SANDY BROWN

Consultants in Acoustics, Noise & Vibration

19051-R01-C

22 June 2020

52 Tottenham Street

Noise and vibration impact assessment

55 Charterhouse Street, London EC1M 6HA T: +44 (0)20 7549 3500
68 Sackville Street, Manchester M1 3NJ T: +44 (0)161 771 2020
2 Walker Street, Edinburgh EH3 7LA T: +44 (0)131 235 2020 **post@sandybrown.com**
87 Caroline Street, Birmingham B3 1UP T: +44 (0)121 227 5020 **www.sandybrown.com**

Sandy Brown Associates LLP
Registered in England & Wales No. OC 307504 Registered Office: 55 Charterhouse Street, London EC1M 6HA

Version	Date	Comments	Author	Reviewer
A	22 Apr 20		Ruairidh Carpenter	Robert Burrell
B	28 Apr 20	Minor changes following initial reviews	Ruairidh Carpenter	Robert Burrell
C	22 Jun 20	Minor changes to plans and sections	Ruairidh Carpenter	Robert Burrell

Summary

Sandy Brown has been commissioned by Flower Island (UK) Ltd to provide acoustic advice in relation to the proposed development at 52 Tottenham Street, London.

An environmental noise and vibration survey has been carried out at the site. The noise survey was carried out between 27 February 2019 and 4 March 2019. The vibration survey was undertaken on 4 March 2019.

The representative background sound levels measured during the survey were $L_{A90,15mins}$ 49 dB during the daytime and $L_{A90,15mins}$ 48 dB at night.

Based on the requirements of the London Borough of Camden and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed L_{Aeq} 39 dB during the daytime and L_{Aeq} 38 dB during the night.

An initial assessment of the proposed external heat rejection plant has been undertaken. The unit is to be located on the level 10 terrace and is to be installed within an acoustic enclosure primarily to reduce noise levels the terrace to no greater than L_{Aeq} 50 dB. The calculated sound pressure level at the nearest noise sensitive receptor is L_{Aeq} 21 dB which complies with the daytime and night time external plant noise criteria.

An initial assessment has been carried out to determine required acoustic performances for the facades. The facade sound insulation requirements for Tottenham Street facade is $R_w + C_{tr}$ 32 dB. This can be achieved using standard double glazing.

The vibration survey indicated that both tactile vibration and ground-borne noise are not considered to be issues at this development.

Contents

1 Introduction

Sandy Brown has been commissioned by Flower Island (UK) Ltd to provide an assessment of noise and vibration in relation to the proposed development at 52 Tottenham Street.

Environmental noise and vibration surveys have been carried out to establish:

- background sound levels around the site and by nearby noise sensitive premises
- ambient and maximum noise levels at the site
- vibration levels affecting the site.

The background sound levels measured during the survey are used as the basis for setting limits for noise emission from proposed building services plant. These limits are set in accordance with the requirements of the London Borough of Camden.

Ambient sound levels are used to assess building envelope sound insulation requirements to achieve appropriate internal noise levels for residences. These follow standards set in accordance with the London Borough of Camden's guidelines.

Vibration levels are used to assess the degree to which the proposed development will be affected by tactile vibration and re-radiated noise.

This report provides details of the noise and vibration surveys, including measurement results, and provides recommendations.

2 Site description

2.1 The site and its surroundings

The site location in relation to its surroundings is shown highlighted in red in Figure 1. It is located on Tottenham Street with Cleveland Street and Tottenham Mews to the east and west of the site. Charlotte Street is roughly 70 m north-east of the site.

Figure 1 Aerial view of site (courtesy of Google Earth Pro)

2.2 Adjacent premises

The surrounding area is mostly made up of residential, retail and commercial office space. It is understood that the nearest residential premises are the houses just south of the proposed development on Tottenham Street, highlighted in green in green in Figure 1. The nearest commercial developments are highlighted in yellow. All Souls Church of England Primary School is located approximately 25 m to the west of the proposed site.

3 Development proposals

Redevelopment of the site, following demolition of the existing building, to provide a mixed use development comprising ground floor affordable workspace (Class B1), four residential units (Class C3) on the upper floors (3 x 1 Bed Units and 1 x 3 Bed Unit), alongside lower ground floor plant, cycle parking and refuse storage.

3.1 Hours of operation

Plant for the residential units is expected to run continuously, while plant serving the ground floor retail unit is expected to operate during normal business hours (09:00-17:00). Although confirmation of this will be required as the design progresses.

3.2 Potential noise sources

The potential noise sources associated with the scheme can be broadly divided into two categories:

- Building services plant
- Internal activity in commercial units.

The potential impact of these sources has been assessed and mitigation measures have been proposed to minimise impact on existing noise sensitive premises around the development.

4 Noise survey

4.1 Method

The survey included unattended and attended noise measurements.

4.1.1 Unattended noise measurements

Unattended noise monitoring was undertaken at the site over 4 days.

Details of the equipment used and the noise indices measured are provided in Appendix A.

The unattended measurements were taken over 15 minute periods between 10:45 on 27 February 2019 and 14:15 on 4 March 2019. The equipment was installed and collected by Ruairidh Carpenter.

The measurement position used during the survey is indicated in Figure 1, denoted by the letter 'L'. A photograph showing the measurement location is provided in Figure 2. This location was chosen to be reasonably representative of noise levels at the site and outside the nearest noise sensitive premises to the north of the development.

The microphone was positioned 1.5 m from the floor of the Ground floor roof terrace to the rear of the property and approximately 3 m from the nearest reflective surface. The noise levels at the measurement position are free field values.

4.1.2 Attended noise measurements

Attended sample measurements were taken by Ruairidh Carpenter at a location to the front of the site. This is indicated in Figure 1 as position 'A'. The attended measurements were carried out on 27 February 2019, over 5-minute periods. A photograph showing the measurement position is given in Figure 2.

At each position the microphone was mounted on a tripod approximately 1.5 m above the ground level and 1 m from the facade. Details of the equipment used and the noise indices measured are provided in Appendix A.

Figure 2 Photographs showing the unattended (left) and attended (right) measurement positions

4.1.3 Vibration survey

Vibration measurements were taken at one location within the site in order to determine the ambient vibration levels and to scope out vibration from the LUL Northern line located approximately 200 m to the east of site. The vibration measurement location is indicated by the letter 'V' in Figure 1.

The measurements were taken on 04 March 2019 by Ruairidh Carpenter between 13:49 and 14:19. Measurements were undertaken as a scoping exercise to determine the vibration levels that would be experienced by the proposed development.

A photograph showing the vibration measurement position in the basement is given in Figure 3.

Vibration time histories were recorded using a tri-axial accelerometer and data recorder. The accelerometers were arranged on a mounting block that was connected to a ground-bearing concrete slab. A metal washer was fixed to the slab using a thin layer of epoxy adhesive, away from the boundaries of the room, with the mounting block attached to the washer.

The vibration measurements were conducted in three axes as follows:

- X axis - Horizontal vibration approximately parallel to the railway tracks
- Y axis - Horizontal vibration approximately perpendicular to the railway tracks
- Z axis - Vertical vibration.

Details of the equipment used and the noise indices measured are provided in Appendix A.

The vibration measurements taken at 'V' are considered to be reasonably representative of the vibration levels to be experienced by the proposed residential premises.

Figure 3 Photograph showing vibration measurement location

4.2 Weather conditions

The weather conditions during the survey are described in Appendix A. The conditions during the monitoring are considered suitable for obtaining representative measurements

4.3 Observations

4.3.1 Noise

The dominant noise sources observed at the site during the survey were construction noise from adjacent developments, traffic and plant noise.

Less significant noise sources included occasional aircraft and pedestrian noise.

4.3.2 Vibration

Subjectively there was no perceptual vibration at the measurement location. The occurrence of train events was determined by monitoring the amplified vibration signal through headphones.

4.4 Results

4.4.1 Unattended noise measurement

A graph showing the results of the unattended measurements is provided in Appendix B.

Day and night-time ambient noise levels measured during the unattended survey are presented in Table 1.

Table 1 Ambient noise levels measured during the unattended survey

Date	Daytime (07:00 – 23:00) $L_{Aeq,16h}$ (dB)	Night (23:00 – 07:00) $L_{Aeq,8h}$ (dB)
Wednesday 27 February 2019	*	49
Thursday 28 February 2019	58	49
Friday 1 March 2019	61	49
Saturday 2 March 2019	59	50
Sunday 3 March 2019	52	51
Average	58	50

* Measurement not made over full period due to monitoring start and end time, not included in the average.

In line with BS 4142:2014, representative background sound levels have been determined using statistical analysis of the continuous measurements.

Daytime and night time statistical analysis of representative values for the site are given in Figure 4 and Figure 5.

From this analysis, the representative background sound levels measured during the survey were $L_{A90,15min}$ 49 dB during the daytime and $L_{A90,15min}$ 48 dB at night.

4.4.2 Attended noise measurement

Noise levels and key sources recorded during the attended measurements are summarised in Table 2. Measurements made at this position are considered facade noise levels.

During the attended measurement survey loading activities were occurring at the adjacent construction site. Measurements made during the period whilst noisy activity was occurring have not been included in Table 2.

4.4.3 Vibration measurement

VDVs measured at location 'V' are presented in Table 3. The maximum VDVs measured for each of the directions are highlighted in red.

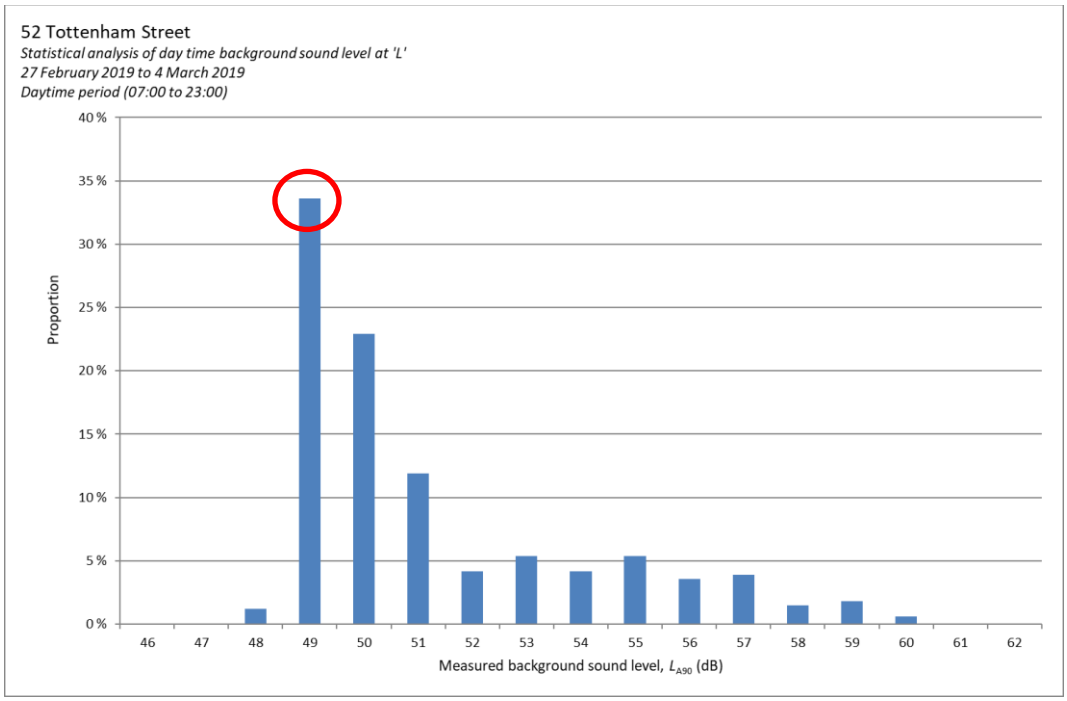


Figure 4 Statistical analysis of daytime background noise level

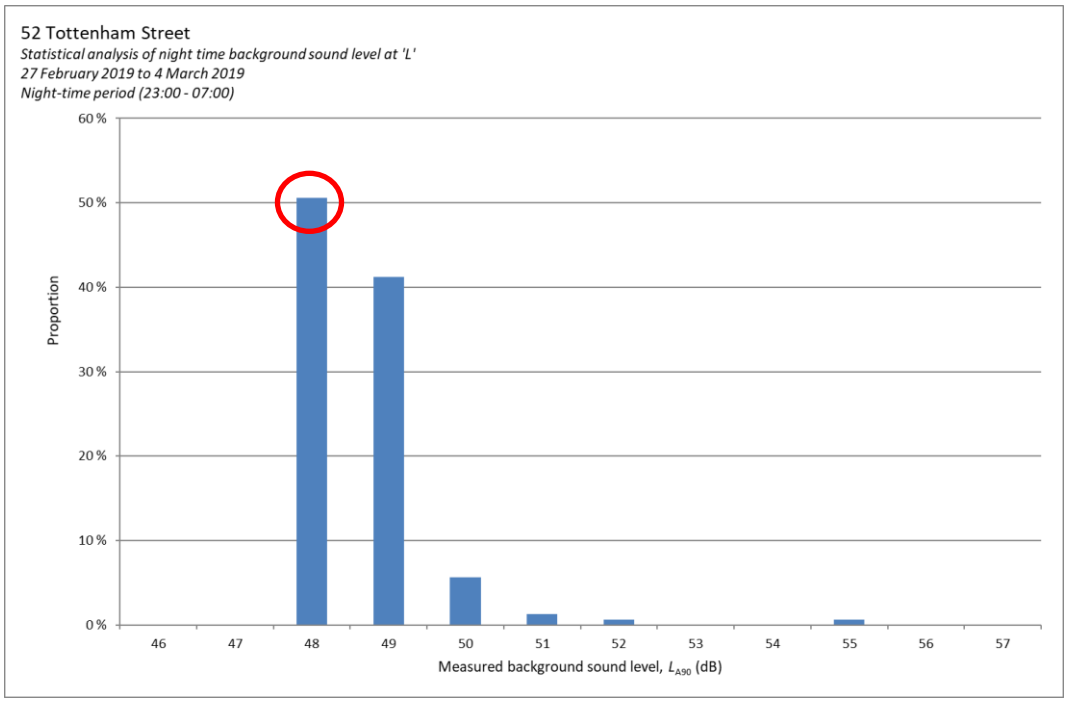


Figure 5 Statistical analysis of night-time background noise level

Table 2 Noise levels and key noise sources from attended measurements at Position 'A'

Start time	Sound pressure levels (dB)		
	$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$
10:35	58	73	52
10:40	62	74	54
10:45	60	77	55
11:00	63	80	54
11:15	61	78	56
11:20	62	75	56

Table 3 VDVs measured at location 'V'

Start time	Duration (min)	Number of events	Type of event	VDV ($m/s^{1.75}$)		
				X	Y	Z
13:49	30	12	N/A	0.0014	0.0008	0.0021
13:51	-	-	Car pass-by	0.0005	0.0003	0.0009
13:54	-	-	Construction	0.0005	0.0001	0.0013
13:58	-	-	Construction	0.0003	0.0002	0.0004
14:02	-	-	Construction – drilling	0.0004	0.0002	0.0011
14:04	-	-	Construction – drilling	0.0005	0.0003	0.0016
14:08	-	-	Construction	0.0002	0.0002	0.0004
14:15	-	-	Car pass-by	0.0004	0.0003	0.0005

5 Noise and vibration criteria

5.1 NPPF and NPSE

The National Planning Policy Framework, February 2019 (NPPF) sets out the UK government's planning policies for England. It supersedes previous guidance notes such as PPG24. No specific noise criteria are set out in the NPPF, or in the Noise Policy Statement for England (NPSE) to which it refers.

The NPPF states:

> *'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:*
>
> - *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 life.*
> - *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.'*

and

> *'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.'*

The NPSE states that its aims are as follows:

> *'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.'*

As such, neither document sets out specific acoustic criteria for new residential developments, but they require consideration of the effect of existing noise on the new development and the effect of noise from the development on the surroundings.

5.2 ProPG

ProPG *Planning & Noise (Professional Practice Guidance on Planning & Noise), New Residential Development, 2017* provides guidance to the management of noise within the planning system in England. It is restricted to consideration of new residential developments that will be exposed predominantly to airborne noise from transport sources.

The two stages of the approach are given below

- Stage 1 – Initial noise risk assessment of the proposed development site
- Stage 2 – Systematic consideration of four key elements
    - Element 1 – Demonstrating a ”Good Acoustic Design Process”
    - Element 2 – Observing internal “Noise Level Guidelines”
    - Element 3 – Undertaking an “External Amenity Area Noise Assessment”
    - Element 4 – Consideration of “Other Relevant Issues”.

Following this approach, there are four possible recommendations, the choice of recommendation is as follows:

- Grant without conditions
- Grant with conditions
- Avoid
- Prevent.

Guidance provided in ProPG has been used to assess the proposed development site and recommend mitigation measures to reduce noise levels.

5.3 Noise egress

5.3.1 Standard guidance

BS 4142:2014 *Methods for rating and assessing industrial and commercial sound* provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive premises.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains ‘attention catching features’ such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

5.3.2 Local Authority criteria

In relation to noise egress from industrial and commercial noise sources, London Borough of Camden's local plan (June 2017) states:

> '*Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. For such cases a 'Rating Level' of 10 dB below background (15 dB if tonal components are present) should be considered as design criterion.'*

Based on the extract from Camden Local Plan, all external plan must be such that the cumulative noise 1 m away from the windows of the nearest noise sensitive receptors is 10 dB below the representative measured background level ($L_{A90,\ 15\ min}$).

5.4 Noise ingress

5.4.1 British Standard guidance

Guidance on acceptable internal noise levels in residential dwellings is given in BS 8233:2014 *Sound insulation and noise reduction for buildings*. The guidance limits are shown in Table 4.

These internal levels are based on annual average data and do not have to be achieved in all circumstances. It is normal to exclude occasional events, such as fireworks night or New Year's Eve.

Table 4 Internal noise criteria for sleeping/resting

Internal space	Indoor ambient noise level, L_{Aeq} (dB)	
	Daytime (07:00 – 23:00)	Night (23:00 – 07:00)
Living rooms	35	-
Dining room	40	-
Bedrooms	35	30[1]

[1] BS 8233 notes that individual noise events can cause sleep disturbance, and that a guideline value may be set depending on the character and number of events per night, although no specific limit is provided. For regular events, such as scheduled aircraft or passing trains, a guideline value may be set in terms of SEL or $L_{Amax,F}$. Sporadic noise events could require separate values.

The standard states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

For external amenity areas, such as gardens and patios, the standard states:

> *'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.'*

5.4.2 ProPG

Internal noise ingress criteria in ProPG are the same as in BS 8233:2014 but additional guidance is provided. In relation to regular individual noise events the following additional guidance is provided:

> *'In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events*.'

5.4.3 Local Authority requirements

Camden Local Plan sets out noise thresholds in terms of 'effect levels' described in the NPPF and PPG:

- NOEL – No Observed Effect Level
- LOAEL – Lowest Observed Adverse Effect Level
- SOAEL – Significant Observed Adverse Effect Level

According to Camden Local Plan, three design criteria have been set for proposed development, as below:

- Green – where noise is considered to be at 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

Bedroom internal criteria, set out in Camden Local Plan in accordance with three design criteria, is duplicated in Table 5.

Table 5 Noise thresholds in accordance with Camden Local Plan

Design period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAEL (Red)
Day	$L_{Aeq\ 16\ hr}$<35 dB	$L_{Aeq\ 16\ hr}$ 35-45 dB	$L_{Aeq\ 16\ hr}$>45 dB
Night	$L_{Aeq\ 8\ hr}$<30 dB	$L_{Aeq\ 8\ hr}$ 30-40 dB	$L_{Aeq\ 8\ hr}$>40 dB
	L_{AFmax} 42 dB	L_{AFmax} 40-73 dB	L_{AFmax} >73 dB

The Camden Local Plan does not specify specific criteria for NOEL category.

The proposed development will be designed to achieve the criteria set out in BS 8233 and WHO which is in general agreement with the Camden LOAEL (Green) criteria.

5.5 Tactile vibration criteria

5.5.1 Standard guidance

Tactile vibration is that which is perceived as mechanical motion. BS 6472-1:2008 *Guide to Evaluation of Human Exposure to Vibration in Buildings Part 1: Vibration Sources Other Than Blasting* provides procedures for assessing the potential human response to vibration.

Vibration is assessed in terms of the equivalent vibration dose value (VDV). This relates the level and duration of vibration.

The BS 6472-1:2008 assessment criteria are presented in Table 6.

Table 6 BS 6472-1: 2008 tactile vibration assessment criteria

VDV ($m/s^{1.75}$) above which might result in various probabilities of adverse comment within residential buildings.			
Place	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16 hr day	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential building 8 hr night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Note that offices and workshops, multiplying factors of 2 and 4 respectively should be applied to the above VDV ranges for a 16 hr day.

It is important to note that people exhibit wide variations of vibration tolerance. Specific values are dependent upon social and cultural factors, psychological attitudes and expected degree of intrusion.

5.5.2 Local Authority requirements

Highest VDV values accepted by London Borough of Camden are indicated in Camden Local Plan and are duplicated in Table 7.

Table 7 Maximum VDV values (from Camden Local Plan)

Measurement location	Period	Time	VDV ($m/s^{1.75}$)
Inside dwellings	Day and evening	07:00-23:00	0.2 to 0.4
Inside dwellings	Night	23:00-07:00	0.13
Inside offices	Day, evening and night	00:00-24:00	0.4

5.6 Ground-borne noise criteria

5.6.1 Standard guidance

There is currently no international or British Standard which provides guidance on assessing the impact of ground-borne noise from railways on the occupants of a building. The Association of Noise Consultants (ANC) guidelines '*Measurement and assessment of ground-borne noise and vibration*', 2nd edition published in 2012, is generally used as the basis of assessments such as this.

This document also provides discussion on the relevant research that has been carried out, and a summary of typically adopted criteria.

The most relevant items are set out below:

- London Underground Limited has studied the relationship between ground-borne noise levels and complaint thresholds. This was used to define a complaint threshold of L_{Amax} 40 dB.
- The ANC guidelines also note that Local Authority guidelines for ground-borne noise were published in London and the South East, and state a limit of L_{AFmax} 35 dB.

In all the above examples, the time constant is not defined, with the exception of the Local Authority guidelines in London and the South East, which is defined as having a fast time weighting.

It should be noted that most of this research relates to residential accommodation and is aimed at providing good sleeping/resting conditions.

5.6.2 Local Authority requirements

London Borough of Camden does not have any specific re-radiated noise criteria.

6 Plant noise

6.1 Basic limits

Based on Camden Council's criteria set out in Section 5.3.2, and the results of the measurements, the cumulative noise level from the operation of all new plant should not exceed the limits set out in Table 8.

The limits apply at 1 m from the worst affected windows of the nearest noise sensitive premises and are presented as facade levels. In this case these limits would apply at the nearest noise sensitive premises, indicated in Figure 1.

Table 8 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, $L_{Aeq,15min}$ (dB)
Daytime (07:00-23:00)	39
Night-time (23:00-07:00)	38

The limits set out in Table 8 do not include any attention catching features. However, as plant are to be designed to be 10 dB below the background noise level noise from residential heat rejection plant items and ventilation plant are unlikely to have attention catching features. This will need to be confirmed as the design progresses.

6.2 Proposed mechanical services strategy

The residential units will be ventilated using individual MVHR units and will have fan coil units to provide comfort cooling. The majority of the apartment FCUs will be connected to basement located heat rejection plant. However, the penthouse will be served by an external air source heat pump unit located externally on the terrace at Level 10.

6.3 Assessment

All building services plant will be designed to achieve the noise limits set out above. Selection of the ventilation and internal plant items is still being carried out. However, these plant items will be suitably controlled by ductwork acoustic attenuators.

An initial assessment of the externally located air source heat pump has been undertaken. The location of this unit is shown in Figure 6, highlighted in red. The nearest noise sensitive receptors are the residential units located south of the site on Tottenham Street at a distance of 30 m from the air source heat pump as indicated in Figure 1.

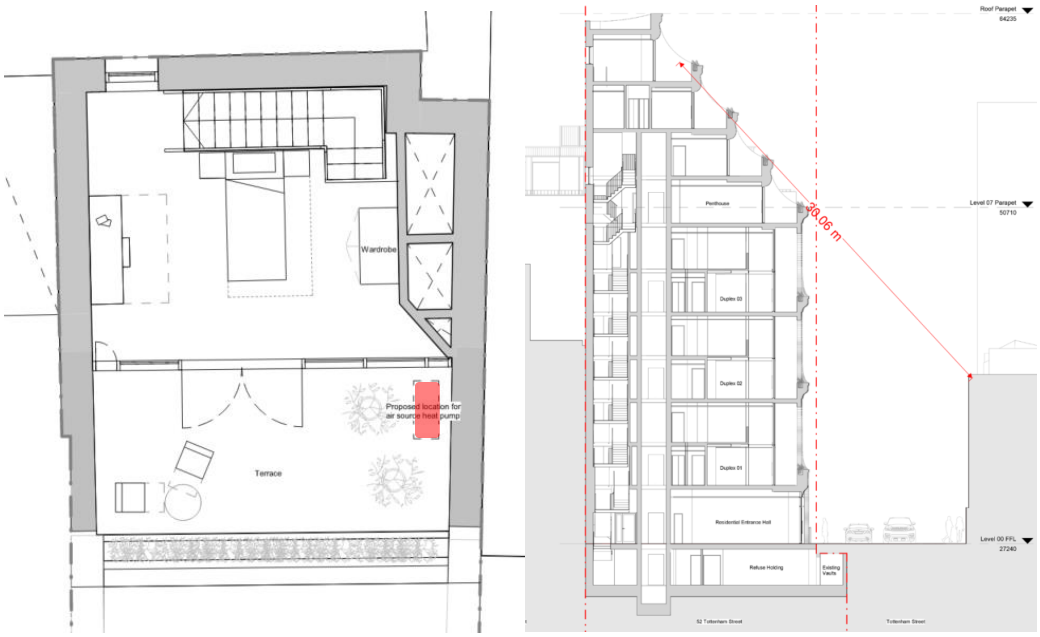


Figure 6 Drawings indicating proposed air source heat pump location and nearest noise sensitive receptor

For the purpose of the assessment a sound pressure level of 65 dB(A) at 1 m from the unit had been assumed.

The unit is proposed to be located in an acoustic enclosure primarily to reduce noise levels on the terrace of the unit it is serving. Acoustic enclosures can provide up to 25 dB, attenuation, however, for the purpose of this assessment only 15 dB attenuation has been assumed.

The distance between the unit and the nearest noise sensitive receptor is 30 m, and line of sight screening is provided by the balcony front.

The calculated sound pressure level at the nearest noise sensitive receptor is L_{Aeq} 21 dB. This complies with the night time external plant noise limit of L_{Aeq} 38 dB, specified in Table 8.

The predicted noise level on the residential terrace of the development itself is L_{Aeq} 50 dB when assessed at a distance of 1.5 m from the enclosure. This noise level is considered to be acceptable to allow reasonable enjoyment of the terrace.

At this stage, the plant strategy is still being developed and will need to be assessed as the design progresses. A planning condition relating to noise egress would provide suitable protection for the surrounding residents and would require further assessment to be carried out as part of the on-going design.

7 Commercial noise egress and transmission

7.1 Noise break-out

Noise breakout from the ground floor commercial premises will be reasonably well controlled by a facade specified to achieve R_w+C_{tr} ≥30 dB. This assumes a typical noise levels within retail/commercial spaces.

7.2 Noise transmission to the residential units above

To provide reasonable protection for the level 1 residential tenants against sound from the ground floor commercial space it is recommended that the sound insulation performance of the level 1 party floor achieve a performance of at least 5 dB above the minimum Building Regulations Approved Document E performance requirements.

As the design progresses the construction of the party floor will need to be reviewed to confirm it is suitable to achieve the recommended performance. In addition, operational noise limits will be set and guidance for additional sound insulation enhancements will be provided to aid the commercial tenant in their fit-out.

8 Facade sound insulation

This section describes an assessment of facade sound insulation to control noise ingress. The required facade specification largely depends on the external noise levels and the internal noise criteria.

The following assessment is based on achieving the internal noise levels recommended in BS 8233 and by the London Borough of Camden, which are set out in Section 5.4.

The residential accommodation is located along the Tottenham Street with the common stair core located along the northern boundary of the site.

8.1 External noise levels

Predicted external noise levels at the Tottenham Street facade of the proposed development, which contains the residential accommodation are:

- Day time average noise level $L_{Aeq,16hour}$ 62 dB
- Night time average noise level $L_{Aeq,8hour}$ 60 dB
- Night time maximum noise level L_{AFmax} 78 dB

8.2 Facade sound insulation

The proposed facade build-up is will be largely glazed with metal louvered secondary facade in front.

At this site the facade sound insulation performance requirements are driven by the night time ambient and maximum noise levels. To meet the internal noise level criteria, Tottenham Street facade must be selected to achieve a minimum sound insulation performance of R_w+C_{tr} ≥32 dB. This performance can be achieved using standard double glazing.

A more detailed facade assessment will be needed as the design develops to ensure the overall performance requirements are met.

9 Vibration assessment

9.1 Tactile vibration

BS 6472 states that the assessment should be based on the axis along which the highest VDV is measured. At measurement location 'V', the highest VDV was measured on the 'Z' axis.

The daytime and night time VDV have been calculated based on the ambient vibration level measurements undertaken at the site. The predicted vibration levels are presented in Table 9.

Table 9 Predicted daytime and night time vibration dose values

	Daytime (07:00 – 23:00)	Night time (23:00 – 07:00)
Equivalent VDV ($m/s^{1.75}$)	0.005	0.004

These predicted equivalent VDVs, during the daytime and night periods are lower than the thresholds of the 'low probability of adverse comment' categories in Table 6.

Based on this, tactile vibration due to trains and road events is not considered to be an issue at this development.

9.2 Ground-borne noise

Based on the vibration levels measured at the site, the predicted ground-borne noise level for the worst affected floor is L_{ASmax} ≤20 dB.

The predicted level is well below the limits at which complaints/disturbance may occur; therefore, ground-borne noise is not considered to be an issue at this development.

10 Conclusion

The representative background sound levels were $L_{A90,15min}$ 49 dB during the day, and $L_{A90,15min}$ 48 dB during the night. Based on the requirements of the Local Authority, the relevant plant noise limits at the worst affected existing noise sensitive premises are L_{Aeq} 39 dB during the day, and L_{Aeq} 38 dB during the night. These limits are cumulative and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent.

An initial assessment of the proposed external plant items associated with the development has been carried out. The proposed plant strategy is suitable to achieve the plant noise limits.

An initial assessment of the facade sound insulation requirements indicates that the internal noise limits can be achieved using standard double glazing.

The assessment of tactile vibration and ground-borne noise indicates that this is not considered to be an issue at this development.

Appendix A

Survey details

Equipment

The unattended and attended noise measurements were taken using a Rion NL-32 sound level meter and a Rion NL-52 sound level meter, respectively.

Tri-axial acceleration measurements were carried out using a Rion PV-87 accelerometer and recorded using a Rion DA-20 data recorder.

Calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	NL-52/00375679	Rion	6 Jul 19	TCRT17/1440
Microphone	UC-59/11168	Rion	6 Jul 19	TCRT17/1440
Pre-amp	NH-25/65806	Rion	6 Jul 19	TCRT17/1440
Calibrator	SV30A/10576	Svan	3 Jul 19	TCRT17/1418
Sound level meter	NL-32/00623761	Rion	06 Oct 19	TCRT17/1654
Microphone	UC-53A/319233	Rion	06 Oct 19	TCRT17/1654
Pre-amp	NH-21/36669	Rion	06 Oct 19	TCRT17/1654
Calibrator	NC-74/34536129	Rion	05 Oct 19	TCRT17/1650
Data Recorder	DA-20/10870889	Rion	8 Sep 19	TCRT17/1581
Accelerometer	PV-87/33827	Rion	8 Sep 19	TCRT17/1593
Accelerometer	PV-87/74274	Rion	5 Dec 19	TCRT17/1808
Accelerometer	PV-87/33829	Rion	8 Sep 19	TCRT17/1594
Vibration Calibrator	AT01/3015	AP Technology	8 Sep 19	TCRT17/1595

Calibration of the meters used for the measurements is traceable to national standards. Calibration certificates for the sound level meters used in this survey are available upon request.

Calibration checks were carried out on the meters and their measurement chains at the beginning and end of the survey. No significant calibration deviation occurred.

Noise indices

Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a fast time weighting.
- $L_{ASmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period, T, with a slow time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

Vibration indices

For each measurement period a number of parameters were recorded. The most relevant of these are described below:

- The vibration dose value (VDV) in each of three axes with the appropriate frequency weightings (as defined in BS 6472-1:2008).
- The maximum RMS acceleration levels in each of three axes in one-third-octave bands, measured using the 'slow response' exponential time weighting.

Weather conditions

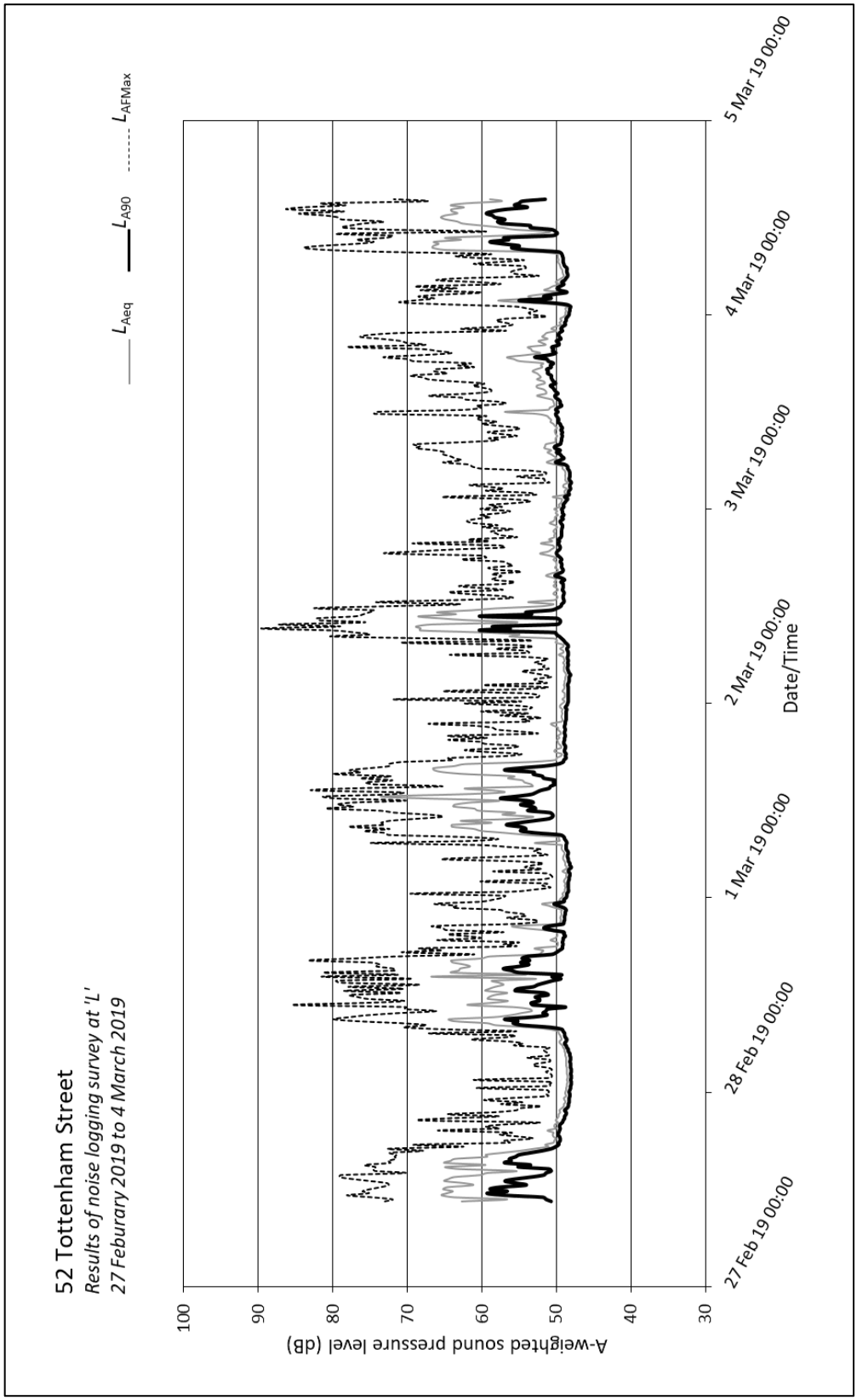
During the attended noise measurements, the weather was generally clear and dry with some occasional, light precipitation. Wind speeds were measured at each position and varied between 0 m/s and 4 m/s.

During the unattended noise measurements, weather reports for the area indicated that temperatures varied between 4°C at night and 18°C during the day, and the wind speed was less than 5 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at Location 'L'


52 Tottenham Street
Results of noise logging survey at 'L'
27 Feburary 2019 to 4 March 2019
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
27 Feb 19 00:00
28 Feb 19 00:00
1 Mar 19 00:00
2 Mar 19 00:00
3 Mar 19 00:00
4 Mar 19 00:00
5 Mar 19 00:00
Date/Time