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ACOUSTIC
CONSULTANTS

PROPOSED MIXED USE DEVELOPMENT
NORFOLK STREET, LIVERPOOL

AMBIENT NOISE ASSESSMENT

architectural

environmental

occupational

industrial

noise control at source

project management

planning

legal services

expert witness

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Document Control

Issue	**1**	**2**	**3**	**4**
Remark	Initial Issue	Minor typo amendment	Increased acoustic performance recommendations in line with LPA request	
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1.0 SUMMARY

PDA were commissioned by Baltic Developments Ltd to carry out an acoustic assessment of the external ambient noise at the mixed use development Norfolk Street, Liverpool.

The proposal is to redevelop the site by erecting a 5 – 9 storey building fronting Norfolk Street, Simpson Street and Watkinson Street, and will comprise 156 studios to the upper floors and a commercial unit for office (Use Class B1) purposes and ancillary services associated with the residential on the ground floor.

The development has been granted planning permission, application number 14F/1333, and as part of Condition 22 of the consent it indicates that the residential accommodation will need to be acoustically insulated.

A long term ambient noise survey has been undertaken over a number of days at the site in order to establish the existing noise climate that the development will be exposed to. It is noted that the noise climate on the site is relatively low with the majority of the noise sources associated with distant traffic on Jamaica Street, though local traffic sources were also audible.

To assess the development for compliance with the planning condition, the results of the survey were used to evaluate the sound insulation of the respective building envelopes and to assess compliance with the guidance contained within BS8233:2014 *Guidance on Sound Insulation and noise reduction for buildings* and WHO Guidelines for Community Noise 1999. In addition, to account for possible future increase in noise at the site, these criteria have been reduced by 5dB(A)

These assessments have demonstrated that utilising the window and ventilation specification recommended within this report the internal ambient noise levels comply with the design criterion.

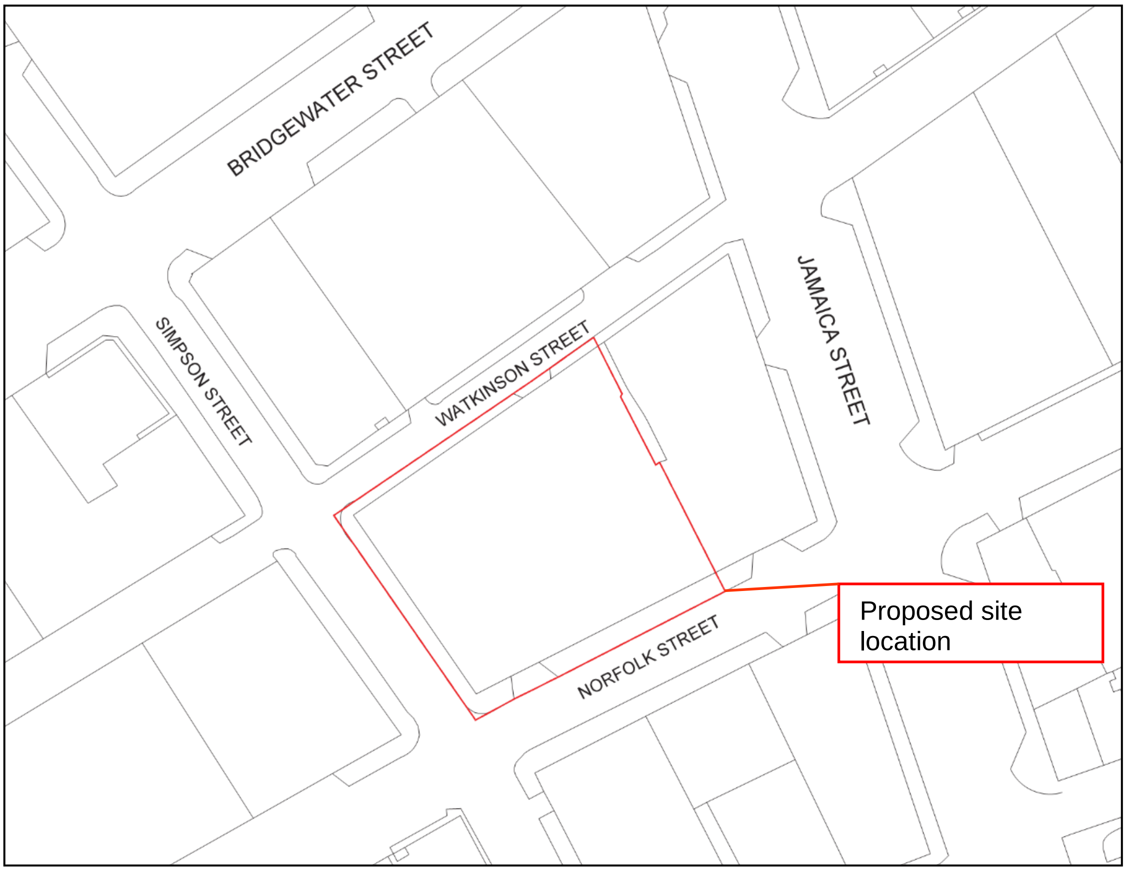
2.0 DEVELOPMENT DESCRIPTION

This report has been prepared to assess the external ambient noise levels surrounding the proposed student accommodation development on Norfolk Street, Liverpool

The proposal is to redevelop the site by erecting a 5 – 9 storey building fronting Norfolk Street, Simpson Street and Watkinson Street, and will comprise 156 studios to the upper floors and a commercial unit for office (Use Class B1) purposes and ancillary services associated with the residential on the ground floor.

The existing and proposed site layout is detailed as follows:

Figure 1. Existing Site Location Plan



3.0 NOISE ASSESSMENT CRITERIA

3.1 Planning Condition 22

Within the consent for the development Planning Condition 22 states the following.

'Prior to occupation the residential accommodation hereby approved shall be acoustically insulated in accordance with a detailed scheme to be submitted and approved by the local planning authority before development commences on site. The sound mitigation must take the form of secondary glazing to the windows of all habitable rooms in accordance with the specification indicated in Schedule 1 of the Noise Insulation Regulations 1975, or double glazing of an equivalent or better acoustic performance. In addition the proposed noise attenuation measures shall

incorporate a suitable scheme of acoustically attenuated continuous mechanical ventilation which removes the need to open windows for ventilation purposes to ensure the same performance criteria can be met.'

We would note that the performance criteria detailed within the Noise Insulation Regulations 1975 are extremely onerous and the condition has not been based upon quantitative noise levels measured on site. We would consider that its use is unsuitable for sites that are exposed relatively modest noise levels.

As an alternative we would recommend utilising the guidance contained within BS8233:2014 and WHO Guidelines for Community Noise. In addition, as the Development is located within the Baltic Triangle we have reduced the noise limits detailed within these standards by 5dB to account for possible future increases in noise level.

Utilising suitable mitigation to the building envelope to meet this standard will provide adequate safeguards for the amenity and health of future residents and therefore will be compliant with the requirements of with Policy H3 of the Liverpool Unitary Development Plan (Adopted November 2002).

3.2 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 1: BS8233 Recommended Internal Noise Level

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35 L_{Aeq}	
Dining	Dining Room / Area	40 L_{Aeq}	
Sleeping (Daytime Resting)	Bedrooms	35 L_{Aeq}	30 L_{Aeq}

In addition BS 8233 suggests, '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'.

3.3 WHO Guidelines for Community Noise 1999

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following noise levels are applicable to residential dwellings.

Table 2: Guideline values for community noise in specific environments.

Specific environment	Critical health effect(s)	L_{Aeq} [dB]	Time base [hours]	L_{Amax}, fast [dB]
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45*

* - WHO guidelines state that for a good sleep, the indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10 – 15 times a night.

4.0 SURVEY DETAILS

4.1 Survey Time and Dates

Measurements at were undertaken between 11:00 on Friday the 2nd October 2015 and 11:00 on Monday the 5th October 2015.

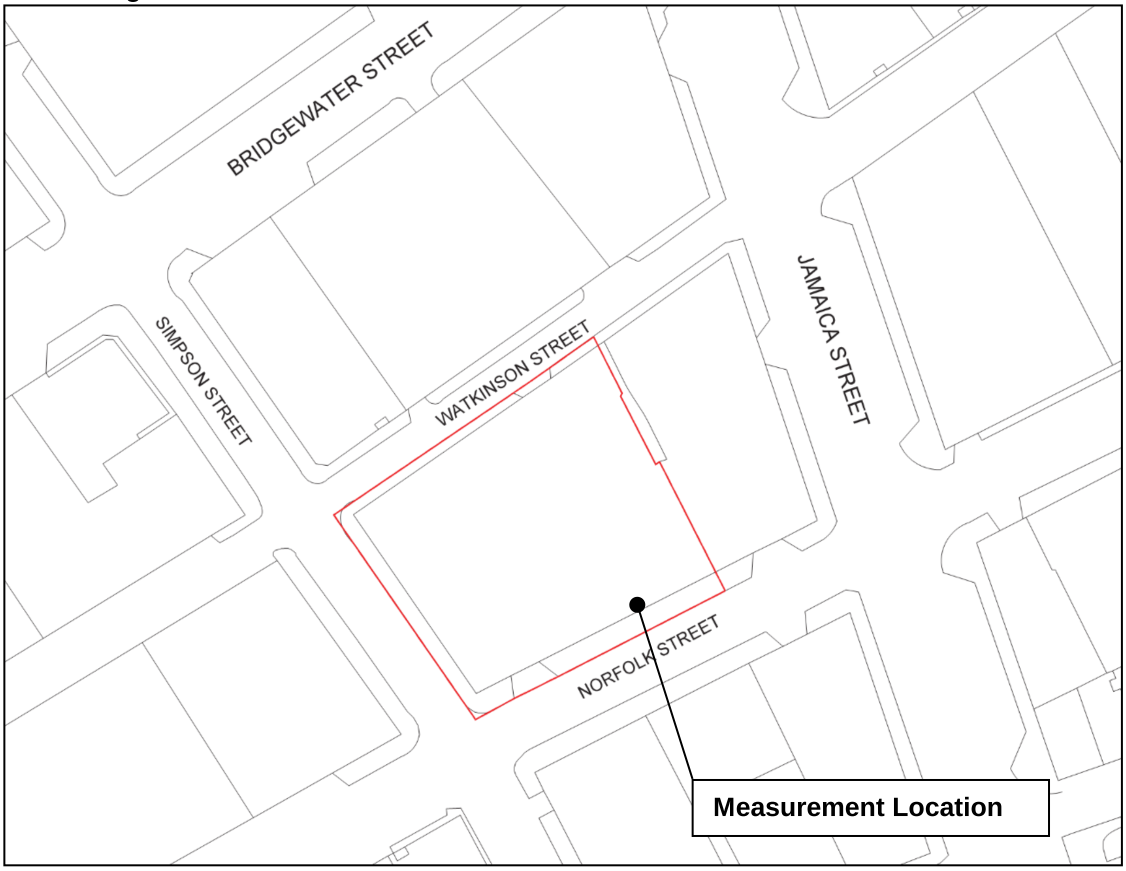
4.2 Weather

Weather conditions varied throughout the monitoring; however weather conditions were conducive to undertake noise measurement.

4.3 Measurement Locations

The measurements were undertaken at one location on the site. The measurement position was located adjacent to Norfolk Street, however as there is hoarding around the site the microphone was mounted at a height of 6m above ground in such that it was not shielded from the road noise sources. In addition measurements were undertaken more than 3.5m from any reflective surface.
Measurement locations were detailed are detailed as follows:

Figure 3. Measurement Locations



4.4 Measurement Equipment

The survey was conducted with an NTi XL2 sound level meters, for which calibration certificates are held. The sound level meter is Class 1 accuracy in accordance with IEC 61672-1. The meters were calibrated directly before any measurement took place and immediately afterwards and no significant drift was observed. For all measurements the meters were set to log automatically every 5 minutes.

4.5 Description of Noise Sources

The dominant noise is is distant road traffic sources within the surrounding roads with the greatest contribution from Jamaica Street. In addition the occasional vehicle on Simpson Street and Norfolk Street was also audible.

It was noted that at the time of the survey there was construction activity on the proposed site. As the monitoring was undertaken to coincide with the weekend, the impact of construction activity was limited, however there was still significant noise contributions from during parts of the daytime of Friday, Saturday and Monday.

4.6 Measured Results

The noise measurements from the survey conducted by PDA are summarised in the tables below. Please note that that the daytime levels correspond to the the logarithmic average L_{Aeq} of the Friday afternoon peak period, 16:00 – 18:00. The nighttime L_{Aeq} period represents the worst case night-time logarithmic average $L_{Aeq,8\text{-}hour}$ and the typical $L_{Amax,f}$. This occurred during the Saturday night period.
Full data are collated within the tables at the rear of the report.

Table 4. Summary of Measurements

Measurement Position	Daytime Noise Level $L_{Aeq,}$	Night-time Noise level $L_{Aeq,}$	Night-time Typical $L_{Amax(Fast)}$
1	55	50	67*

* - Typical L_{Amax} based upon the 10th loudest event occurring on the 10th loudest night-time period as measured on the worst case Saturday night period

5.0 NOISE MITIGATION MEASURES

We would recommend that the noise mitigation scheme should be associated with the building fabric. Utilising the measured noise level the sound ingress into the habitable rooms has been predicted by determining the sound insulation properties of the building envelope.

The sound insulation provided by the building envelope is a combination of the sound reduction indices of the individual façade elements and the area of the façade they cover. The result is a composite sound insulation value for the whole façade.

It is likely, however, that the acoustically weak areas that will dominate the sound insulation performance of the building envelope will be the windows and any ventilation inlets directly into the living spaces.

5.1 External Element Construction Details Recommendations

In order to meet the internal noise criteria detailed within Section 3.2 above we would recommend the following external element construction details:

5.1.1 External Walls

We have been informed that the external wall will be constructed of a brick outer leaf and a structural framing system internal leaf lined with plasterboard. We would expect this to have a significantly greater acoustic performance than the windows and trickle ventilators and as such will not contribute to the internal acoustic environment.

5.1.2 Glazing

It is noted that the details within Planning Condition 22 indicate that secondary glazing or equivalent acoustic performance is required, however this has not taken into account for the external noise level the proposed residential reciever will be exposed to. Our measurements have indicate that the noise level exposure is relatively low as there are no major noise sources close to the proposed site. We would therefore consider that standard double glazed units can provide the required mitigation to meet the internal noise environment.

Our calculations have indicated that the minimum acoustic performance are as follows:

Table 5. Glazing Specification

Location	**Octave Band (Hz) Sound Insulation, R (dB)**							**R_w (dB)**	**Typical Construction**
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**		
All Levels	23	23	23	30	38	36	43	35	6mm Glass, 12mm gap, 8mm glass

It will need to be ensured that the acoustic performance of the window frames matches the performance of the glazing that is fitted within them. Glazing framing systems must be fully sealed with any small gaps (<10mm nominal) around perimeter to be sealed both sides with acoustic non-setting mastic. No gaps should be left unsealed, and in no instance should lightweight foams be used as a sealant behind weathering protection.

5.1.3 Ventilation

It is noted that the details within Planning Condition 22 indicate that a full mechanical ventilation system is required, however this has not taken into account for the external noise level the proposed residential reciever will be exposed to. Our measurements have indicate that the noise level exposure is relatively low as there are no major noise sources close to the proposed site. We would therefore consider that the use of trickle ventilators with enhanced acoustic performance can provide the required mitigation to meet the internal noise environment as an alternative to mechanical ventilation.

Our calculations have indicated that the following acoustic performance will be required to meet the internal noise level.

Table 6. Ventilator Specification

Location	**Octave Band (Hz) Sound Insulation, Dn,e (dB)**							**$D_{n,e,w}$ (dB)**	**Typical Unit**
	63	**125**	**250**	**500**	**1000**	**2000**	**4000**		
All Levels	36	40	36	35	33	37	37	36	RW Simon EHA

The ventilator requirements described are predicted to have adequate sound insulation to maintain the required internal noise level. Each habitable room needing façade ventilation inlets will need to incorporate no more than two of such inlets to achieve acceptable internal noise levels. It should be noted that the inclusion of ventilators checked for compliance with Building Regulations requirements for background ventilation.

In addition we would recommend that windows can be openable for purge ventilation as per the guidance detailed within BS8233:2014 Section 8.4.5.4 summarised as follows:

"The Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice."

5.2 Design Assumptions

Assessment and specification of the acoustic performance of the building envelope, has been undertaken based on achieving the internal ambient acoustic conditions, highlighted in Section 3 above.

Information on the sound insulation properties for specific element details has either been sourced from manufacturer's literature or from Insul® Sound insulation prediction software.

In accordance with the reverberation time standardisation detailed within ISO 140-4 the reverberation time within residential habitable rooms have been assumed as 0.5 seconds.

Calculations have been conducted on a selection of rooms on each façade. All room and façade dimensions have been scaled from the drawings supplied by Falconer Chester Hall Architects.

5.3 Calculation Results

Based upon the ambient noise level measurements and the building envelope reccomendations detailed above we have calculated that the internal noise level within the worst case room would be 28dB L_{Aeq} during the day and 23dB L_{Aeq} / 40dB L_{Amax} during the night. This is therefore compliant with the recommendations within BS8233:2014.

6.0 CONCLUSION

PDA were commissioned by Baltic Developments Ltd to carry out an acoustic assessment of the external ambient noise at the proposed mixed use development at Norfolk Street, Liverpool.

The results of the survey were used to evaluate the sound insulation of the respective building envelopes and to assess compliance with the guidance contained within BS8233:2014 *Guidance on Sound Insulation and noise reduction for buildings* WHO Guidelines for Community Noise 1999. In addition, to account for possible future increase in noise at the site, these criteria have been reduced by 5dB(A)

These assessments have demonstrated that utilising the window and ventilation specification recommended within this report the internal ambient noise levels comply with the design criterion.

Appendix A. Definition of Acoustic Terms

The decibel
This is the basic unit of noise, denoted dB.

A-Weighting
This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB L_{Aeq}. Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$
This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n
This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB $_{LAn.}$ It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}
This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) L_{max}, dB L_{Amax}, etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis
Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.

Appendix B. Measured Levels

Chart 1. Measurement Position 1 Time History