

CLEARVIEW COURT, 201 PINNER ROAD  
NORTHWOOD HA6 1BX

## ENVIRONMENTAL NOISE ASSESSMENT

### **Report to**

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A9877-R02-TC  
5<sup>th</sup> June 2015

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Appendix 1: Glossary of Acoustic Terminology

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## **1.0 INTRODUCTION**

Bickerdike Allen Partners (BAP) have been retained by Clearview Homes Ltd to advise on environmental noise issues regarding a planning application for a proposed development located in the existing parking lot at 201 Pinner Road, Northwood Hills HA6. The development will be three storeys and is to comprise a total of 8 No. flats on the first and second floors with office accommodation on the ground floor.

This report determines the sound insulation requirements of the proposed extension envelope in order to control the ingress of environmental noise to comply with recognised noise standards including local authority standards. It provides outline acoustic specifications for elements of the facades such that the building envelope will provide an appropriate level of sound insulation.

This report supplements a previous planning noise report Ref: A7788-R02-ALN, dated 2<sup>nd</sup> November 2007.

Section 2.0 of the report provides a description of the site and the proposed development.

Section 3.0 sets out the environmental noise criteria considered and the limits adopted on this project for controlling the ingress of environmental noise.

Section 4.0 describes the environmental noise survey undertaken in May this year and details the expected noise levels on the facades of the proposed buildings, and Section 5.0 assesses these noise levels.

Recommendations for the building envelopes are set out in Section 6.0.

Section 7.0 discusses the potential effect of vibration from railways may have on the proposed development.

A summary of the report is provided in Section 8.0.

This report has been prepared specifically in response to instructions received from Clearview Homes and is not intended for any other purpose. Survey work carried out in connection with this commission is limited in extent to the scope of those instructions.



second floors. The layout has been designed to minimise noise intrusion by avoiding any habitable windows along the southern façade facing the railway and restricting living rooms to the side flanks of the building. Bedroom windows are restricted to the quietest (northern) façade, shielded from both railway noise and the noise of any activity within the Royal Mail sorting office.

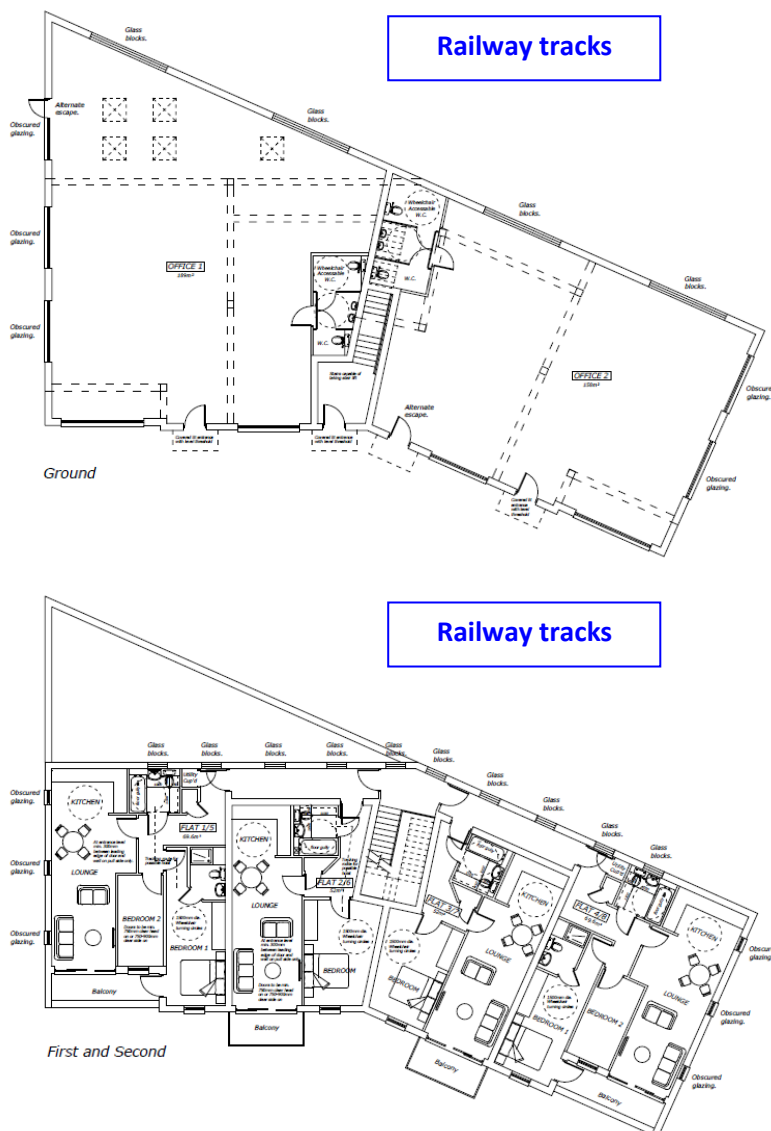


**Figure 2 – Proposed floorplan Ground Floor (above), First and Second Floor (below), based on drwg ref: 15/3351/2 dated: 10<sup>th</sup> April 2015**

### 3.0 NOISE CRITERIA AND RELEVANT GUIDANCE

In assessing the requirements for controlling environmental noise at a proposed development, consideration is normally given to a number of different noise standards and design criteria. It is common practice to consider both the general ambient noise level and individual peak noise events. The following section presents current published environmental noise criteria relevant to the project.

#### 3.1 London Borough of Hillingdon Unitary Development Plan

The London Borough of Hillingdon's Adopted Unitary Development Plan (UDP) (September 1998) provides a comprehensive set of planning policies for Hillingdon which forms the basis for regulating development across the borough. An extract from the policies relevant to this site, with regard to noise issues, is reproduced below.

*"Policy OE5. Proposals for the siting of noise sensitive developments such as family housing, schools or certain forms of commercial activity where the occupiers may suffer from noise or vibration will not be permitted in areas which are, or are expected to become, subject to unacceptable levels of noise or vibration. Where development is acceptable in principle, it will still be necessary to establish that the proposed building or use can be sited, designed, insulated or otherwise protected from external noise or vibration sources to appropriate national and local standards. Account will be taken of any changes likely to occur in noise levels within a 10-15 year period following the date of submission of any application for planning permission."*

The definition of appropriate national and local standards is discussed by Hillingdon in their draft supplementary planning guidance, see section 3.2 below.

#### 3.2 London Borough of Hillingdon Supplementary Planning Guidance – Noise

This document sets out the noise issues that the Hillingdon Planning Services will take into account when deciding whether to approve or refuse development proposals.

The guidance takes on board the Department of the Environment Planning Policy Guide 24 (PPG24). (Note: PPG 24 has now been withdrawn and replaced with the National Planning Policy Framework which no longer contains any numerical noise criteria to guide planning authorities, advising that each site should be considered on its own merits.) However, for the assessment of noise exposure categories (NECs) for housing development the London Borough of Hillingdon have reduced the noise ranges by 3 dB(A) for the assessment of aircraft noise, to account for the effect of ground noise in some named areas.

Table 1 sets out the draft SPG criteria for noise exposure categories.

| <b>NOISE LEVELS CORRESPONDING TO THE NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS <math>L_{Aeq, T}</math></b> |                                |          |          |          |
|--------------------------------------------------------------------------------------------------------------|--------------------------------|----------|----------|----------|
|                                                                                                              | <b>NOISE EXPOSURE CATEGORY</b> |          |          |          |
| <b>NOISE SOURCE</b>                                                                                          | <b>A</b>                       | <b>B</b> | <b>C</b> | <b>D</b> |
| Road traffic                                                                                                 |                                |          |          |          |
| 07.00 – 23.00                                                                                                | <55                            | 55 – 63  | 63 – 72  | >72      |
| 23.00 – 07.00                                                                                                | <45                            | 45 – 57  | 57 – 66  | >66      |
| Rail Traffic                                                                                                 |                                |          |          |          |
| 07.00 – 23.00                                                                                                | <55                            | 55 – 66  | 66 – 74  | >74      |
| 23.00 – 07.00                                                                                                | <45                            | 45 – 59  | 59 – 66  | >66      |
| Air Traffic                                                                                                  |                                |          |          |          |
| 07.00 – 23.00                                                                                                | <54                            | 54 – 63  | 63 – 69  | >69      |
| 23.00 – 07.00                                                                                                | <45                            | 45 – 54  | 54 – 63  | >63      |
| Mixed Sources                                                                                                |                                |          |          |          |
| 07.00 – 23.00                                                                                                | <55                            | 55 – 63  | 63 – 72  | >72      |
| 23.00 – 07.00                                                                                                | <45                            | 45 – 57  | 57 – 66  | >66      |

**Table 1 – L.B. Hillingdon NEC Categories**

In addition to this change, compared to PPG24, the planning guidance provides additional advice on the consequences of dealing with a site within noise exposure category C. The guidance states that *“Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise to meet the Council’s recommended internal noise levels”*.

The planning guidance document includes a table of residential noise standards. It appears that these have been taken from the World Health Organisation document along with a 3 dB façade reflection included for external noise limits. These are reproduced in Table 2. The document states that planning permission for a residential development will be granted if the following internal and external noise levels are met.

| Time                             | Location           | Recommended noise level                                     |
|----------------------------------|--------------------|-------------------------------------------------------------|
| Daytime Noise (07:00 – 23:00)    | Amenity Areas      | Less than 50 $L_{AeqT}$ * (external)                        |
|                                  | Internal           | Less than 35 $L_{AeqT}$ *                                   |
| Night-time Noise (23:00 – 07:00) | External (Façade)  | Less than 48 $L_{AeqT}$<br>(less than 45 $L_{AeqT}$ *)      |
|                                  | External (Façade)  | Less than 63 $L_{AFmax}$ **<br>(less than 60 $L_{AFmax}$ *) |
|                                  | Internal (Bedroom) | Less than 30 $L_{AeqT}$<br>(less than 45 $L_{Amax}$ )       |

\* denotes free-field measurement

\*\* denotes individual noise events regularly exceeding 63  $L_{Amax}$  (F time weighting) several times in any hour should be treated as NEC B even if the night-time  $L_{Aeq}$  falls below 45 dB.

**Table 2 - LBH Recommended noise standards**

The above external noise levels set out in Table 2 equate to a site where World Health Organisation guideline noise values can be met with windows open. This is comparable to PPG24 Noise Exposure Category A where external environmental noise is not a determining factor in granting planning permission.

Additional information about PPG24, BS8233:2014, and World Health Organisation guidelines are found in Appendix 2.

### 3.3 Recommended criteria

Based on the above criteria, BAP propose to adopt the following acoustic performance standards:

- 35 dB  $L_{Aeq, 16h}$  for environmental noise in living/dining rooms during the day,
- 35 dB  $L_{Aeq, 16h}$  and 30 dB  $L_{Aeq, 8h}$  for bedrooms during daytime and at night, respectively,
- Individual noise events should not normally exceed 45 dB  $L_{AFmax}$  within bedrooms at night.

## 4.0 ENVIRONMENTAL NOISE SURVEY

The southern property line is adjacent to London Underground Metropolitan Line and main line Chiltern Railways, both of which operate trains above ground. Road traffic along Pinner Road also contributes to the noise environment.

### 4.1 Survey

An unattended, 24 hour environmental noise survey was carried out between the mornings of Thursday, 7<sup>th</sup> May and Friday, 8<sup>th</sup> May 2015. A long term monitor was set up at the southern corner of the property with a direct view of the railways as shown in Figure 3. For this position, the monitor was more than 6 m away from the nearest existing building façade (i.e. free-field) and approximately 3 m above the hard ground. The microphone was elevated (above the normal height of 1.2 metres) in order to obtain a clear line of sight to the trains along the railway.

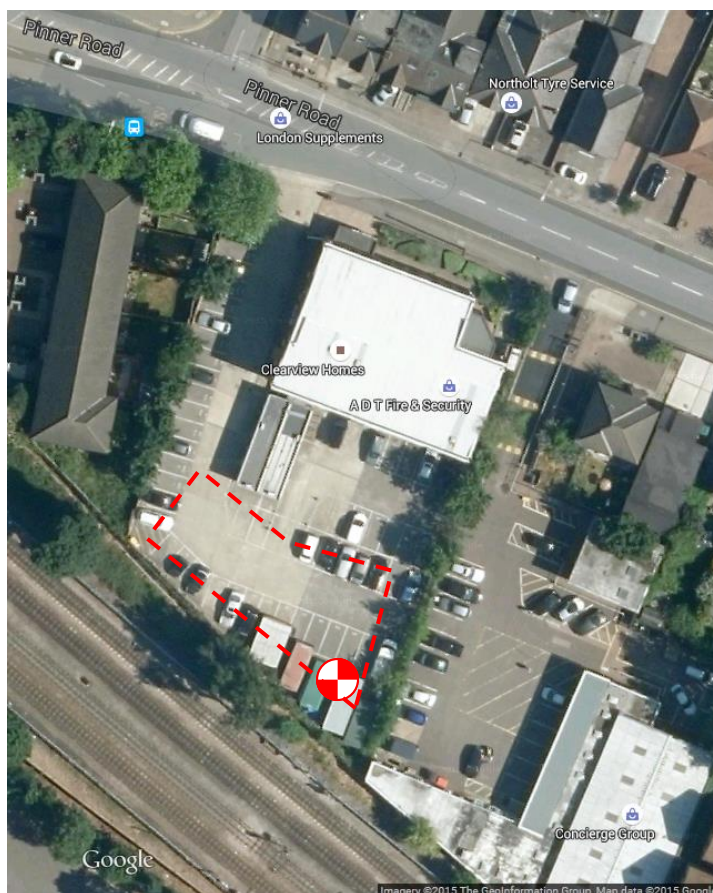


Figure 3 – Unattended measurement location (shown in red)

The instrumentation used consisted of a Class 1 Norsonic 140 sound level meter with Norsonic Type 1225 Microphone. The meter was calibration checked before and after the survey using a Norsonic 1251 calibrator. No significant calibration drift was observed.

The meters were set to take measurements in 30-minute continuous samples with 30-second resolution over the entire measurement duration.

## 4.2 Results

A summary of the survey results can be seen below in Table 3. Detailed graphical results of the unattended survey can be seen in Appendix 3. While on site, the dominant noise source came from each Metropolitan Line train passing at ground level to the south of the property. Road traffic noise from Pinner Road was largely shielded by the existing Clearview House. Occasional aircraft flybys could also be heard.

| Period | Time                                                                       | $L_{Aeq, T}^*$ | $L_{AFMax, T}^*$<br>(average) | $L_{ASMax, T}^*$<br>(average) | $L_{A90}^{**}$<br>(average) | $L_{A90}$<br>(min) |
|--------|----------------------------------------------------------------------------|----------------|-------------------------------|-------------------------------|-----------------------------|--------------------|
| Day    | 09:20 – 23:00 (7 <sup>th</sup> May)<br>07:00 – 11:00 (8 <sup>th</sup> May) | 62             | 78                            | 77                            | 48                          | 40                 |
| Night  | 23:00 – 07:00                                                              | 57             | 74                            | 72                            | 35                          | 28                 |

**Table 3 - Summary of unattended survey results (free field)**

\* Logarithmic and \*\* Arithmetic mean of 16-hour day and 8-hour night measurements

Similarly, the maximum measured sound level also varies from day to day. Again using the histogram shown in Figure 4, it is recommended to adopt the prevailing maximum level during night time periods which is 79 dB  $L_{AF Max, 5min}$ . The prevailing maximum level is caused by rail traffic passing adjacent to the site.

The noise levels recorded during the survey place the site in noise exposure category (NEC) B in regard to London Borough of Hillingdon's NEC Categories reproduced in Table 1.

In the withdrawn PPG24 for category B development *"noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise"*.

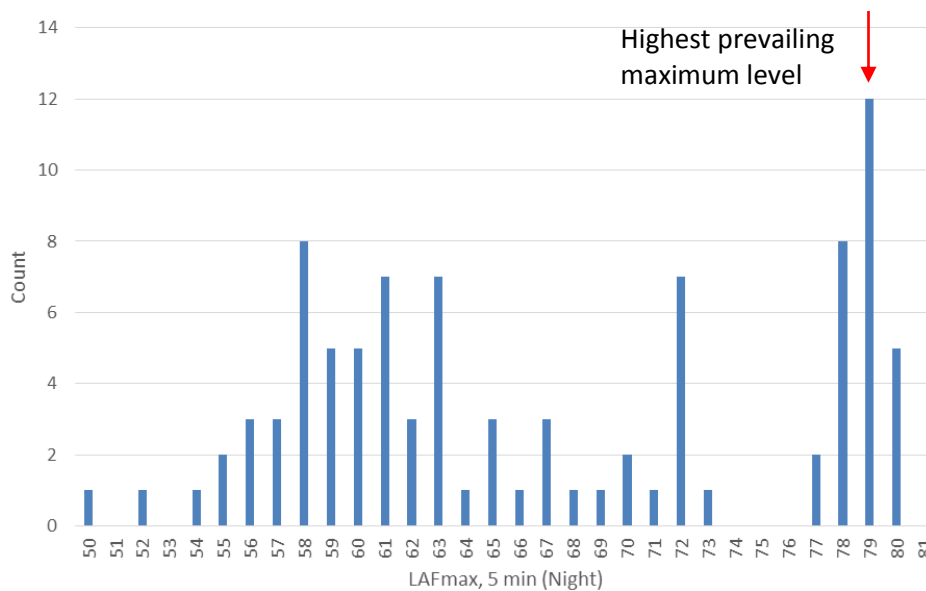


**Figure 4 – Histogram of night time noise maxima (from 23:00, 7<sup>th</sup> May to 07:00, 8<sup>th</sup> May) at southern corner (free field)**

## **5.0 ENVIRONMENTAL NOISE ASSESSMENT**

In order to ensure that the noise levels experienced in habitable rooms meet the requirements set out in 3.3 above, the façade, glazing and ventilation elements of the building envelope will have to be specified accordingly.

### **5.1 Assumptions**

The area of glazing and method of ventilation in any particular room, along with the room size and room acoustic conditions, affects the degree of reduction in noise transmission from outside to inside. BAP have carried out an initial assessment using some generic assumptions. These will require reviewing during design development.

The following assumptions have been used for the assessment of the sound insulation requirements of the building envelope:

- Predictions are made using the general method set out in BS EN 12354-3:2000;
- Sound insulation data based on both BAP library data and specific manufacturers' data. It has been assumed that the on-site performance will be comparable with manufacturer's claimed performance;
- The predictions assume good quality workmanship, for example that windows, doors and opening lights are well sealed. Poor workmanship or low quality seals may result in predicted internal noise levels being exceeded;
- BAP have been advised that the proposed external construction is to be of lightweight twin frame construction. The following construction details have been used in the assessment:
  - External leaf to incorporate solid boarding to achieve a mass of not less than  $10 \text{ kg/m}^2$  (e.g. 18mm plywood)
  - Inner leaf to incorporate solid boarding to achieve a mass of not less than  $20 \text{ kg/m}^2$  (e.g. 2 x 12.5mm Soundbloc plasterboard)
  - Studwork/joists to be of either metal construction or timber construction with resilient bars to support the inner leaf, to form an overall cavity depth of not less than 140 mm.
  - Cavity to contain at least 50 mm mineral fibre, density not less than  $10 \text{ kg/m}^3$  The number of background or trickle ventilators has a substantial influence on the sound insulation of the building envelope. Current guidance on complying with

the Building Regulations (Approved Document F 2010) offers many options to provide adequate ventilation. Some of these are preferable in regard to noise break-in, such as whole house ventilation with heat recovery as no trickle vents are required. Other options require anywhere between 1 and 6 vents per room.

- Windows to the residential façades facing the railway (south, west, and east) comprise of glass blocks.
- This construction (excluding any ventilation openings) is capable of providing a sound reduction of 52 dB  $R_w$  and 48 dB  $R_w+C_{tr}$ .
- It is understood that the preferred solution is continuous mechanical ventilation and therefore one ventilator per room is assumed.

## 5.2 Noise Design Levels

BAP have received preliminary layout drawings for the proposed development. A worst case scenario for living room and bedroom noise has been assumed based on current drawings, i.e. the lowest room volume to exposed façade area ratio.

The following design levels used in the calculations for the assumed external levels at the proposed building façades are shown below in Table 4. The façades to which these levels relate can be seen in Figure 5.

| Façade                                                                              | Design level    | Octave Band Centre Frequency, Hz |     |     |      |      |      |    |
|-------------------------------------------------------------------------------------|-----------------|----------------------------------|-----|-----|------|------|------|----|
|                                                                                     |                 | 125                              | 250 | 500 | 1000 | 2000 | 4000 | A  |
|  | $L_{Aeq}$ Day   | 61                               | 60  | 58  | 58   | 54   | 49   | 62 |
|                                                                                     | $L_{Aeq}$ Night | 56                               | 55  | 53  | 53   | 49   | 45   | 57 |
|                                                                                     | $L_{AF}$ Max    | 77                               | 78  | 76  | 76   | 71   | 67   | 79 |
|  | $L_{Aeq}$ Day   | 51                               | 50  | 48  | 48   | 44   | 39   | 52 |
|                                                                                     | $L_{Aeq}$ Night | 46                               | 45  | 43  | 43   | 39   | 35   | 47 |
|                                                                                     | $L_{AF}$ Max    | 67                               | 68  | 66  | 66   | 61   | 57   | 69 |

**Table 4 – Assumed design levels (free field)**

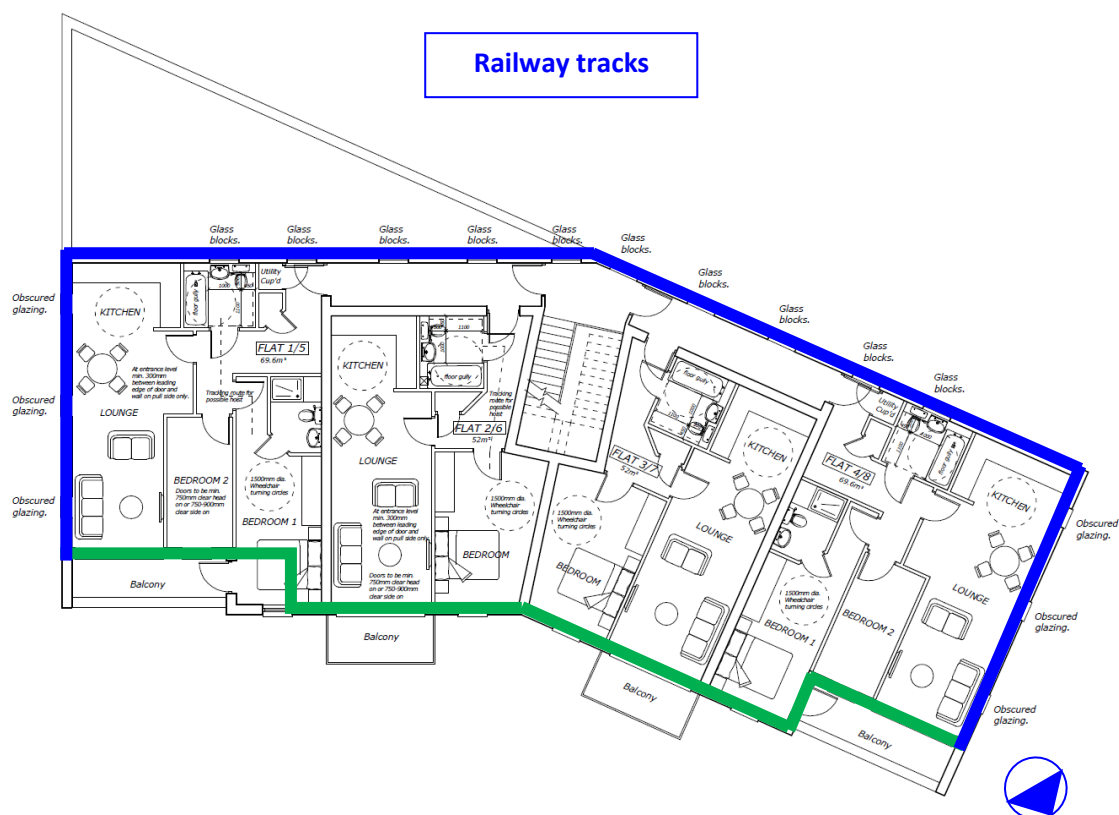


**Figure 5 – Façade noise exposure zones for sound insulation scheme**

## 6.0 RECOMMENDED PERFORMANCE STANDARDS

### 6.1 Envelope Design

This section provides indicative glazing sound insulation performance requirements for the living room and bedrooms, which with careful detailing are expected to provide the necessary performance requirements to meet the relevant criteria.

The glazing requirements are applicable to the window system as a whole including frames, and any mullions and panels. They are based on BS EN ISO 10140-2:2010 *Acoustics. Laboratory measurement of sound insulation of building elements*. Measurements of airborne sound insulation are rated in accordance with BS EN ISO 717-1:1997 *Acoustics – Rating of sound insulation in buildings and of building elements Part 1. Airborne sound insulation*.

When selecting window glazing products, acoustic performances must be verified by test data from an independent testing facility.

Table 5 provides a summary of the minimum sound insulation requirements for the windows. The specified sound reduction indices,  $R_w$  and  $R_w + C_{tr}$ , should be met, as a minimum in each case. Where the glazing is unknown, indicative glazing constructions are provided that, subject to frame considerations and if installed correctly, should satisfy the performance requirements. Alternative constructions may be used provided they meet the stated performance requirements.

The window suppliers will be required to submit laboratory spectral sound reduction indices data to demonstrate compliance with the performance requirements, which will be considered in more detail in later stages of design. The window performance requirements apply to the entire window assembly, including: frames, transoms, mullions and seals to opening lights, in addition to the glazing itself.

The performance requirements are likely to need review following design development. Based on the current calculations and assumptions, the proposed roof construction is adequate.

Full calculation sheets can be provided upon request.

| Façade                                                                                                 | Room Type   | Performance Requirements                                         |                                    |
|--------------------------------------------------------------------------------------------------------|-------------|------------------------------------------------------------------|------------------------------------|
|                                                                                                        |             | Window Unit/Balcony Door                                         | Ventilation Unit                   |
| South, East, West<br> | Living room | 40 dB $R_w$ and 36 dB $R_w + C_{tr}$<br>Window: 19mm glass block | 31 dB $D_{ne,w}$<br>Acoustic vent. |
|                                                                                                        | Bedroom     | None planned                                                     | None planned                       |
| North<br>             | Living room | 29 dB $R_w$ and 25 dB $R_w + C_{tr}$<br>(e.g. 4/12/4mm glazing)  | 31 dB $D_{ne,w}$<br>Acoustic vent. |
|                                                                                                        | Bedroom     | 31 dB $R_w$ and 27 dB $R_w + C_{tr}$<br>(e.g. 6/12/4mm glazing)  | 35 dB $D_{ne,w}$<br>Acoustic vent. |

**Table 5 – Recommended minimum sound insulation requirements**

## 6.2 Amenity Spaces

For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable, in accordance with BS 8233:2014, 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.

From the noise survey results at the Clearview Court site, external noise levels at balconies are predicted to be between 50-55 dB, which is within the recommended limit. BS 8233 recognizes 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.

BS 8233:2014 goes on to state that:

*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.*

## 7.0 VIBRATION ASSESSMENT

BAP has conducted a series of vibration measurements to assess the likely impact of vibration from trains on the occupants of the proposed development.

### 7.1 Vibration Perception in Buildings

BS 6472:2008 *“Guide to evaluation of human exposure to vibration in buildings (1Hz to 80Hz)”* sets out criteria relating to vibrations in buildings. This standard and the criteria specified within considers the extent to which a person is able to feel a vibration through the structure of the building upon which one stands, sits or lies.

The unit used to categorise response to vibrations in this regard is the vibration dose value (VDV). This unit takes account both the magnitude and duration of a vibration. It also takes account of how the body responds more to some frequencies of vibration than others.

Vibration dose values ( $\text{ms}^{-1.75}$ ) above which various degrees of adverse comment may be expected to arise in residential buildings are given in Table 6.

| Residential Buildings | Low Probability of Adverse Comment | Adverse Comment Possible | Adverse Comment Probable |
|-----------------------|------------------------------------|--------------------------|--------------------------|
| Day (16 hour)         | 0.2 – 0.4                          | 0.4 – 0.8                | 0.8 – 1.6                |
| Night (8 hour)        | 0.1 – 0.2                          | 0.2 – 0.4                | 0.4 – 0.8                |

**Table 6 – BS 6472:2008 Vibration Dose Limits ( $\text{ms}^{-1.75}$ )**

### 7.2 Vibration Results

Spot vibration measurements were done in the parking lot area at the expected footprint of the proposed building as shown in Figure 6. Measurements were performed using a 01dB Metravib multichannel system coupled with a dB4 Acquisition Unit and a PCB 356B18 tri-axial accelerometer.

The measurements indicate that the dominant acceleration levels were measured in the horizontal direction.

A total of 63 separate train pass-bys during a 3.5 hour period were recorded. The total number of trains passing next to the property over a typical day and night was determined by reference to timetables provided by London Underground and Chiltern Railways.

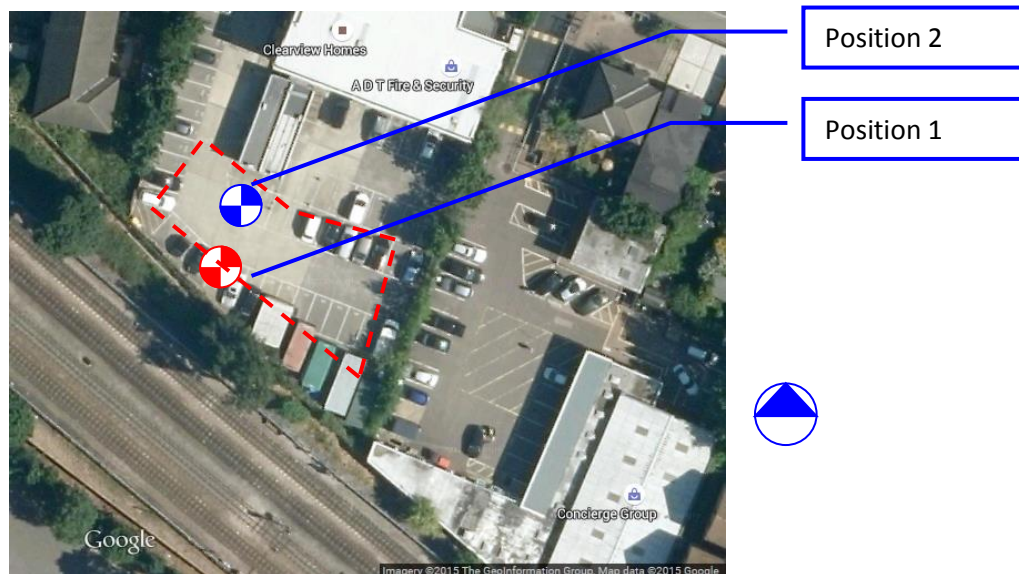


**Figure 6 – Vibration measurement positions 1 and 2 (red and blue respectively)**

The calculated Vibration Dose Values at the proposed site footprint are presented in Table 7. The results show that the ground vibration levels are well below those normally considered to give rise to a low probability of adverse comment.

| Time                  | VDV - Vibration Dose Value ( $\text{ms}^{-1.75}$ ) |              | Total expected number of trains |
|-----------------------|----------------------------------------------------|--------------|---------------------------------|
|                       | Position 1                                         | Position 2   |                                 |
| Day (07:00 – 23:00)   | 0.028 (<0.2)                                       | 0.018 (<0.2) | 370                             |
| Night (23:00 – 07:00) | 0.052 (<0.1)                                       | 0.033 (<0.1) | 64                              |

**Table 7 – Calculated vibration dose values at measurement positions (horizontal axis)**

## **8.0 SUMMARY**

Bickerdike Allen Partners (BAP) have been retained by Clearview Homes Ltd to advise on environmental noise and vibration issues regarding a planning application for a proposed development located in the existing parking lot at 201 Pinner Road, Northwood Hills HA6.

This report records the results of a noise and vibration survey conducted to establish the exposure of the site to environmental noise and provides initial guidance on the sound insulation requirements of the building envelope.

Design performance standards for envelope elements have been recommended to ensure the building envelope is capable of controlling external noise levels to the recommended criteria.

The study found that the ground vibration levels produced by train passbys at the proposed site lie well below those normally considered to give rise to a low probability of adverse comment. No adverse effects are therefore expected at the site as a result of train passbys.

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for Bickerdike Allen Partners

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Partner

## APPENDIX 1

### GLOSSARY OF ACOUSTIC TERMINOLOGY

### **The Decibel, dB**

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of  $2 \times 10^{-5}$  Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level,  $L_w$  is expressed in decibels, referenced to  $10^{-12}$  watts.

### **Frequency, Hz**

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

### **A-weighting**

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

## Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

| Statistical Term | Description                                                                                                                                                                                                                                                                                                    |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| $L_{Aeq,T}$      | The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ( $L_{Aeq,T}$ ). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound. |
| $L_{A90}$        | The level exceeded for 90% of the time is normally used to describe background noise.                                                                                                                                                                                                                          |
| $L_{Amax,T}$     | The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)                                                                                                                                                                                                  |

## Sound Transmission in Rooms

Sound energy is reflected from the room surfaces and this gives rise to reverberation. At short distances from a sound source, the sound level will fall off at a rate of 6 dB per doubling of distance, as it would in the open air – this is known as the direct field. Beyond a certain distance, the effect of reverberation takes over and the level ceases to fall off significantly with distance from the source. This is known as the reverberant field. For receiver positions in this part of the room, sound levels can be reduced by applying sound absorbing finishes to the surfaces of the room. A 3 dB reduction can normally be obtained by doubling the absorption present, which corresponds to halving the reverberation time (see below).

## Sound Insulation - Airborne

Voices, hi-fi systems, television and radio sound and musical instruments are all sources of airborne sound. They excite the air around them and the vibration in the air is transmitted to surrounding surfaces, such as walls, ceilings and floors. This sets these constructions into vibration and this vibration is radiated in neighbouring rooms as sound. Energy is lost in the transmission path and this is referred to as transmission loss or, more generally, sound insulation. The most simple measure of sound insulation is the sound level difference,  $D$ , which is the arithmetic difference between the sound level, in dB, in the source room and the sound level in the receiving room.

Other measures of sound insulation include the sound reduction index,  $R$ , which is a measure of the acoustical performance of a partition, obtained in a laboratory, and the standardised level difference,  $D_{nT}$ , which is used mainly in the sound insulation of domestic separating walls and separating floors. The relevant test procedures are laid down in BS EN ISO 140. A single figure “weighted” result can be obtained from one-third octave band test results by using a curve-fitting procedure laid down in BS EN ISO 717. The subscript “w” is added to the relevant descriptor (eg  $D_{nT,w}$ ).

The sound reduction index,  $R$ , is used in the specification of components, such as partitions, doors and windows. It is important to bear in mind that the performance of components in the field is usually lower than can be obtained in a laboratory. The transmission of sound via other components common to both rooms (“flanking transmission”) can reduce the apparent sound reduction index ( $R'$ ) significantly.

## APPENDIX 2

### NATIONAL POLICIES AND GUIDELINES

## PPG24 (now withdrawn and replaced by the National Planning Policy Framework)

In assessing the suitability of sites for housing, local authorities are guided by the Department of the Environment Planning Policy Guidance, PPG 24, Planning and Noise.

PPG 24 introduced the concept of Noise Exposure Categories (NEC's) ranging from A-D to help local authorities in their consideration of applications for residential development near transport-related noise sources. Category A represents the circumstances in which noise is unlikely to be a determining factor, while Category D relates to the situation in which development should normally be refused. Categories B and C deal with situations where noise mitigation measures should be taken to make the development acceptable.

Table 8 below is an extract from PPG 24 giving the recommended noise exposure categories for new dwellings near existing noise sources.

| NOISE LEVELS CORRESPONDING TO THE NOISE EXPOSURE CATEGORIES FOR NEW DWELLINGS $L_{Aeq, T}$ |                         |         |         |     |
|--------------------------------------------------------------------------------------------|-------------------------|---------|---------|-----|
|                                                                                            | NOISE EXPOSURE CATEGORY |         |         |     |
| NOISE SOURCE                                                                               | A                       | B       | C       | D   |
| Road traffic                                                                               |                         |         |         |     |
| 07.00 – 23.00                                                                              | <55                     | 55 – 63 | 63 – 72 | >72 |
| 23.00 – 07.00                                                                              | <45                     | 45 – 57 | 57 – 66 | >66 |
| Rail Traffic                                                                               |                         |         |         |     |
| 07.00 – 23.00                                                                              | <55                     | 55 – 66 | 66 – 74 | >74 |
| 23.00 – 07.00                                                                              | <45                     | 45 – 59 | 59 – 66 | >66 |
| Air Traffic                                                                                |                         |         |         |     |
| 07.00 – 23.00                                                                              | <57                     | 57 – 66 | 66 – 72 | >72 |
| 23.00 – 07.00                                                                              | <48                     | 48 – 57 | 57 – 66 | >66 |
| Mixed Sources                                                                              |                         |         |         |     |
| 07.00 – 23.00                                                                              | <55                     | 55 – 63 | 63 – 72 | >72 |
| 23.00 – 07.00                                                                              | <45                     | 45 – 57 | 57 – 66 | >66 |

**Table 8 - PPG24 NEC Categories**

PPG24 also states that “during the night time period (23.00 – 07.00) sites where individual noise events regularly exceed 82 dB  $L_{Amax}$  (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the  $L_{Aeq, 8h}$  (except where the  $L_{Aeq, 8h}$  already puts the site in NEC D)”.

With regard to the insulation of residential buildings against external noise, such as road and rail traffic noise, PPG24 refers to the guidance provided in BS8233.

## National Planning Policy Framework (NPPF)

The NPPF has recently replaced PPG 24 as the guidance of the Government with respect to planning and noise. The NPPF and the Noise Policy Statement for England (NPSE) provide no numerical thresholds for determining the acceptability or otherwise of a site for residential development.

The National Planning Policy Framework (NPPF) aims to avoid significant adverse impacts on health and quality of life from noise, and mitigate and minimise its lesser adverse impacts, as a result of new development. The adopted Noise Policy Statement for England (2010) recognises that noise exposure can cause annoyance and sleep disturbance, both of which impact on quality of life and give rise to adverse health effects. It also points to evidence that long term exposure to some types of transport noise can additionally cause an increased risk of direct health effects.

In this particular instance, PPG 24 guidelines are still relevant because they are adopted into the planning policy of London Borough of Hillingdon and will be discussed in section 3.1.

## BS8233:2014

BS 8233:2014 “Guidance on sound insulation and noise reduction for buildings” provides guidance on the control of external noise. The standard presents design ranges deemed acceptable for indoor noise levels in spaces when they are unoccupied. These are generally in keeping with guidance set by the WHO and 1999 version of the standard.

The criteria relevant to this site have been presented in Table 9.

| Activity                   | Location         | 07.00 to 23.00       | 23.00 to 07.00      |
|----------------------------|------------------|----------------------|---------------------|
| Resting                    | Living room      | 35 dB $L_{Aeq,16hr}$ | -                   |
| Dining                     | Dining room/area | 40 dB $L_{Aeq,16hr}$ | -                   |
| Sleeping (daytime resting) | Bedroom          | 35 dB $L_{Aeq,16hr}$ | 30 dB $L_{Aeq,8hr}$ |

**Table 9 – BS 8233:2014 recommended indoor ambient noise levels in unoccupied spaces**

*Note: 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. Sporadic noise events could require separate values.*

## World Health Organisation

The World Health Organisation (WHO) publishes Guidelines for Community Noise that include internal noise levels for daytime and evening, and for night-time. These criteria are reproduced below in Table 10.

| Specific Environment | Critical Health Effect(s)                                        | L <sub>Aeq</sub><br>dB(A) | Time<br>Base<br>(hours) | L <sub>Amax</sub><br>Fast<br>dB(A) |
|----------------------|------------------------------------------------------------------|---------------------------|-------------------------|------------------------------------|
| Dwellings, indoors   | Speech intelligibility & moderate annoyance, daytime and evening | 35                        | 16                      | -                                  |
| Inside bedrooms      | Sleep disturbance, night-time                                    | 30                        | 8                       | 45                                 |

**Table 10 – WHO Guidelines for Community Noise**

## APPENDIX 3

### GRAPHICAL UNATTENDED SURVEY RESULTS

