

## 11 Noise and Vibration

### 11.1 Introduction

An assessment has been made of the existing ambient noise climate at the site of the Beorma Quarter mixed use development. This report details the results of all site measurements and reviews this data with respect to applicable guidance and standards for residential and office development and also the requirements of the local planning authority.

### 11.2 Legislation and Policy Context

#### 11.2.1 National Policy

National Planning Policy Framework (NPPF)

The National Planning Policy Framework (NPPF) 2012 sets out the Government planning policies for England and how these are expected to be applied.

Section 11, Conserving and enhancing the natural environment, paragraph 123 of NPPF states:

‘Planning policies and decisions should aim to:

- Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development
- Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions
- Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put upon them because of changes in nearby land uses since they were established
- Identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason’

Reference is made to the DEFRA Noise Policy Statement for England 2010 (NPSfE). This latter document is intended to apply to all forms of noise other than that which occurs in the workplace and includes environmental noise and neighbourhood noise in all forms.

NPSfE advises that the impact of noise should be assessed on the basis of adverse and significant adverse effect but does not provide any specific guidance on assessment methods or limit sound levels. Moreover, the document advises that it is not possible to have ‘a single

objective noise-based measure...that is applicable to all sources of noise in all situations’. It further advises that the sound level at which an adverse effect occurs is ‘likely to be different for different noise sources, for different receptors and at different times’.

In the absence of specific guidance for assessment of environmental noise within NPPF and NPSfE it is considered appropriate to base assessment on current British Standards and appropriate local or national guidance.

**BS8233: 2014**

BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’ is the current British Standard providing guidance for acoustic requirements within buildings. The Standard advises appropriate criteria and limits for different building types including dwellings.

BS8233 provides guidance regarding acceptable internal and external noise level criteria for dwellings but does not form any statutory requirement to achieve the guidance values provided therein.

The BS8233 internal design criteria for dwellings are detailed in *Table 11.1*.

**Table 11.1:** *BS8233 internal design criteria for dwellings*

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living rooms	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 $L_{Aeq,8hour}$

Section G1 of BS 8233 advises that sound reduction is limited to 15 dB where windows are open.

For gardens and terraces, the Standard states that it is desirable that the steady noise level does not exceed  $L_{Aeq,T}$  50 dB whilst a level of  $L_{Aeq,T}$  55 dB would be acceptable in noisier environments. BS 8233 also states that, *‘it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable...In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited’*.

11.2.2 Regional Policy

**Birmingham City Council Planning Consultation Guidance No.1**

Birmingham City Council (BCC) has adopted standard planning requirements with regard to noise and vibration, the guidelines are set out in the EPU document ‘Planning Consultation Guidance No. 1 Noise & Vibration Edition3’ (March 2013). Section 6 of this document sets out the acoustic performance of facades to buildings used for residential purposes with reference to external noise levels (*Table 11.2*).

**Table 11.2:** External noise level and acoustic performance as detailed in Section 6 of BCC Planning Consultation Guidance No.1

External noise level		Acoustic performance	
Day <i>L</i> <sub>Aeq</sub> (dB)	Night <i>L</i> <sub>Aeq</sub> (dB)	Windows	Ventilators
		All windows and doors to habitable rooms to provide a sound reduction index ( <i>R</i> <sub>w</sub> + <i>C</i> <sub>tr</sub> dB) of not less than	Ventilation to habitable rooms to provide a sound reduction index ( <i>D</i> <sub>n,e,w</sub> + <i>C</i> <sub>tr</sub> dB) of not less than
< 50	< 45	No requirement See Note 1 below	
57	52	25	31
60	55	26	32
63	58	29	35
66	61	32	38
69	64	35	41
72	67	38	44
> 72	> 67	See Note 2 below	
Noise levels shall be rounded up to whole dB to determine the external noise exposure			
<p><b>Note 1:</b> Research provided by the World Health Organisation suggests that 'general daytime outdoor noise levels of less than 50dB <i>L</i><sub>Aeq</sub> are desirable to prevent any significant community annoyance'. Where noise exposure is below this level no specific building envelope sound insulation is required.</p>			
<p><b>Note 2:</b> The EPU will not support approval. If consent is granted by Planning Committee then EPU will recommend standards unique to each application upon the request of Planning.</p>			

In the case of noise from new plant installations associated with the project, it will be necessary to comply with PGN 1 section 5 ‘Proposed Developments Containing Noise Generating Uses’ which states the following:

*'Where applications contain noise sources which may have an impact upon existing noise-sensitive uses, the applicant will be required to provide supporting information to allow this impact to be evaluated, in line with the provisions of this section'.*

In addition it states that:

'For most general noise sources an assessment should be carried out at the façade of the most noise sensitive premises to demonstrate that the following three criteria would be met:

- The rating level (calculated in accordance with BS4142) is at least 10dB below the existing ambient noise level ( $L_{Aeq}$ )
- The rating level (calculated in accordance with BS4142) is at least 5dB below the existing background noise level ( $L_{A90}$ )
- Between the hours of 19:00 and 07:00 the maximum noise level ( $L_{AFmax}$ ) from the development shall not exceed the  $L_{A90}$  by more than 10dB, however, where the existing background noise level is 45dB  $L_{A90}$  or less, the maximum noise levels shall not exceed 55dB  $L_{AFmax}$ .

It is considered that these requirements will need to be achieved at the hotel and residential facades adjacent King Edward House and also at new residential windows within the development.

### 11.2.3 Local Policy

There are no local policies relevant to noise and vibration.

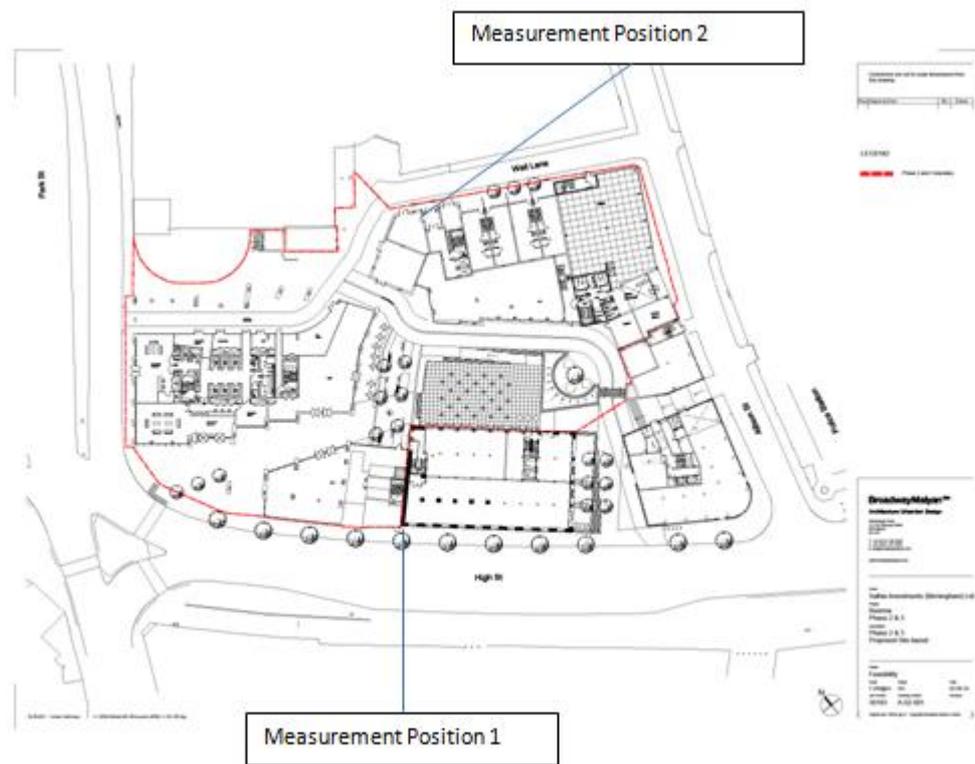
## 11.3 Assessment Methodology and Significance Criteria

### 11.3.1 Noise

Hoare Lea Acoustics has carried out a noise monitoring survey to establish the prevailing noise conditions at the site. The survey primarily comprised automated logged noise level measurements at the Park Street and Well Lane sides of the site over the period Thursday 4th to Friday 5th September 2014. The measurement positions were as follows:

- **Position 1** - high level on scaffolding overlooking the junction of Park Street and High Street - the microphone was located approximately 500 mm from the existing façade.
- **Position 2** - to the rear of the site overlooking Well Lane and the multi-storey car park

The measurement positions are outlined in *Figure 11.1*.



**Figure 11.1:** Noise measurement locations

Measurements were made in 5-minute sample periods to determine the  $L_{Aeq}$ ,  $L_{Amax}$  and  $L_{A90}$  indices.

All equipment was calibration-checked before and after the survey and no significant drift was observed.

Weather conditions over the survey period were dry with little or no wind and temperatures ranged between  $13^{\circ}$  and  $25^{\circ}$  Celsius. It is considered that the measurement data obtained is representative of the overall noise climate at site.

All measurements were made with a calibrated precision grade sound level meter in accordance with BS EN 60651 and BS 7445:1993. All equipment was calibration-checked before and after the survey (*i.e.* no significant drift was observed). The equipment used was a Rion Type NL-52 Sound Level Meter (S/N 00710261) and a Rion Type NA-31 Sound Level Meter (S/N 2497394). The above equipment fulfils IEC 61672 Class 1 and is traceable to calibration under BS7580: Part 1:1997.

### 11.3.2 Vibration

#### Criteria

The primary cause of community concern in relation to vibration generally relates to building damage from construction activities especially from piling. The human body can perceive vibration at levels that are substantially lower than those required to cause superficial damage in buildings such as for example cracks on the ceiling plaster.

BS 5228 – Part 4: 1992 Noise and vibration control on construction and open sites - Code of practice for noise and vibration control applicable to piling operations, states that for residential properties in general good repair, a conservative threshold for minor and superficial, non-structural damage, should be taken as a p.p.v.1 of  $10\text{mms}^{-1}$  for intermittent vibrations and  $5\text{mms}^{-1}$  for continuous vibration. Below these vibration magnitudes, minor damage, *i.e.* cracks on the wall and ceiling plaster, is unlikely to occur. For industrial and commercial buildings constructed with light structural frames, infill panels and sheet cladding, the assigned threshold is in the order of  $20\text{mms}^{-1}$  p.p.v. for intermittent vibrations and  $10\text{mms}^{-1}$  for continuous vibration. For industrial and commercial buildings with a heavier structure higher p.p.v. of  $30\text{mms}^{-1}$  for intermittent vibrations and  $15\text{mms}^{-1}$  for continuous vibration are allowed.

#### Methodology

Operations that are considered likely to give rise to significant levels of vibration, such as for example during piling activities, should be monitored at the nearest sensitive area during such works to ensure that the given acceptable limits shown in *Table 11.3* are not exceeded, but it is not possible in any meaningful way to pre-emptively model where vibration may occur and at what level.

**Table 11.3:** Summary of the acceptable vibration limits due to construction works [BS 5228:1992 – Part 4]

Type of Construction	Intermittent Vibration P.P.V. ( $\text{mms}^{-1}$ )	Continuous Vibration P.P.V. ( $\text{mms}^{-1}$ )
Residential in general good repair	10	5
Residential where preliminary survey reveals significant defects	5	2.5

1 P.P.V. peak particle velocity is the instantaneous maximum velocity reached by the vibrating element as it oscillates about its rest position

Commercial/Industrial light and flexible structure	20	10
Commercial/Industrial heavy and stiff structure	30	15

Regarding people’s response to vibration where generated by piling, transportation traffic or other low frequency sources such as music, the use of Vibration Dose Values (VDVs) is recommended according to the British Standard BS 6472-1:2008 Guide to Evaluation of human exposure to vibration in buildings.

People’s sensitivity to vibration changes at different times of the day as vibration perception is related to standing, sitting or laying down positions. It is reasonable to assume that people will normally be sitting or standing during daytime and lying down during the night. The BS 6472 presents thresholds values that define various degrees of adverse comments in response to building vibration. *Table 11.4* presents the summary of the VDVs to which various degrees of adverse comment may be expected during day and night periods.

**Table 11.4:** *Vibration dose values (m/s<sup>1.75</sup>) above which various degrees of adverse comment may be expected*

Place	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings (16 hr day)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings (8 hr night)	0.13	0.26	0.51
Measurements should be taken across each of the three orthogonal axes through which vibration can enter the body, <i>i.e.</i> standing, sitting and lying positions.			

Again, pre-emptive prediction of the likely levels of vibration that could arise is not practical but measurements can be made during the construction phase if off-site vibration becomes noticeable or likely. Vibration effects if any are only likely to be associated with the construction phase (piling, heavy plant and machinery).

### 11.4 Baseline Conditions

The development site is located on the south east side of Birmingham City centre at the junction of Park Street and High Street. The site is currently part occupied by commercial buildings with the remainder occupied by the construction site for the Phase 1 development. The surroundings are as follows:

- Park Street forms the western site boundary and provides the principal traffic route on the eastern side of the City.
- The southern boundary is formed by High Street which is the principal traffic route through the Digbeth commercial district.
- The northern boundary is formed by a multi-storey car park and by Well Lane which provides access to the site and adjacent commercial premises. Land use across Well Lane to the north appears to be given over to office accommodation.
- The eastern site boundary is formed by Alison Street which provides local traffic access to nearby residential and commercial properties. Land use across Alison Street to the east is given over to residential apartments.

Traffic flows on Alison Street and Well Lane are low with only intermittent vehicle movement.

**11.4.1 Position 1**

The results of Position 1 site measurements are tabulated in *Table 11.5*.

**Table 11.5: Measured Sound Pressure Levels – Position 1**

	from	to	L <sub>Aeq</sub>	L <sub>Amax</sub>	L <sub>A10</sub>	L <sub>A90</sub>
Day 1	11:00	11:59	73.8	86.1	75.8	66.9
	12:00	12:59	72.6	92.6	74.8	66.3
	13:00	13:59	71.6	96.8	74.1	64.8
	14:00	14:59	71.4	86.2	74.2	64.7
	15:00	15:59	71.7	96.2	74.1	63.5
	16:00	16:59	72.3	96.8	74.3	63.9
	17:00	17:59	72.0	98.3	74.2	62.1
	18:00	18:59	70.5	89.2	73.8	61.3
	19:00	19:59	70.6	94.3	73.7	60.0
	20:00	20:59	69.6	89.5	73.1	59.5
	21:00	21:59	68.5	83.3	72.8	57.8
	22:00	22:59	67.9	86.5	72.1	55.7
	23:00	23:59	67.1	83.0	71.8	54.3
Day 2	00:00	00:59	65.8	90.3	69.9	51.4
	01:00	01:59	64.5	82.5	68.8	49.6
	02:00	02:59	63.9	80.1	68.4	49.2
	03:00	03:59	63.8	80.8	67.9	50.7
	04:00	04:59	64.2	85.9	67.9	51.8
	05:00	05:59	67.4	96.7	70.9	53.8

	from	to	L <sub>Aeq</sub>	L <sub>Amax</sub>	L <sub>A10</sub>	L <sub>A90</sub>
	06:00	06:59	69.2	86.2	73.3	58.9
	07:00	07:59	71.7	94.3	75.0	62.6
	08:00	08:59	72.0	92.8	75.1	64.5
	09:00	09:59	71.9	92.5	74.9	63.7
	10:00	10:59	71.7	96.5	74.3	63.5
	11:00	11:59	72.2	98.5	74.4	64.8
	12:00	12:59	72.1	91.5	74.7	64.8
	13:00	13:59	75.6	100.7	74.2	63.1

Measured sample levels have been corrected by -2.5 dB for façade reflection. The corrected levels ranged between L<sub>Aeq(5min)</sub>73.1dB during daytime and L<sub>Aeq(5min)</sub>56.2 dB during night time (Table 11.).

**Table 11.6:** Extrapolated mean noise levels for both day and night-time at Position 1.

Period	Mean L <sub>Aeq</sub>	mean L <sub>A10</sub>	Mean L <sub>A90</sub>
Thursday 4th (11:45 – 23:00)	68.8 dB(A)	70.7 dB(A)	62.2 dB(A)
Thursday 4th (23:00 – 07:00)	63.7 dB(A)	67.4 dB(A)	52.5 dB(A)
Friday 5th (07:00 – 13:15)	70.2 dB(A)	72.2 dB(A)	63.9 dB(A)

This equates to a measured daytime average of L<sub>Aeq,16hr</sub> 69.4 dB.

The lowest measured background level was L<sub>A90</sub> 46.2 dB at 04:20 hours on Friday 5th September 2014.

The survey data indicates that maximum levels during the night at the measurement position, generally, were in the range L<sub>Amax</sub> 75-80 dB but with a few event noise levels up to L<sub>Amax</sub> 85dB.

### 11.4.2 Position 2

The results of Position 2 site measurements are tabulated in Table 11.7.

**Table 11.7:** Measured Sound Pressure Levels – Position 2

	from	to	L <sub>Aeq</sub>	L <sub>Amax</sub>	L <sub>A10</sub>	L <sub>A90</sub>
Day 1	12:00	12:59	63.6	77.3	67.3	59.6
	13:00	13:59	63.9	79.1	66.3	58.6
	14:00	14:59	61.8	76.6	64.2	57.3

	from	to	L <sub>Aeq</sub>	L <sub>Amax</sub>	L <sub>A10</sub>	L <sub>A90</sub>
	15:00	15:59	61.2	80.6	63.2	57.0
	16:00	16:59	59.7	79.2	61.2	56.4
	17:00	17:59	56.6	75.9	58.2	53.4
	18:00	18:59	55.7	76.6	57.6	52.3
	19:00	19:59	56.0	74.9	57.4	52.3
	20:00	20:59	54.9	74.1	56.3	52.1
	21:00	21:59	54.9	67.0	56.5	52.5
	22:00	22:59	52.9	75.0	54.2	50.1
	23:00	23:59	51.1	68.7	52.8	47.5
Day 2	00:00	00:59	50.1	70.8	51.7	46.3
	01:00	01:59	51.4	64.0	52.8	46.3
	02:00	02:59	52.3	63.2	53.1	48.4
	03:00	03:59	53.7	60.3	54.8	47.6
	04:00	04:59	45.7	62.5	48.5	38.5
	05:00	05:59	51.2	83.3	51.0	42.4
	06:00	06:59	52.1	75.7	53.6	46.5
	07:00	07:59	58.7	81.6	59.8	54.3
	08:00	08:59	59.2	82.0	60.9	56.0
	09:00	09:59	58.5	75.9	60.2	54.6
	10:00	10:59	59.1	84.3	60.2	54.0
	11:00	11:59	58.1	74.1	59.8	54.7
	12:00	12:59	59.6	75.2	62.1	54.9
	13:00	13:59	57.7	73.0	61.0	53.4

Measured sample levels ranged between L<sub>Aeq(5min)</sub> 65.5 dB during daytime and L<sub>Aeq(5min)</sub> 43.7dB during night time (Table 11.8).

**Table 11.8:** extrapolated mean noise levels for both day and night-time at Position 2.

Period	Mean L <sub>Aeq</sub>	mean L <sub>A10</sub>	Mean L <sub>A90</sub>
Thursday 4th (11:45 – 23:00)	59.8 dB(A)	73.9 dB(A)	62.2 dB(A)
Thursday 4th (23:00 – 07:00)	51.4 dB(A)	69.9 dB(A)	52.5 dB(A)
Friday 5th (07:00 – 13:15)	58.7 dB(A)	74.7 dB(A)	63.9 dB(A)

This equates to a measured daytime average of L<sub>Aeq,16hr</sub> 59.4 dB. The lowest measured background level was L<sub>A90</sub> 35.7 dB at 04:25 hours on Friday 5th September 2014.

The survey data indicates that maximum levels during the night at the measurement position, generally, were in the range  $L_{Amax}$  55-60 dB but with a few event noise levels up to  $L_{Amax}$  65 dB.

### 11.4.3 Existing noise climate

The noise climate across the site is determined by general traffic movements on Park Street and High Street and other nearby roads. During the quieter late evening and night time periods it is probable that there is some contribution from plant associated with nearby commercial premises.

There were no significant noticeable discrete noise sources and the survey data indicates a fairly steady noise climate throughout the daytime and night time with only a gradual falling off of levels during the late evening into the night.

## 11.5 Assessment of Project Impacts

### 11.5.1 Noise

#### Internal noise levels (BS8233 Assessment)

Based upon the corrected site measurement data, it may be extrapolated that, in order to achieve the BS 8233 internal noise criteria, the building fabric to residential areas would need to provide a minimum temporal sound reduction of the order of 34 dB(A) for daytime resting/sleeping and night time sleeping for those elevations overlooking Park Street and High Street. For residential elevations overlooking Well Lane, the corresponding sound reduction requirements are 24 dB(A) daytime and 21 dB(A) night time. It is, however, noted that for phase 2, the residential units are at high level above the office floors and it is probable that this increased distance from the roadway will significantly reduce traffic noise levels. It is anticipated that the sound reduction requirement at the Phase 2 residential floor levels would be of the order of 30 dB.

In practice, the structural components of the building envelope can be expected to provide a sound reduction in excess of 45 dB and will not provide a significant pathway for noise break-in. Greatest sound break-in can be expected to occur via windows.

Data given in BRE IP 12/89 and BS 8233 indicates that, for road traffic and general urban noise, standard thermal double glazing provides a typical sound reduction of the order of 33 dB(A). This reduction would enable the BS 8233 internal criteria to be achieved for all habitable rooms on the development.

BS 8233 notes that regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. Glazing achieving a typical sound reduction of the order of 33 dB(A) would reduce internal maximum levels within habitable rooms to less than  $L_{Amax}$  45 dB for the majority of the night time.

In the case of commercial premises, elevations overlooking Park Street and High Street would need to provide a sound reduction of the order of 30 dB(A) whilst elevations to Well Lane and Alison Street would need to provide a reduction of the order of 20-25 dB(A).

**Open Windows**

The sound reductions discussed above apply to closed windows and BS8233 Section G1 advises that sound reduction across a partially open window will be limited to 15 dB. Under these conditions the BS 8233 internal criteria will be exceeded for rooms on roadside elevations and it will be necessary for these rooms to be provided with alternative means of ventilation. Background ventilation in accordance with Building Regulations requirements can be achieved with proprietary window or wall mounted trickle vents. All such vents would, when open, need to provide a comparable sound reduction to the room window system.

For windows located on internal elevations, there will be a significant reduction of ambient noise levels due to screening effects together with additional distance attenuation and it is considered that these rooms could achieve BS 8233 internal criteria when windows are open.

**BCC Assessment**

In accordance with the guidance set out in BCC planning consultation guidance document No. 1, the glazing and vent performance requirements for outer elevations are detailed in *Table 11..*

**Table 11.9:** *Glazing and vent performance requirements for outer elevations set out in BCC planning consultation guidance*

Park Street/High Street	Sound level	PGN1 Glazing Requirement	PGN1 Vent Requirement
Daytime	$L_{Aeq}$ 69.4dB	$R_w + C_{tr}$ 35dB	$D_{n,e,w} + C_{tr}$ 41dB
Night time	$L_{Aeq}$ 63.7dB	$R_w + C_{tr}$ 35dB	$D_{n,e,w} + C_{tr}$ 41dB
Well Lane			
Daytime	$L_{Aeq}$ 59.4dB	$R_w + C_{tr}$ 26dB	$D_{new} + C_{tr}$ 32dB

Night time	$L_{Aeq}$ 51.4dB	$R_w + C_{tr}$ 25dB	$D_{new} + C_{tr}$ 31dB
------------	------------------	---------------------	-------------------------

The derived requirements for Park Street and High Street do not include for any attenuation attributable to the height of the residential floor levels. Allowing for this effect would reduce the sound reduction requirement and it is considered that a more realistic window requirement based upon the BCC criteria would  $R_w + C_{tr}$  32 dB whilst vents should be rated  $D_{new} + C_{tr}$  38 dB.

It is considered that there will be no specific acoustic requirement for windows on internal elevations where rooms do not have a view of adjacent roads or the multi-storey car park.

In the case of noise from new mechanical services plant, noise limits in accordance with the criteria set by Birmingham City Council document PGN1 are given in *Table 11.1010*.

**Table 11.10:** noise limits in accordance with the criteria set by Birmingham City Council document PGN1

Time	Ambient	Bkgrd	Condition 1	Condition 2	Condition 3
Location	$L_{Aeq}$	$L_{A90}$	>10dB below $L_{Aeq}$	>5dB below $L_{A90}$	$L_{Amax}$ <10dB above $L_{A90}$
Park St/High St	62.5	46.2	52.5	41.2	56.2
Well Lane	43.1	35.7	33.1	30.7	55

Based upon Conditions 1 and 2, it is determined that the Rating Level of any mechanical plant operating during night time should be no greater than  $L_{Aeq}$  41.2 dB at the nearest habitable window on Park Street or High Street or  $L_{Aeq}$  30.7 dB on Well Lane. Assuming a character correction of +5dB in accordance with BS4142, the derived plant noise limit levels at the nearest residential receptors are  $L_{Aeq}$  36 dB and  $L_{Aeq}$  26 dB respectively.

Based upon Condition 3, it is determined that the noise level of any mechanical plant associated with the development should be no greater than  $L_{Amax}$  55 dB at the nearest noise sensitive window.

The assessment is based upon the lowest 5 minute night time sample over the survey period and higher levels will be acceptable during daytime.

The above figures indicate the combined noise level of all items of newly installed plant running at 100% load. Without detailed acoustic information, it is not possible to predict the individual contribution of each of the items of plant.

It will be necessary to assess noise output from all plant installations during the construction phase of the project to ensure compliance with the noise limit criteria.

### **11.5.2 Vibration**

Piling is identified as the activity that generates the highest vibration levels typically associated with construction impacts and the extent of the effect is directly related to the soil condition (which can affect the transmissibility and damping or resonance of the vibration) and distance to the nearest sensitive receptors as the vibration will dissipate over distance. At this preliminary stage the piling method or precise location where piling will take place on the site has not been determined. Furthermore, the proposed buildings will have basements which will reduce the level (elevation) at which piling will take place relative to surrounding land-uses (which again could influence the vibration pattern and intensity that could be experienced at off-site receptors). It should be accepted at the outset that whilst the precise location and intensity of vibration that may be felt associated with the piling cannot be determined in advance of the works, the potential for such impacts should be recognised by the piling contractor and developer and appropriate measures be adopted during the piling works to minimise the potential for vibration disturbance to be experienced by off-site receptors.

There could also be temporary vibration impacts associated with HGV movements bringing materials to the site and with stationary plant such as compressors and generators.

## **11.6 Assessment of Cumulative Impacts**

It is considered unlikely that there will be any additive effects of similar impacts from elsewhere if they may combine with impacts from the development.

## **11.7 Impact Mitigation and Residual Effects**

### **11.7.1 Noise**

On the basis of the site measurement data, it is recommended that all habitable rooms on the outer elevations of the Phase 2 building be provided with windows having a minimum manufacturer's rating of  $R_w + C_{tr}$  32 dB. Habitable windows to the Phase 3 building which overlook Well Lane should have a minimum manufacturer's rating of  $R_w + C_{tr}$  26 dB. All habitable rooms to inner elevations which do not have a view of adjacent roads or of the multi-storey car park should be provided with windows having a minimum manufacturer's rating of  $R_w$  30 dB. The reduction should be from the window units as a whole, including the frame and any associated furniture.

All habitable rooms throughout the development should be provided with proprietary wall or window mounted trickle vents to achieve background ventilation in accordance with the Building Regulations requirements.

All such vents to rooms on the Phase 2 outer building elevations should, when open, have a minimum rated sound reduction of  $D_{n,e,w} + C_{tr} 38$  dB. For the phase 3 Well Lane elevation, the minimum rated sound reduction should be  $D_{n,e,w} + C_{tr} 32$  dB. All windows to commercial units on both phases should have a minimum manufacturer's rating of  $R_w 33$  dB.

All new plant installations associated with the development should be selected, sited and installed to achieve the limit criteria derived in section 7.3 of this report. The total noise level for all plant operating at rated output should not exceed a Rating Level of  $L_{Aeq} 41$  dB when measured at any habitable window on Park Street or High Street or a Rating level of  $L_{Aeq} 31$  dB when measured at any habitable building on Well Lane.

### 11.7.2 Vibration

Quieter piling plant and techniques should be used, where reasonably practicable, to reduce the potential for adverse impact. Similarly, where possible, if using multiple piling rigs, operating piling rigs in clusters (*i.e.* all together in one area) should be avoided. Stationary plant such as generators, pumps and compressors should be located as far as possible from sensitive receptors and where practicable isolated from the ground or other structures that are continuous with that of the sensitive premises, using resilient mountings to dampen vibration effects where this is not possible. In some instances it may be possible to reduce vibration transmission by cutting a structure (*e.g.* slab) to separate site work from sensitive premises. Clearly, it is important to take account of safety and structural issues before carrying out any work of this nature, but this approach is unlikely to be applicable on this site given that there will be substantial excavation of the site into natural soils before piling commences, rather than working off an existing slab.

It is recommended that during the piling activities, if vibration is evident or likely off site, monitoring of the vibration levels should be undertaken at the identified sensitive receptors to verify compliance with the recommended limits. Reference should be made to the existing ambient vibration levels from trains, road traffic, *etc.*, which should be measured prior to commencement of monitoring of the piling activities.

HGV deliveries of construction materials will be managed to avoid standing queues or intense periods of activity and the size of the site itself precludes large scale localised vehicle manoeuvring which is when vibration potential would be at its highest. The routing of vehicles into and out of the site should avoid idling and revving of vehicles outside sensitive (residential) properties.

## 11.8 Summary

Measurements and observations made at this site indicate that the noise climate is determined by general road traffic to the west and south of the site.

The survey data indicates that BS 8233 requirements within dwellings can be achieved by use of appropriate acoustic rated windows and vents.

Similarly, BCC planning requirements can be achieved with appropriate acoustic rated windows and vents.

It will be necessary to limit noise emissions from all plant associated with the new development to ensure compliance with the BCC planning criteria and it will be necessary to review plant selection and location during the construction phase.

Construction and vibration works will need to be controlled and managed to reduce the impact to acceptable levels at the nearest identified noise sensitive receptors (residential users). It may be necessary to provide noise and vibration monitoring to certify compliance with the adopted criteria and noise limits if during construction works it becomes evident that noise and vibration nuisance could be occurring.

Based upon the appraisal of noise & vibration impacts discussed above, the residual impacts associated with the **Construction Phase** are deemed to be of **LOW** significance and short-term and temporary in nature. The residual impacts associated with the **Operational Phase** are deemed to be of **LOW** significance and long-term or permanent in nature.

### GLOSSARY

AADT	Annual Average Daily Traffic
ADMS-5	Atmospheric Dispersion Modelling System model for point sources
AQMA	Air Quality Management Area
AURN	Automatic Urban and Rural Network
CHP	Combined Heat and Power
Defra	Department for Environment, Food and Rural Affairs
EPUK	Environmental Protection UK

**SECTION 11: NOISE AND VIBRATION**

Exceedence	A period of time when the concentration of a pollutant is greater than the appropriate air quality objective. This applies to specified locations with relevant exposure
IAQM	Institute of Air Quality Management
LAQM	Local Air Quality Management
LDF	Local Development Framework
$\mu\text{g}/\text{m}^3$	Microgrammes per cubic metre
NO	Nitric oxide
NO <sub>2</sub>	Nitrogen dioxide
NO <sub>x</sub>	Nitrogen oxides (taken to be NO <sub>2</sub> + NO)
NPPF	National Planning Policy Framework
Objectives	A nationally defined set of health-based concentrations for nine pollutants, seven of which are incorporated in Regulations, setting out the extent to which the standards should be achieved by a defined date. There are also vegetation-based objectives for sulphur dioxide and nitrogen oxides
PM10	Small airborne particles, more specifically particulate matter less than 10 micrometres in aerodynamic diameter
PM2.5	Small airborne particles less than 2.5 micrometres in aerodynamic diameter
PPG	Planning Practice Guidance