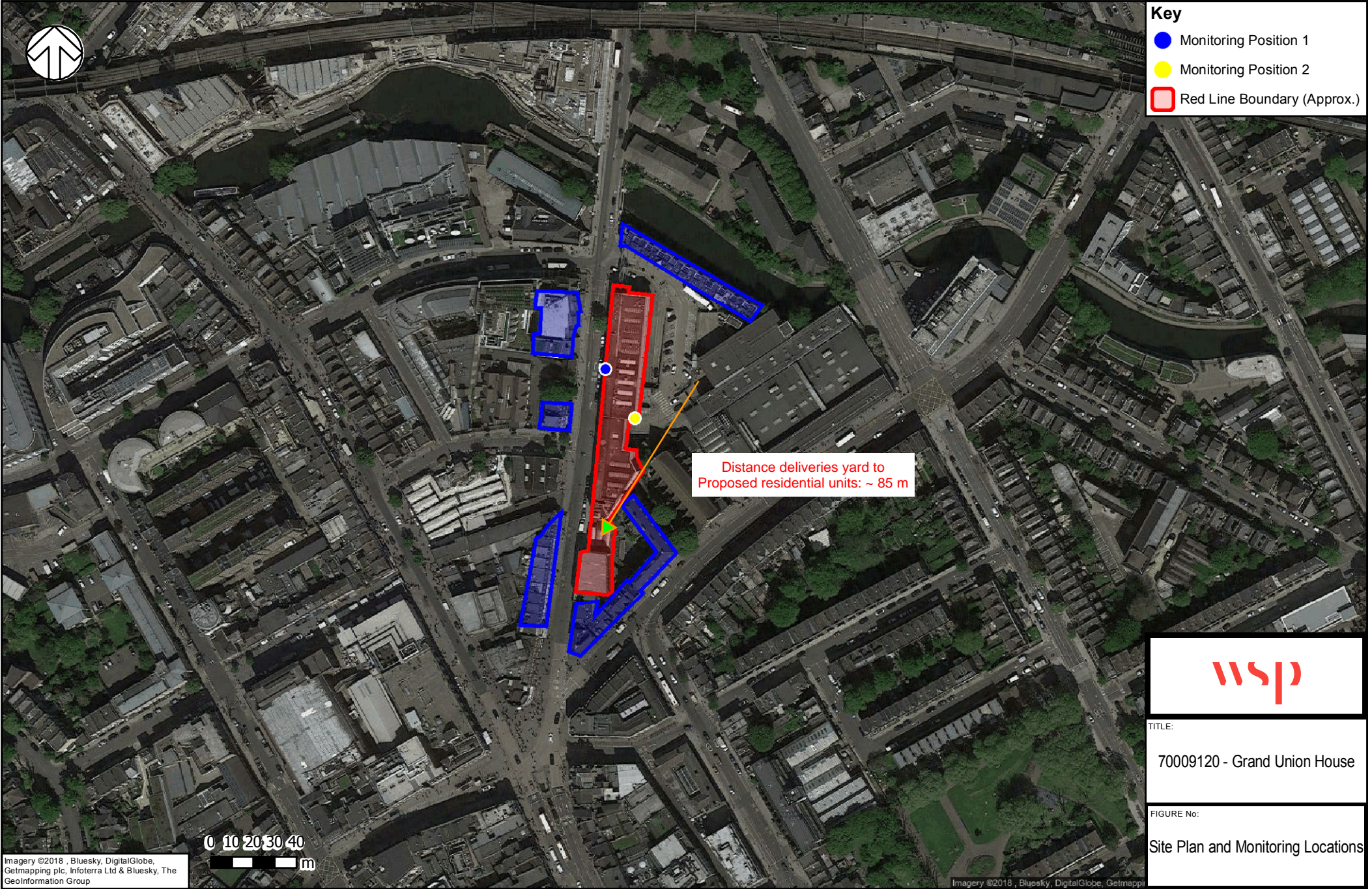




Appendix C

NOISE SURVEY LOCATIONS





TITLE:

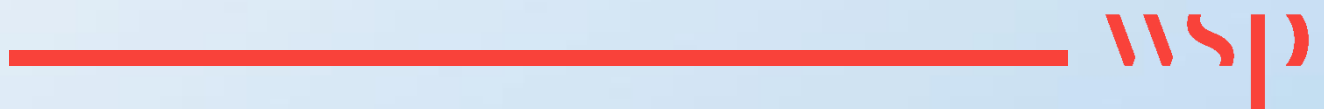
70009120 - Grand Union House

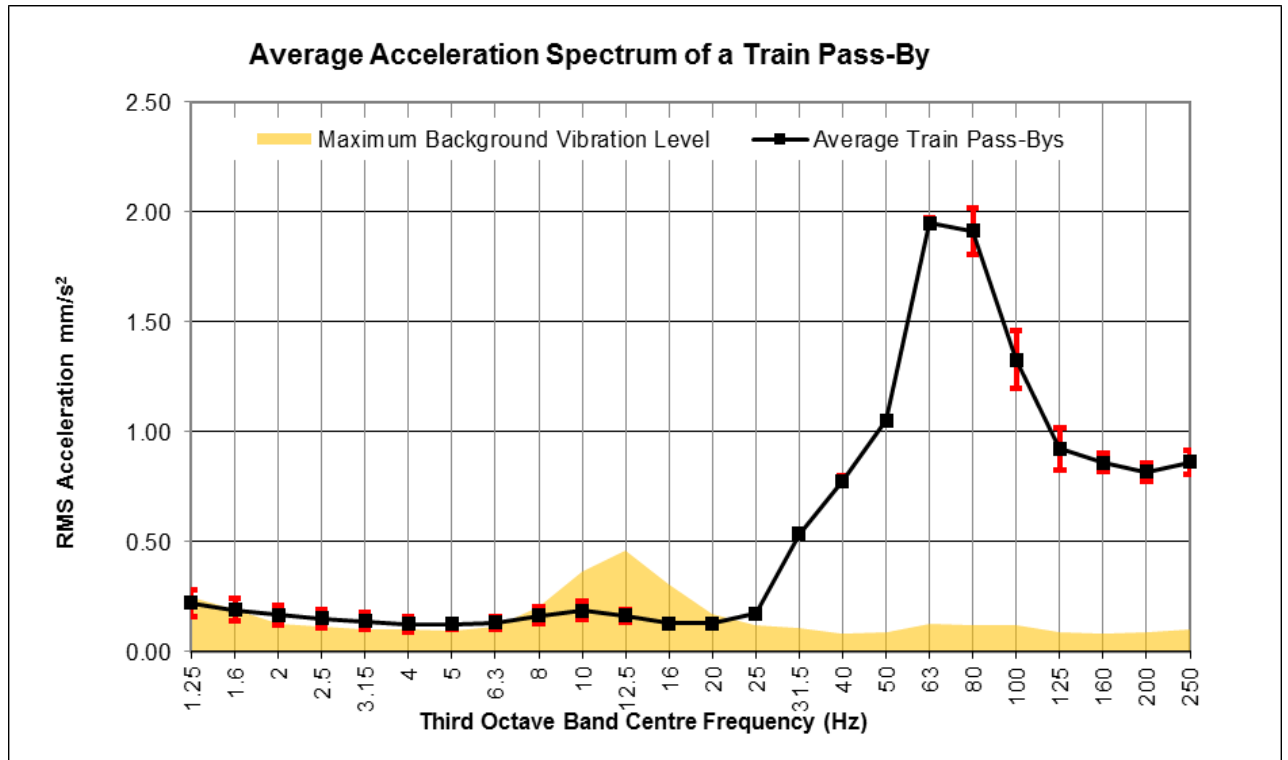
FIGURE No:

Site Plan and Monitoring Locations

Appendix D

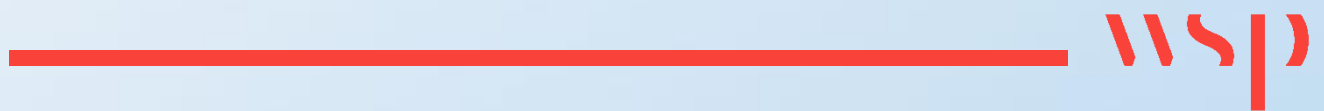
VIBRATION SURVEY RESULTS





Appendix E

LIMITATIONS TO THIS REPORT





This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of WSP UK Limited. WSP UK Limited accepts no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/ or WSP UK Limited and agree to indemnify WSP UK Limited for any and all loss or damage resulting therefrom. WSP UK Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions expressed are relevant to the dates of the site works and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations WSP UK Limited reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.



4th Floor
6 Devonshire Square
London
EC2M 4YE

wsp.com

CONFIDENTIAL