



Reading Borough Council

GEORGE STREET

Noise and Vibration Assessment



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1 INTRODUCTION

1.1 GENERAL

- 1.1.1. WSP has been instructed by Reading Borough Council (RBC) to undertake a noise and vibration assessment of a site at George Street, Reading to determine suitability of the site for development as residential use.
- 1.1.2. WSP has carried out a survey to determine the existing noise and vibration levels on the proposed development site.
- 1.1.3. A glossary of technical terms used in this report can be found in Appendix A.

1.2 SITE DESCRIPTION

- 1.2.1. The site is located at the northern end of George Street in Reading, Berkshire. The site is west of Reading railway station and the Reading to Reading West railway line borders the north of the site. There is existing terrace housing to the south of the site and to the east is an open recreational field with a playground.
- 1.2.2. The site is currently an area of unused scrubland. The railway line which borders the site is on an embankment approximately 4 m in height. George Street is a no-through road which finishes at the development site.
- 1.2.3. A satellite photo showing the development site bounded with a red line is shown Figure 1.

Figure 1 - Site Location (Google Earth)



1.3 DESCRIPTION OF SCHEME

- 1.3.1. The proposed development is for 4 residential units which will be affordable housing. The units are within a 2.5 storey building with a building height of approximately 9m. There are 2 units located on the ground floor. The other two units are comprised of 2 storeys and split over the first and second floor. There are bedrooms located on the ground and second floors.

Table 1 - Residential units

Unit	Storeys
Unit 1	2 – first and second floor
Unit 2	1 – ground floor
Unit 3	1 – ground floor
Unit 4	2 – first and second floor

1.3.2. The unit layouts are shown in the figures below.

Figure 2 - Ground Floor Layout

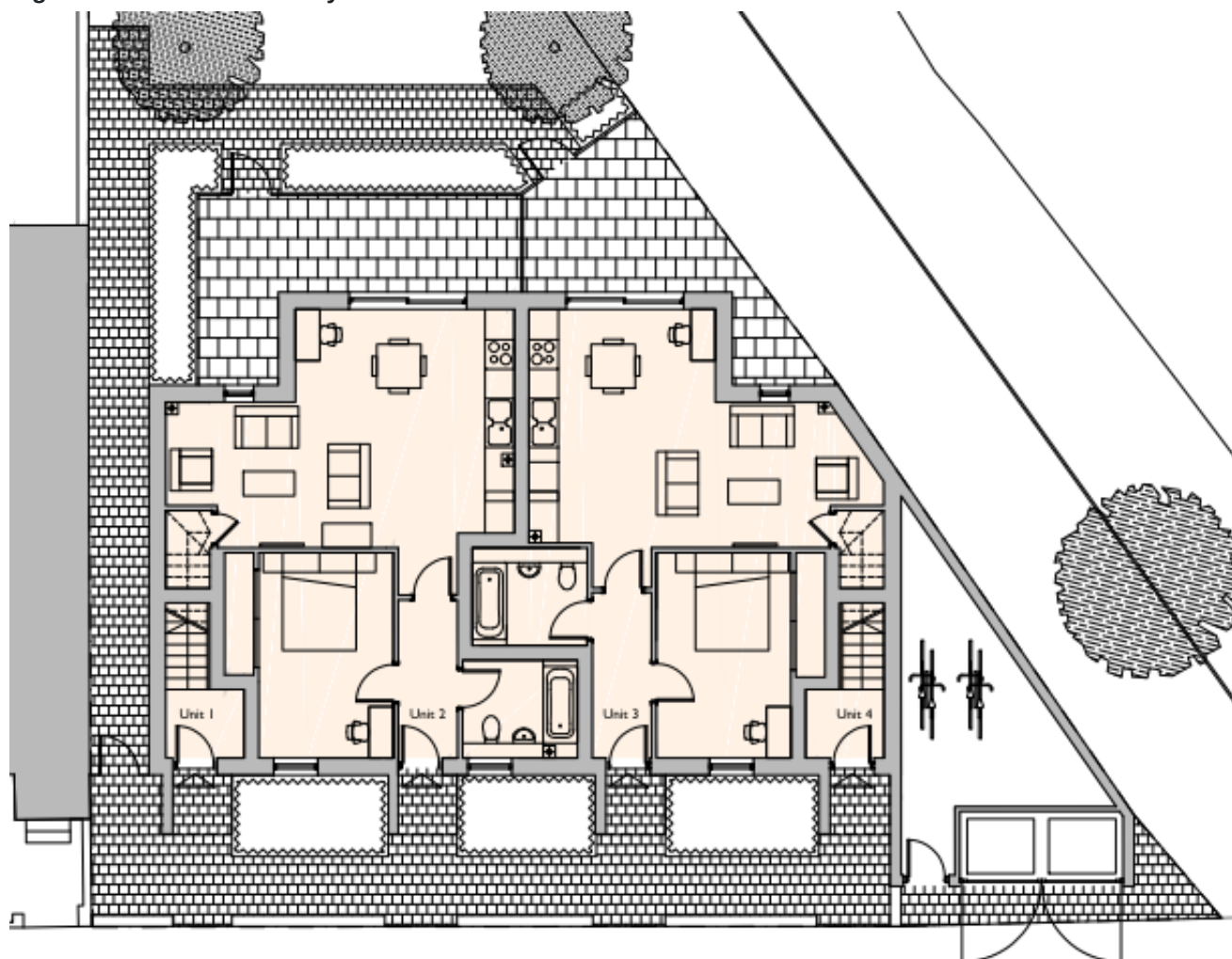


Figure 3 - First Floor Layout

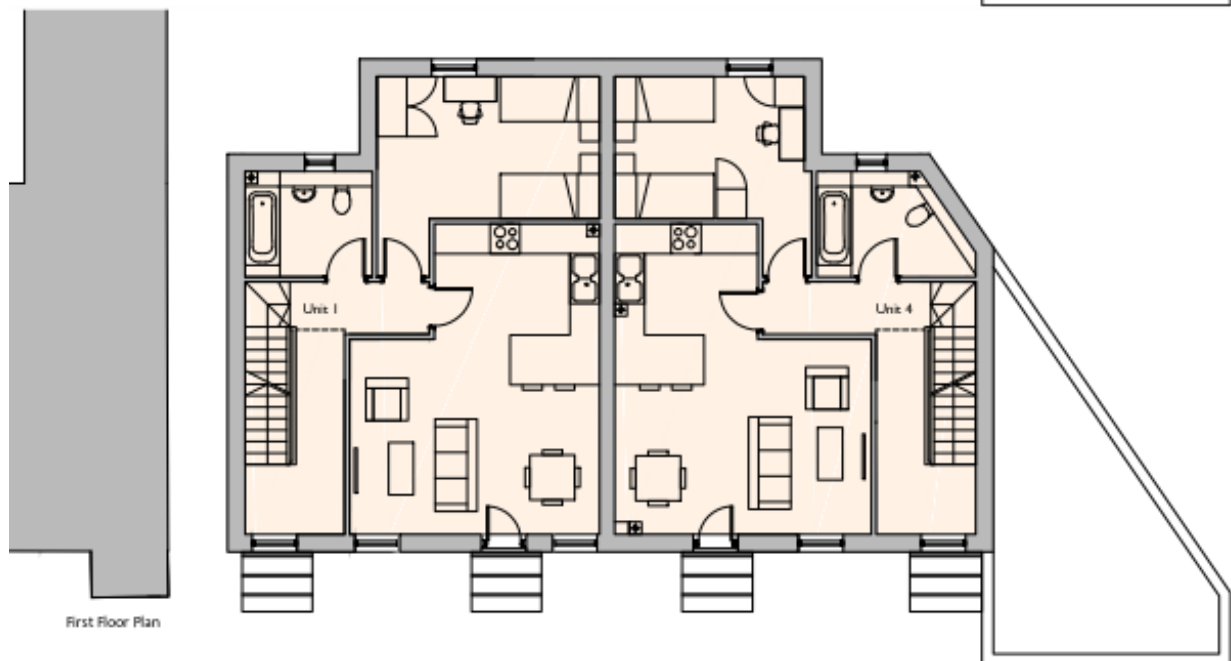
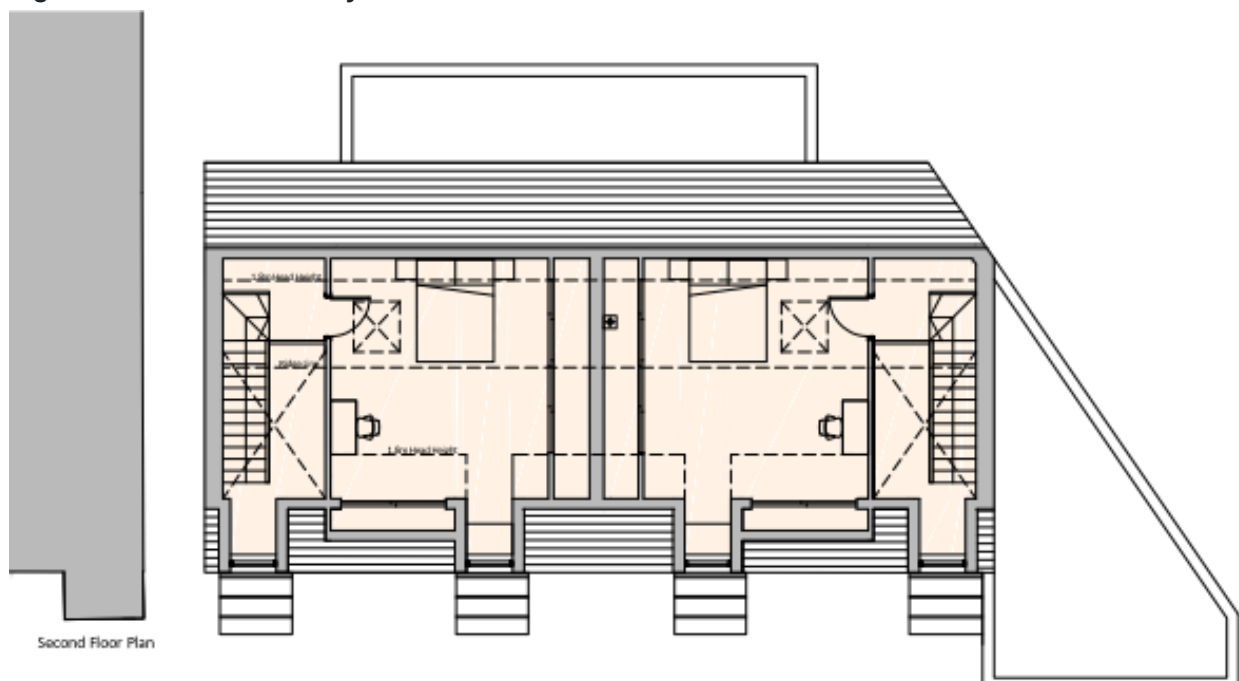


Figure 4 - Second Floor Layout



2 CRITERIA

2.1.1. The following policy and guidance has been taken into consideration in this assessment.

2.2 NATIONAL PLANNING POLICY FRAMEWORK

2.2.1. The NPPF provides guidance and key objectives for local policy development. Relevant policies are outlined below:

2.2.2. Paragraph 14 states:

“At the heart of the National Planning Policy Framework is a presumption in favour of sustainable development...”

For decision-taking this means:

- *approving development proposals that accord with the development plan without delay; and*
- *where the development plan is absent, silent or relevant policies are out of date, granting permission unless:*
 - *Any adverse impacts of doing so would significantly and demonstrably outweigh the benefit, when assessed against the policies in [the NPPF] taken as a whole; or*
 - *Specific policies in [the NPPF] indicate development should be restricted.”*

2.2.3. Paragraph 98:

“When determining planning applications, local planning authorities should:

- *...approve the application if its impacts are (or can be made) acceptable...”*

2.2.4. Paragraph 123:

“Planning policies and decision 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 on them because of changes in nearby land uses since they were established...”*

2.3 NOISE POLICY STATEMENT FOR ENGLAND (NPSE)

2.3.1. The NPSE outlines primary policy aims in relation to the control of environmental, neighbour and neighbourhood noise to achieve sustainable development in line with the NPPF. These aims are to:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.*

2.3.2. The accompanying explanatory note introduces the concepts behind observed effect levels in relation to noise policy, and the phrases “Significant adverse” and “adverse” in describing the related impacts.

2.3.3. The NPSE Explanatory note also states that these relevant descriptors do not have a single objective measure associated with them, and as such additional guidance is required along with relevant context in sufficiently assessing any related noise impact

- **NOEL** – No Observed Effect Level. *“This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.”*
- **LOAEL** – Lowest Observed Adverse Effect Level. *“This is the level above which adverse effects on health and quality of life can be detected.”*
- **SOAEL** – Significant Observed Adverse Effect Level. *“This is the level above which significant adverse effects on health and quality of life occur.”*

2.4 PROPG: PLANNING AND NOISE

- 2.4.1. Professional Practice Guidance (ProPG) on Planning and Noise for new residential development was published by a Working Group consisting of the Association of Noise Consultants (ANC), Institute of Acoustics (IoA) and the Chartered Institute of Environmental Health (CIEH) in May 2017. Whilst it does not constitute official government code of practice, it provides a framework for delivering sustainable development by promoting good health and well-being through the effective management of noise as encouraged by the NPSE and NPPF.
- 2.4.2. ProPG sets a systematic, proportionate, risk based, 2-stage approach for assessing new residential development. These are:
- Stage 1 – an initial noise risk assessment of the proposed development site: and
 - Stage 2 – a systematic consideration of the four key elements, which comprise the following:
 - Element 1 – demonstrating a “Good Acoustic Design Process”;
 - Element 2 – observing internal “Noise Level Guidelines”;
 - Element 3 – undertaking an “External Amenity Area Noise Assessment”; and
 - Element 4 – consideration of “Other Relevant Issues”.
- 2.4.3. The Stage 1 initial noise risk assessment is based on placing the site within ranges of external noise levels, which correspond to varying degrees of risk. It is noted that the external noise levels refer to those from all sources of transport noise, and only include industrial noise sources where they are ‘not dominant’. The external noise level ranges overlap slightly, ensuring that the site is not simply assessed in terms of an absolute noise limit. The initial noise risk assessment approach is illustrated in Figure 1 contained within the ProPG, which is shown in Figure 1 below.
- 2.4.4. The Stage 1 initial noise risk assessment is not designed to enable a final decision to be made on the suitability of the site in terms of noise, but to allow an early indication of the suitability and identification of any noise issues which may be associated with the site.
- 2.4.5. The Stage 2 assessment is then carried out, with the four elements detailed in Section 2.4.2 undertaken in parallel.

Figure 5 - ProPG Initial Site Noise Risk Assessment

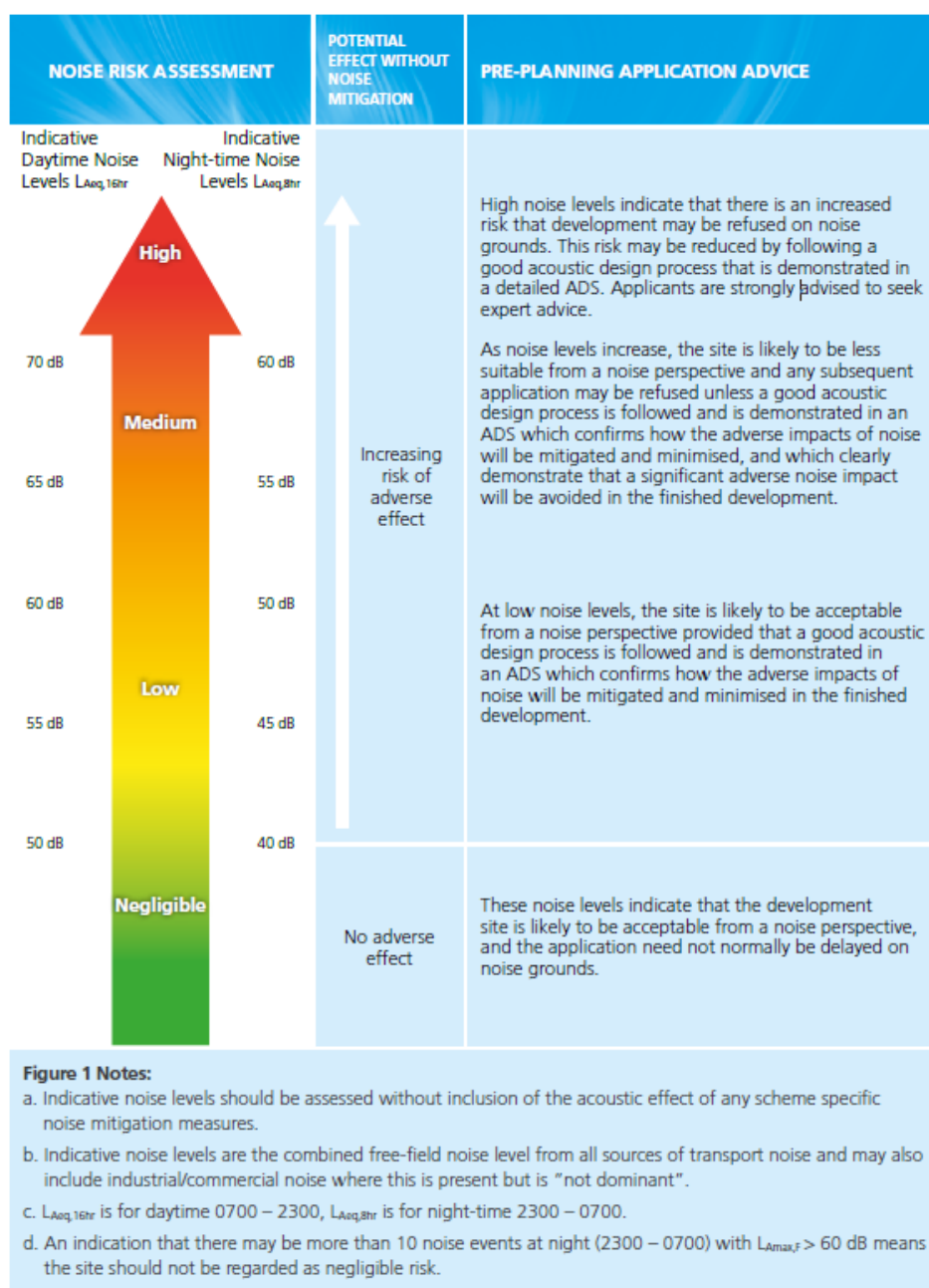


Figure 1. Stage 1– Initial Site Noise Risk Assessment

2.5 LOCAL POLICY

- 2.5.1. The Reading Borough Local Development Framework Core Strategy was adopted in January 2008 (with an alteration adopted January 2015). It contains a policy relating to noise which is relevant to the proposed development site.
- 2.5.2. Policy CS43 Pollution and Water Resources states that developments that are sensitive to noise will only be permitted in areas where they are not subject to high levels of noise pollution, unless adequate mitigation measures are provided to minimise the impact of such pollution.

2.6 BS8233:2014 “GUIDANCE ON SOUND INSULATION AND NOISE REDUCTION FOR BUILDINGS”

- 2.6.1. BS8233:2014 recommends appropriate internal noise levels for habitable rooms such as bedrooms and living rooms for daytime and night-time periods.
- 2.6.2. BS8233 recommends an internal noise limit of 35 dB $L_{Aeq,T}$ for bedrooms and living rooms during daytime hours (0700 – 2300) and an internal noise limit of 30 dB $L_{Aeq,T}$ bedrooms during night-time hours (2300 – 0700). BS8233 also recommends an external noise limit range of 50-55 dB $L_{Aeq,T}$ in outdoor amenity areas such as gardens during daytime hours.
- 2.6.3. Shorter duration and intermittent noise events can be responsible for sleep disturbance. While BS8233:2014 does not recommend specific maximum noise limits for controlling these events, World Health Organisation (WHO) Guidelines for Community Noise (1999) propose a value of 45 dB L_{Amax} for the onset of sleep disturbance in bedrooms at night. As a rough approximation, this equates to 60 dB L_{Amax} externally through an open window. ProPG also references a level of 60 dB L_{Amax} that when exceeded on more than 10 occasions at night, the site should not be regarded as negligible risk (see notes for Figure 5).
- 2.6.4. The indoor noise limits for bedrooms during daytime and night-time periods have been taken into consideration in assessing the necessary façade insulation. The values are detailed in Table 2 below:

Table 2 - BS8233:2014 Noise Limits for Bedrooms

Period	Internal Noise Limit (dB)
Daytime (0700 – 2300 hrs)	35 $L_{Aeq,16hr}$
Night-time (2300 -0700 hrs)	30 $L_{Aeq,8hr}$

2.7 BS6472-1:2008 “GUIDE TO EVALUATION OF HUMAN EXPOSURE TO VIBRATION IN BUILDINGS”

- 2.7.1. Part 1 of BS6472 ‘Vibration sources other than blasting’ provides guidance that relates to the probability with which various degrees of adverse comments to vibration are likely. Table 3 sets out the vibration levels at which varying degrees of adverse comments may be expect within those dwellings.

Table 3 - Vibration Dose Values (VDV $ms^{-1.75}$) above which various degrees of adverse comment maybe expected within residential buildings

	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential buildings 16-hour day	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential buildings 8-hour night	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

- 2.7.2. The application of BS6472 is primarily intended to measure and assess existing sources of vibration rather than proposed potential sources. However, this standard does advise that where it is not possible to measure within buildings, either because of access or for a building yet to be constructed, vibration can be estimated within the building by using the estimated vibration dose value, eVDV.

2.8 GROUND BORNE NOISE (GBN)

- 2.8.1. Ground Borne Noise (GBN) occurs as a result of vibration transmitted into neighbouring buildings being re-radiated as noise. This type of noise can be heard as a rumbling type sound during train pass bys. GBN is usually measured in terms of the $L_{Amax,s}$ in dB.
- 2.8.2. There are no relevant national or international standards setting criteria for acceptable levels of GBN. The requirements are generally specified for each project and may identify specific building types that have different requirements. However, criteria in general used on rail schemes in the UK state that GBN levels

below 35 dB $L_{Amax,s}$ for residential buildings are unlikely to cause complaint. It is also noted that GBN is only a problem when it is audible above the ambient noise external to the building. It therefore follows that for naturally ventilated rooms where the existing ambient at the external facade is more than 15 dB above the GBN level (this assumes 10 dB for an open window and a 5 dB level difference), GBN will not be an issue.

3 METHODOLOGY

3.1 GENERAL APPROACH

- 3.1.1. The assessment has considered the impact of the existing noise sources on the proposed residential site.
- 3.1.2. Given the small-scale nature of the development, impacts during construction and changes in road traffic noise levels as a result of the development have been scoped out.
- 3.1.3. The methodology used, standards and guidance followed in this assessment have been agreed with the Environmental Health Officer at RBC.

3.2 NOISE AND VIBRATION SURVEY

- 3.2.1. The noise and vibration survey was carried out at the site between 6th and 7th September 2017. The locations are shown in Figure 6 and exact locations shown in Table 4.
- 3.2.2. The main aim of the survey was to determine the existing ambient noise and vibration levels on the site.

Figure 6 - Monitoring Locations Map (Google Earth)

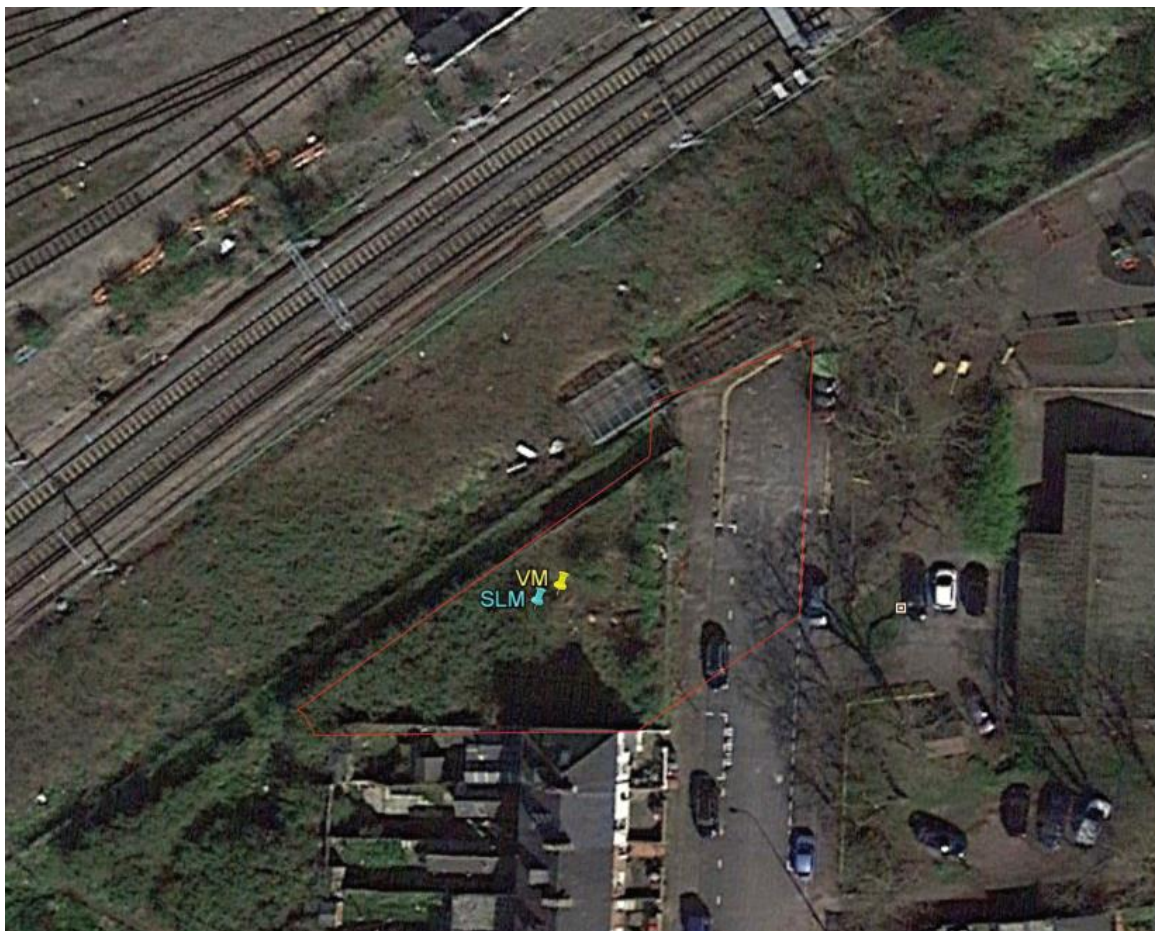


Table 4 - Monitoring Locations

Equipment	Location
Sound Level Meter (SLM)	51°27'29.95"N, 0°59'9.32"W
Vibration Meter	51°27'29.99"N, 0°59'9.22"W

- 3.2.3. Daytime noise measurements were undertaken over one hour period; night-time noise measurements were undertaken over 15 minutes' periods. Vibration measurements were undertaken over an hour, in this time a total of 15 trains were counted.
- 3.2.4. The ambient noise level was dominated by train noise and some aircraft noise; few vehicle movements were noticed on George Street which is a no-through road.
- 3.2.5. Weather conditions over the survey were generally calm, with some gusts below 2.5 m/s during daytime, generally dry with some drizzle at night. The temperature was approximately 18°C during daytime and 11°C during night-time.
- 3.2.6. Sound measurements were made using Rion NL52, Class 1 Sound Level Meter (SLM). The measurement microphone was half inch microphone type UC-53A. The microphone was mounted at a height of 1.2m from the local ground level. The meter was calibrated on site using a Rion NC-74 calibrator; the levels were within accepted tolerances following all calibration procedures.
- 3.2.7. The vibration measurements were made using a Svantek 948 Vibration Analyser. Equipment used in the survey is detailed in Table 5 and Table 6. Calibration certifications are provided in Appendix B.

Table 5 - Sound Equipment

Measurements	Sound Level Meter	Pre-Amplifier	Microphone	Calibrator
SLM	Rion NL-52 S/N 00320637	Rion NH-25 S/N 10645	Rion UC-59 S/N 05708	Rion NC-74 S/N 35125825

Table 6 - Vibration Equipment

Measurements	Vibration Meter	Accelerometer	Cable Type
VM	Svantek 948 S/N 6534	Dytran 3233A S/N 1042	6812A10

- 3.2.8. A summary of the measurement results is provided in Table 7 and Table 8.

Table 7 - Summary of Results from Noise Survey

Date And Time	Elapsed Minutes	L _{Aeq} , dB	L _{A90} , dB	L _{A10} , dB
06/09/2017 12:57	60	58.9	42.3	53.8
07/09/2017 00:36	15	53.6	33.1	46.2
07/09/2017 01:27	15	53.1	30.2	48.7

Table 8 - Summary of Train Noise Levels

Train Type	L _{Aeq} , dB	L _{A90} , dB	L _{A10} , dB	L _{Amax} , dB
Cross Country	58.2	47.0	64.0	64.0
GWR-3	62.1	45.2	67.8	67.8
GWR-2	61.6	46.3	67.7	67.7
Freight Train 1-30	75.8	55.9	79.1	79.1
FWR Diesel 10	67.4	45.5	72.7	72.7
RGD Diesel-3	63.4	51.2	69.1	69.1

Table 9 - Summary of Results from Vibration Survey

Train Type	Date & Time	x, VDV (m/s^{1.75})	y, VDV (m/s^{1.75})	z, VDV (m/s^{1.75})	Per Train, VDV (m/s^{1.75})
Cross Country - 4 carriages	06/09/2017 13:02	0.0001	0.0001	0.0009	0.0009
GWR - 3 carriages	06/09/2017 13:07	0.0001	0.0002	0.0008	0.0008
GWR - 2 carriages	06/09/2017 13:13	0.0002	0.0003	0.001	0.001
FWR Diesel- 10 carriages	06/09/2017 13:33	0.0002	0.0002	0.002	0.002
Freight train 1- 30	06/09/2017 13:36	0.0003	0.0003	0.004	0.004

- 3.2.9. Full details of the noise and vibration monitoring survey are contained in the monitoring forms within Appendix C.

4 ASSESSMENT

- 4.1.1. The following assumptions have been made in carrying out this assessment:
- Daytime noise levels measured on the site over a 1 hour period are considered to be representative of the 16 hour daytime period.
 - Night-time noise levels measured on the site over 15 minutes periods in two circuits have been averaged and considered as representative of the 8 hour night-time period.
- 4.1.2. Table 10 shown the potential effect of the development according to the noise levels measured on site according to the categories described in ProPG.

Table 10 - Potential Development Effect

Period	L _{Aeq, T} dB	Potential Effect Without Noise Mitigation
Daytime, 16 hour (0700 – 2300 hrs)	59	Low risk of adverse effect
Night-time, 8 hour (2300 – 0700 hrs)	53	Medium risk of adverse effect

- 4.1.3. The proposed development is a 2.5 storey building with living accommodation on all floors. Therefore the measured noise level, taken at ground floor, has been adjusted to account for the increase elevation and line of sight to the adjacent railway. The calculated noise levels are shown in Table 11.

Table 11 - Calculated Noise Level

Period	Floor	L _{Aeq, T} dB	Potential Effect Without Noise Mitigation
Daytime, 16 hour (0700 – 2300 hrs)	First	64	Low risk of adverse effect
	Second	70	High risk of adverse effect
Night-time, 8 hour (2300 – 0700 hrs)	First	58	Medium risk of adverse effect
	Second	64	High risk of adverse effect

- 4.1.4. Appendix A of ProPG provides advice for dealing with noise events (L_{max} levels) during night-time periods. ProPG states that where the external façade noise level is above 60 dB and the number of events exceeding this value is greater than 10, the site cannot be regarded as negligible risk. ProPG also concludes that a significant effect on sleep disturbance is likely where external facade noise levels exceed 80 dB and the number of events exceeding this value is greater than 20, and therefore the site should be regarded as high risk. A review of the train timetables and based on observations during the noise monitoring, trains operate on the section of track adjacent to the proposed development during night-time periods. The most frequent type of train movement is from GWR trains which have an associated L_{Amax} noise level of 67 dB (see Table 8). It is estimated that number of movements would be between 15-20 per night with the vast majority occurring between 23:00 – 01:00 and 05:00 – 07:00. Freight trains also operate during night periods which have a higher maximum noise level (79 dB) however the number of movements is much less (below 1-2 per night).
- 4.1.5. Based on the maximum noise levels, number of events and the source of the noise being trains which, at this location are travelling at a low speed and at scheduled intervals, the site is regarded being as medium risk of adverse effect without noise mitigation.

4.2 FAÇADE NOISE INGRESS

- 4.2.1. The results from the noise survey have been used to determine the sound insulation required to achieve the internal limits from BS8233:2014.
- 4.2.2. The BS8233 simple calculation method for the evaluation of sound insulation requirements for facades has been used in this assessment to provide a typical sound insulation performance requirement value (R_w + C_{tr}, dB) for habitable rooms at this preliminary stage in the design process. The calculation and derived

$R_w + C_{tr}$ performance requirement values for the site are shown in Table 12. The assessment is based on the measured and calculated day and night-time noise levels at the site.

Table 12 - Required Façade Sound Insulation for the Site

Period	Floor	External Noise Level dB	Target Indoor Criteria dB	Sound Reduction ($R_w + C_{tr}$) dB
Daytime L_{Aeq}	Ground	59	35	24
	First	64	35	29
	Second	70	35	35
Night-time L_{Aeq}	Ground	53	30	24
	First	58	30	28
	Second	64	30	29
Night-time L_{AFmax}		67	45	22

- 4.2.3. An external building façade would typically achieve a minimum sound insulation of 40-45 dB $R_w + C_{tr}$. The weakest elements in a building façade will be the glazing and ventilators, and these will therefore determine the overall composite performance of the façade as a whole.
- 4.2.4. Achievement of the BS8233 internal noise limits is based on windows being closed in habitable rooms, with ventilation provided through trickle vents or a mechanical ventilation system, depending on the design development.
- 4.2.5. Typical performance ranges for glazing and ventilators are shown in Table 13 and Table 14 below. It is noted that glazing performance is stated in terms of an $R_w + C_{tr}$ value, whereas ventilator performance is stated in terms of a $D_{ne,w} + C_{tr}$ value, which is a weighted laboratory sound reduction performance value for a single ventilation element. The configurations are indicative only and full detailed calculations will be required during the detailed design stage.

Table 13 - Typical Sound Insulation ratings for glazing (BS6262-2)

	$R_w + C_{tr}$
Typical 4mm / 12mm / 4mm glazing	29 dB
Typical 6mm / 12mm / 4mm glazing	32 dB
Typical 6mm / 12mm / 6mm glazing	31 dB
Typical 10mm / 12mm / 4mm glazing	35 dB
Typical 10mm / 12mm / 6mm glazing	36 dB

Table 14 - Typical Sound Insulation ratings for passive ventilators

	$D_{ne,w} + C_{tr}$
Trickle vent with direct air path	32 dB
Through wall vent (100mm diameter)	34 dB

- 4.2.6. It can be seen by comparing the required sound reduction values in Table 13 with the information in Table 12 that a workable glazing solution exists that would result in the target internal noise levels being achieved. The values in Table 14 also show that a suitable arrangement for passive ventilations could be achieved.

EXTERNAL NOISE LEVELS

- 4.2.7. BS8233 recommends an external noise level of 50-55 dB $L_{Aeq,T}$ in outdoor amenity areas such as gardens during daytime hours. External daytime noise levels measured at the site are around 59 dB L_{Aeq} (ground floor) and therefore have the potential to exceed the BS8233 recommended level. It is noted that BS8233:2014 advises this guideline level may not be achievable in all circumstances where a development might be desirable and that the development should be designed to achieve the lowest practicable noise levels in external amenity spaces.

4.3 VIBRATION SITE SUITABILITY

- 4.3.1. During the vibration survey, a total of 15 trains were recorded in a one hour. Using this assumption of 15 trains per hour the VDV day and night has been calculated according to BS6472 based in the formula:

$$VDV \text{ b/d, day/night} = \left(\sum_{n=1}^{n=N} VDV^4 \text{ b/d, tn} (VDV^4 \text{ b/d, tn}) \right)^{0.25}$$

- 4.3.2. Values obtained for the worst case scenario are

- VDV, day = 0.016 ($\text{m/s}^{1.75}$)
- VDV, night = 0.013 ($\text{m/s}^{1.75}$)

- 4.3.3. Both values are below the limits considered in BS6472 for a low probability of adverse comment from vibration. Therefore, no vibration impact is expected to affect the site.

- 4.3.4. The potential for ground-borne noise (GBN) has also been considered. During consultation with the planning officer at RBC the issue of GBN was raised in relation train pass-bys inside nearby houses on Gower Street, approximately 215 m south of the site but at a similar set back distance from the railway line as the proposed development.

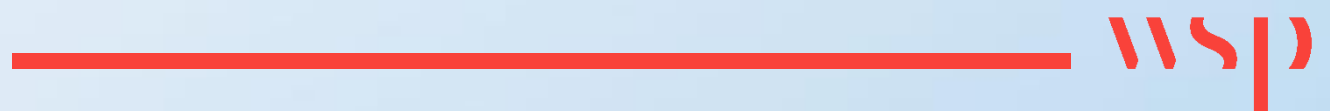
- 4.3.5. Using the vibration results from the survey of train pass-bys, the GBN level associated with a 3-car GWR train (the most frequent type of train movements) at the site have been estimated. At first floor level, GBN is estimated to be 22 dB $L_{Amax,s}$. This would equate to approximately 19.5 dB at second floor. It is noted that this is a conservative prediction based on the maximum 1/1 octave data obtained during the vibration survey. The estimated GBN level is significantly below the 35 dB criteria set for residential buildings, below which complaints are unlikely. Therefore, the potential for GBN affecting the site is considered to be low.

5 CONCLUSIONS

- 5.1.1. This assessment has been prepared to determine the suitability of the site for residential development.
- 5.1.2. The assessment concludes that noise levels at the proposed site are currently characterised by the railway line which borders the site. Noise levels are not considered high in absolute terms.
- 5.1.3. Based on vibration analysis from the data obtained in the survey it is concluded that the site is not affected by vibration as the levels obtained are well below the limits described in the BS6472. The estimated GBN level from trains at the site are significantly below the 35 dB criteria set for residential buildings, below which complaints are unlikely. Therefore, the potential for GBN affecting the site is considered to be low.
- 5.1.4. The site could be suitable for residential use subject to provision of appropriate building envelope sound insulation.
- 5.1.5. Full detailed calculations will be required to determine specific sound insulation performance requirements at different façades. It is anticipated that this requirement will be included as a condition to any planning permission granted for the scheme.

Appendix A

GLOSSARY OF ACOUSTIC TERMINOLOGY



Decibel (dB)	The decibel scale is used in relation to sound because it is a logarithmic rather than a linear scale. The decibel scale compares the level of a sound relative to another. The human ear can detect a wide range of sound pressures, typically between 2×10^{-5} and 200 Pa, so the logarithmic scale is used to quantify these levels using a more manageable range of values.
Sound Pressure Level (SPL)	The Sound Pressure Level has units of decibels, and compares the level of a sound to the smallest sound pressure generally perceptible by the human ear, or the reference pressure. It is defined as follows: $\text{SPL (dB)} = 20 \log_{10}(P/P_{\text{ref}}) \text{ where } P = \text{Sound Pressure (in Pa)}$ $P_{\text{ref}} = \text{Reference Pressure } 2 \times 10^{-5} \text{ Pa}$ An SPL of 0dB suggests the Sound Pressure is equal to the reference pressure. This is known as the threshold of hearing. An SPL of 140dB represents the threshold of pain.
A-Weighting	The human ear can detect a wide range of frequencies, from 20Hz to 20kHz, but it is more sensitive to some frequencies than others. Generally, the ear is most sensitive to frequencies in the range 1 to 4 kHz. The A-weighting is a filter that can be applied to measured results at varying frequencies, to mimic the frequency response of the human ear, and therefore better represent the likely perceived loudness of the sound. SPL readings with the A-weighting applied are represented in dB(A).
L10 or LA10 and other percentile measures	This represents the SPL which is exceeded 10% of the time, expressed in dB or dB(A). LA10 is used to quantify road noise levels. Other percentiles exist and are used for various types of noise assessment. These include L01, L50, L90, L99.
Noise	A noise can be described as an unwanted sound. Noise can cause nuisance.
Noise Sensitive Receptors (NSR's)	Any identified receptor likely to be affected by noise. These are generally human receptors, which may include residential dwellings, work places, schools, hospitals, and recreational spaces.
Rw + Ctr	Sound insulation requirements are stated in these terms. Rw is the weighted sound reduction index and Ctr is a spectral correction term which takes account of the lower sound insulation performance of building elements at low frequencies.

Appendix B

CALIBRATION CERTIFICATES



CERTIFICATE OF CALIBRATION

Date of Issue: 18 January 2016

Certificate Number: UCRT16/1036

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

Telephone 01908 642846 Fax 01908 642814

E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page	1	of	2	Pages
Approved Signatory				
				
M. Breslin []	K. Mistry []	J. Harriman [✓]		

Customer WSP Environmental Ltd
3rd Floor
Kings Orchard
1 Queen St
Bristol
BS2 0HQ

Order No. 20016308

Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification	Manufacturer	Instrument	Type	Serial No. / Version
	Rion	Sound Level Meter	NL-52	00320637
	Rion	Firmware		1.5
	Rion	Pre Amplifier	NH-25	10645
	Rion	Microphone	UC-59	05708
	Rion	Calibrator	NC-74	35125825
		Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES **Approval Number** 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 14 January 2016

ANV Job No. UKAS16/01010

Date Calibrated 18 January 2016

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	Dated	Certificate No.	Laboratory
	27 January 2014	TCRT14/1029	ANV Measurement Systems

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number

UCRT16/1036

UKAS Accredited Calibration Laboratory No. 7623

Page 2 of 2 Pages

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source		Manufacturer
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data		Manufacturer
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data		Manufacturer
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections		Manufacturer
Total expanded uncertainties within the requirements of IEC 61672-1:2002	Yes	
Specified or equivalent Calibrator		Specified
Customer or Lab Calibrator		Customers Calibrator
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		15 January 2016
Calibrator cert. number		UCRT16/1034
Calibrator cal cert issued by		7623
Calibrator SPL @ STP	94.03	dB Calibration reference sound pressure level
Calibrator frequency	1001.90	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Wind Shield WS-10

Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	22.57	22.06	± 0.20 °C
Humidity	37.2	34.0	± 3.00 %RH
Ambient Pressure	100.26	100.23	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.2	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A	C	Z
	10.7	15.5	20.7
	dB	dB	dB
	UR	UR	UR

Uncertainty of the electrical self generated noise ± 0.12 dB

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

END

Calibrated by: A Patel

Additional Comments

None

R 2

Span 948 Cal



CERTIFICATE OF CALIBRATION



0653

Date of Issue: 19 April 2017

Issued by:

ANV Measurement Systems

Beaufort Court

17 Roebuck Way

Milton Keynes MK5 8HL

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E-Mail: info@noise-and-vibration.co.uk

Web: www.noise-and-vibration.co.uk

Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Certificate Number: UCRT17/1289

Page 1 of 2 Pages

Approved Signatory

K. Mistry

CUSTOMER

WSP UK Ltd
4th Floor
6 Devonshire Square
London
EC2M 4YE

ORDER No

20043455

Job No

UKAS17/04171

DATE OF RECEIPT 13 April 2017

PROCEDURE

Procedure TP 1 Calibration of Sound Calibrators or Calibration Engineer's Handbook section 2

IDENTIFICATION

Sound Calibrator 01dB type CAL21 serial number 35103574(2010) with one-inch housing and adapter type BAC21 for half-inch microphone

CALIBRATED ON

19 April 2017

PREVIOUS CALIBRATION

Calibrated on 01 April 2016, Certificate No. 09050 issued by this laboratory.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate No UCRT17/1289

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MEASUREMENTS

The sound pressure level generated by the Sound Calibrator in its half-inch configuration was measured using a B&K type 4134 microphone with the protective grid in position. The microphone sensitivity was traceable to National Standards.

RESULTS

The mean level of the calibrator output, corrected to the standard atmospheric pressure of 101.3 kPa using manufacturers' data, was

$$94.00 \pm 0.1 \text{ dB rel } 20 \mu\text{Pa}$$

The fundamental frequency of the sound output was $1002 \text{ Hz} \pm 0.06 \%$, and its total distortion was $(1.14 \pm 0.09) \%$.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

During the measurements the laboratory environmental conditions were:

Temperature: 21 to 22 °C

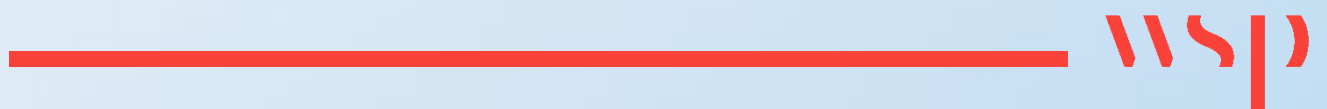
Atmospheric pressure: 102.6 to 102.7 kPa

Relative humidity: 32 to 44 %

The tests carried out were based on Annex B of BS EN 60942:2003, but with five determinations of sound pressure level, and limited to the above level(s) & freq(s). This is a subset of the tests specified in Annex B of BS EN 60942:1998. The mean level, frequency and total distortion of the sound output as measured meet the Class 1 requirements of BS EN 60942:1998 for the environmental conditions under which the tests were performed. This does not imply that the sound calibrator meets this standard under any other conditions. However it has successfully undergone pattern evaluation to the earlier Standard IEC 942:1988

Appendix C

NOISE AND VIBRATION MONITORING FORMS



Vibration Monitoring Form

Attended Results

Project:	RBC Affordable Houses	Job Number:	70012984
Location:	George Street (51°27'29.99"N, 0°59'9.22"W)		
Equipment:	Svantek 958	Engineer:	Angela Lorenzo
Pre-Calibration Level:	94.0dB	General Weather Description:	19 C, overcast, breezy
Post-Calibration Level:	94.0dB		

Additional Comments: Railway embankment 5-6 meters high, approximately 10.5 meters from the adjacent building and 26 from the railway

Measurement Period			Description of Audible Noise
Date	Start / Stop Time	Measurement Periods	Aircraft noise, wind in the trees, train noise, playground
06/09/2017 12:39	12:37	1m	
06/09/2017 13:44	13:07		



06.00 3 carriages Great Western South, 3 carriages Great Western North accelerating
 10.50 5 carriages Cross Country diesel
 12.39 3 carriages Great Western
 22.55 4 carriages Cross Country diesel (slow speed)
 27.41 3 carriages Great Western (wheel sequel)
 33.5 2 carriages Great Western
 48.10 3 carriages Great Western
 53.49 10 carriages diesel FGW (slam door)
 56.28 Freight train (1 engine, 30 carriages) -50s
 60.25 3carriages RDG bound diesel
 60.47 3carriages RDG bound diesel



The Forum
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Exeter, Devon
EX1 1QR

wsp.com