SHARPS REDMORE

ACOUSTIC CONSULTANTS

Report

44 Gloucester Avenue
Noise and Vibration Assessment

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1.0 Executive summary

1.1 Sharps Redmore (SR) have been instructed to undertake a noise assessment of a proposed residential-led mixed redevelopment site at 44 Gloucester Avenue.

1.2 The objective of the assessment is to consider the development in relation to the existing noise and vibration environment, in particular noise and vibration from the nearby rail lines and noise generated by road traffic in the vicinity, principally from Gloucester Avenue.

1.3 The assessment has been undertaken by reference to noise and vibration surveys undertaken at the site in December 2014, the results of which were used both to assess the site and to understand noise levels likely to be experienced at the proposed development.

1.4 The assessment has been based on advice in BS 8233:2014, in conjunction with the World Health Organisation Guidelines. BS6472:2008 contains the relevant guidance in respect of vibration.

1.5 Recommendations are made on mitigation measures necessary to ensure an acceptable noise and vibration environment for future residents against present international and national guidelines.

1.6 The conclusions of the assessment are that the noise environment is such that the residential use can proceed in a way which provides an acceptable noise climate for future residents.

1.7 Noise emissions from any commercial elements and from plant and machinery serving the development can be controlled through the use of an appropriate planning condition.

2.0 Introduction

2.1 Sharps Redmore have been commissioned to provide an acoustic assessment relating to a proposed residential-led mixed development at 44 Gloucester Avenue. The proposed development consists of the demolition of buildings identified as number 2 at the northwest corner of the site and number 4 at the eastern corner of the site to provide a new ground plus 5 upper storey building along the north west part of the site and a ground plus 2 upper storey building at the eastern corner and refurbishment of the existing building on site to create 40 residential units, employment floor area (Use Class B1a) car parking and landscaping within the courtyard and ancillary works.

2.2 The site is currently occupied by a variety of generally disused commercial and warehouse buildings.

2.3 This report will assess the sound insulation requirements of the building external envelope necessary to achieve appropriate internal noise level criteria and confirm the measures likely to be necessary to ensure that the proposal will not result in any noise impacts on existing nearby residents. Levels of vibration are also assessed in relation to the likelihood of adverse comment from future residents.

2.4 It is proposed to provide a number of apartments on the site, arranged around a central courtyard. The blocks would include accommodation up to 2nd floor level. Commercial space is included at ground floor and basement levels.

2.5 This report details the environmental noise survey undertaken in December 2014 to assess the current noise climate at the site.

2.6 This data forms the basis of assessing the acoustic requirements of the building, in order to achieve acceptable internal noise criteria for residential use, and for background noise levels to establish noise emission criteria.

3.0 Assessment Criteria

3.1 The key local policy applicable to this development would be Camden Borough Council Development Management Plan Policy DP28. The policy refers to the Noise Thresholds for Camden, as set out below:

Table A: Noise levels on residential sites adjoining railways and roads at which planning permission will not be granted

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	74 dB L_{Aeq},12h	72 dB L_{Aeq},12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	74 dB L_{Aeq},4h	72 dB L_{Aeq},4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	66 dB L_{Aeq},8h	66 dB L_{Aeq},8h

Table B: Noise levels on residential streets adjoining railways and roads at and above which attenuation measures will be required

Noise description and location of measurement	Period	Time	Sites adjoining railways	Sites adjoining roads
Noise at 1 metre external to a sensitive façade	Day	0700-1900	65 dB L_{Aeq},12h	62 dB L_{Aeq},12h
Noise at 1 metre external to a sensitive façade	Evening	1900-2300	60 dB L_{Aeq},4h	57 dB L_{Aeq},4h
Noise at 1 metre external to a sensitive façade	Night	2300-0700	55 dB L_{Aeq},1h	52 dB L_{Aeq},1h
Individual noise events several times an hour	Night	2300-0700	>82dB L_{Amax} (S time weighting)	>82dB L_{Amax} (S time weighting)

3.2 The Camden thresholds relate to external noise levels. In relation to internal design standards for new dwellings, BS 8233:2014 is the relevant standard. This recently replaced (28th February 2014) BS 8233:1999. Table 4 of the standard contains the following design targets for residential dwellings, which are adopted in the assessment that follows:

Table 4 **Indoor ambient noise levels for dwellings**

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

3.3 There is no longer a L_{AMAX} standard for bedrooms In BS 8233. However, footnote 4 to Table 4 states that *"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."* In this case, it is proposed that the previous BS 8233 internal standard (also referenced in World Health Organisation Guidelines for Community Noise) is applied. This is 45 dB L_{AMAX}, inside bedrooms.

3.4 For outdoor areas (i.e. gardens/balconies), BS 8233:2014 recommends that "it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$." However, the document recognises that that these guideline values are not achievable in all circumstances and in higher noise areas, a compromise might be warranted. In such circumstances, development should be designed to achieve the lowest practicable levels in these external amenity spaces.

Vibration

3.5 Camden Policy DP28 contains the following advice on vibration levels:

Table C: Vibration levels on residential sites adjoining railways and roads at which planning permission will not be granted

Vibration description and location of measurement	Period	Time	Vibration levels
Vibration inside critical areas such as a hospital operating theatre	Day, evening and night	0000-2400	0.1 VDV ms-1.75
Vibration inside dwellings	Day and evening	0700-2300	0.2 to 0.4 VDV ms-1.75
Vibration inside dwellings	Night	2300-0700	0,13 VDV ms-1.75
Vibration inside offices	Day, evening and night	0000-2400	0.4 VDV ms-1.75
Vibration inside workshops	Day, evening and night	0000-2400	0.8 VDV ms-1.75
Where dwellings may be affected by ground-borne regenerated noise internally from, for example, railways or underground trains within tunnels, noise levels within the rooms should not be greater than 35dB(A)max			

3.6 This advice is the same as a previous version of BS6472, which was updated in 2008. BS 6472:2008 (Part 1) provides guidance on the vibration in buildings with respect to human annoyance or complaints about interference with activities. The vibration levels are expressed as vibration dose value (VDV), which relates to the level of vibration of an event and the number of occurrences of events in a period of time. For residential buildings BS 6472:2008 (Part 1) states the following VDV which might result in various degrees of adverse comment:

Vibration Dose Value ranges which might result in various probabilities of adverse comment within residential buildings.			
Place and time	Low Probability of Adverse Comment ($m.s^{-1.75}$)[1]	Adverse Comment Possible ($m.s^{-1.75}$)	Adverse Comment Probable ($m.s^{-1.75}$)[2]
Residential buildings 16 hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

[1] Below these ranges adverse comment is not expected

[2] Above these ranges adverse comment is very likely

4.0 Noise Surveys

4.1 An environmental noise survey was carried out from 10th to 11th December 2014 to determine the existing noise and vibration levels from the railway. This survey included long-term measurements over a 24-hour period. Further short-term measurements were undertaken during the day on 16th December 2014 in proximity to Gloucester Avenue, to establish prevailing road traffic noise conditions.

4.2 The long-term measurements were undertaken continuously at a location within the development site, to the north-east of the existing warehouse/factory building, on the façade facing the railway. The measurements represent the location of the nearest proposed façade to the rail lines. Vibration measurements were taken on the floor slab of the factory building to represent vibration levels at ground/basement floor level.

4.3 All noise measurements were facade measurements. The measurement locations are shown in Appendix A, and the full survey results and summaries are shown in Appendix B.

4.4 All measurements were made in 15 minute periods.

4.5 Measurements were made using calibrated type 1 sound level meters and data logging systems.

4.6 The meters were field checked for calibration before and after the measurements. No drift was noted.

4.7 The weather was dry and calm with no significant wind.

Railway Noise

4.8 The results of the survey of railway noise can be summarised as follows. These levels represent the "design levels" used to determine the requirements of the façade sound insulation set out later in the report.

Period	Sound level (dB)		
	L_{Aeq}	L_{AMAX}	L_{A90}
Daytime (0700-1900)	67 dB	n/a	47 dB
Evening (1900-2300)	68 dB	n/a	44 dB
Night (2300-0700)	63 dB	87 dB*	40 dB

*90th percentile level for design purposes

Road Traffic Noise

4.9 Noise surveys were undertaken at the site on 16th December 2014. A measurement location was selected at the site, at the façade of the buildings fronting Gloucester Avenue, some 3 metres from the edge of the road. The levels recorded are "facade" levels.

4.10 Road traffic noise measurements were undertaken in 3 consecutive hours, in accordance with the methodology for calculation of road traffic noise set out below. During these measurements, the sound level meter was paused when trains passed, so as to obtain measurements of road traffic noise only.

4.11 The Department of Transport document "Calculation of Road Traffic Noise" (CRTN) defines a shortened noise measurement procedure which uses three consecutive hourly measurements made during 1000-1700 hours to establish a value for $L_{Aeq,16hr}$ for use in assessing the site.

4.12 The CRTN methodology is to calculate the arithmetic average of the three hourly values and then calculate the $L_{A10,18hr}$ as follows:

$L_{A10,18hr}$ = $L_{A10,3hr}$ average -1 dB

The $L_{A10,18hr}$ is then converted to $L_{Aeq,16hr}$ by the relationship: $L_{Aeq,16hr}$ = $L_{A10,18hr}$ -2 dB.

4.13 The hourly noise measurements and calculation are shown below:

Period	L_{A10}, dB
First Hour	60
Second Hour	62
Third Hour	60
Arithmetic Average	61
So, $L_{A10,18hr}$ =	60
Therefore, $L_{Aeq,16hr}$ =	58

4.14 As evidenced by the measurements above, Gloucester Avenue is not a particularly busy or noisy road. L_{AMAX} levels from passing traffic were typically 75 dB L_{AMAX} and this is taken to be an appropriate design level for the Gloucester Avenue facades.

5.0 Sound Insulation Requirements of the Building Envelope

5.1 In the case of both road traffic on Gloucester Avenue and rail noise on the railway side of the site, the noise levels are such that Camden Policy would require attenuation, but are not at levels where permission will not be granted on account of noise.

5.2 The acoustic performance of the building elements will be expressed in terms of Sound Reduction Index (R) in octave bands. Example glass configurations are given in the format glass-cavity-glass, in millimetres. It is assumed that the minimum cavity depth would be 20mm, for thermal reasons.

5.3 For the facades facing the railway, the following specifications are recommended:

Window System Performance – R(dB) – Railway Facades

	Octave band centre frequency Hz						
	63	125	250	500	1k	2k	4k
Living Rooms	20	23	28	37	37	34	39
Bedrooms	25	28	32	43	46	48	55

5.4 The specification for living rooms above is based on the performance of 8-12-10 sealed unit double-glazed system. Bedrooms require a heavier sealed unit system (e.g. 10-12-17(laminated)), or the same double-glazed system as living rooms, with an additional secondary internal pane, separated by a 100mm cavity. For information purposes, the overall weighted sound reduction index of the example system for living rooms is 36 dB R_w and for bedrooms is 45 dB R_w, but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

5.5 For facades facing Gloucester Avenue, the following specifications are recommended:

Window System Performance – R(dB) – Gloucester Avenue facades

	Octave band centre frequency Hz						
	63	125	250	500	1k	2k	4k
Living Rooms	19	24	22	29	39	33	38
Bedrooms	20	23	28	37	37	34	39

5.6 The specification for living rooms above is based on the performance of 6-12-6 sealed unit double-glazed system. Bedrooms require a slightly better performance an 8-12-10 system, for example. For information purposes, the overall weighted sound reduction index of the example system for living rooms is 32 dB R_w and for bedrooms is 36 dB R_w, but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

5.7 For all other facades (i.e. those facing in to the development) a thermal double-glazing system will provide adequate protection, provided the following performance is achieved:

Window System Performance – R(dB)- Internal facades

	Octave band centre frequency Hz						
	63	125	250	500	1k	2k	4k
All Windows	19	24	22	29	39	33	38

5.8 The specification above is based on the performance of 6-12-6 sealed unit double-glazed system. For information purposes, the overall weighted sound reduction index of the example system is 32 dB $R_{w,}$ but it is important that the spectrum performance set out above is achieved, not just the overall sound weighted sound reduction index.

5.9 The internal noise environment for future residents would be acceptable, and within BS 8233:2014 standards, by the provision of double-glazing systems meeting the above specifications.

Ventilation

5.10 Background ventilation, in accordance with Building Regulations, would need to be provided to residential units. Ventilation can be achieved by way of a number of widely available acoustic vent systems, either in the window frames or through the walls. The acoustic performance of the vents should be so as not to degrade the sound insulation performance of the façade as a whole. Alternatively, a whole-building ducted passive or active ventilation system can be installed, with acoustically treated intakes and outlets where necessary. Calculations of overall façade performance including cladding, windows and ventilation openings would need to be undertaken to confirm adequate sound insulation on an ongoing basis.

5.11 The final specification and design of any glazing and ventilation systems will be determined at construction stage, and this can be required through the imposition of an appropriate planning condition.

6.0 Vibration Survey Results and Assessment

6.1 Vibration levels were measured during the noise surveys from 10th to 11th December 2014 at a location on the floor slab of the existing warehouse/factory building nearest to the railway lines. A Vibrock 901 vibration meter, connected to a tri-axial accelerometer was used, placed on the concrete floor and weighted.

6.2 Vibration levels (VDV) at the measurement location were, in the worst-case axis, measured as VDV_{16hour} (Day) = 0.077 $m/s^{1.75}$ and VDV_{8hour} (Night) = 0.038 $m/s^{1.75}$. The daytime and night time thresholds for a low probability of adverse comment contained in BS 6472 Part 1: 2008 are 0.1 to 0.2 $m/s^{1.75}$ and 0.2 to 0.4 $m/s^{1.75}$ for night time and daytime respectively. Measured levels are well below that level.

6.3 Adverse comment from vibration would, therefore, not be expected (BS 6472:2008) and the levels set out in Camden Policy DP28 would not be reached.

7.0 Noise generated by the development

7.1 Residential developments are not inherently noisy. Noise from the commercial elements will be contained within the buildings and sound transfer from commercial elements to residential units above will be controlled through the design and construction of the development. Sound insulation requirements and detailing can be required through the imposition of an appropriate planning condition.

7.2 Plant and machinery noise emissions (for example from lift machinery, water heating systems and mechanical ventilation systems) will need to be controlled, but this is not unusual, and simple measures can be incorporated into the construction design. The majority of plant serving the development will be located in a dedicated basement plant room.

7.3 It would be normal to impose a planning condition limiting plant noise emissions to a level relative to the background noise level at the nearest sensitive receptors. It is understood that the Local Authority have a standard requirement that plant noise be controlled to 5dB below the background level at the nearest premises. The following condition would be appropriate:

> *"The level of noise from all fixed plant and machinery installed at the site shall be 5 dB below the pre-existing background noise level at any time when measured or calculated at 1 metre from the facade of the nearest existing noise sensitive properties.*

8.0 Conclusions

8.1 Noise and vibration survey data obtained in December 2014 has been used to assess the noise and vibration climate impingent on the proposed future development at 44 Gloucester Avenue. The site is the subject of a proposal for residential-led mixed development.

8.2 External and internal noise level criteria have been proposed in line with the standards set out in the Camden Development Management Plan (DP28), BS 8233:2014 and the World Health Organisation guidelines. Vibration criteria have been proposed in accordance with BS 6472:2008 and Camden Policy DP28.

8.3 The noise surveys have shown that levels are such that the Camden guidance would require attenuation to be included in the development to control noise. Calculations of façade glazing systems required to achieve the internal noise criteria set out have been undertaken. A general specification for acoustic glazing systems is provided.

8.4 Ventilation to residential apartments, where it would be expected that windows remain closed to control noise, will need to be provided via acoustically treated vents in the window frame or walls, or via an alternative whole-building system.

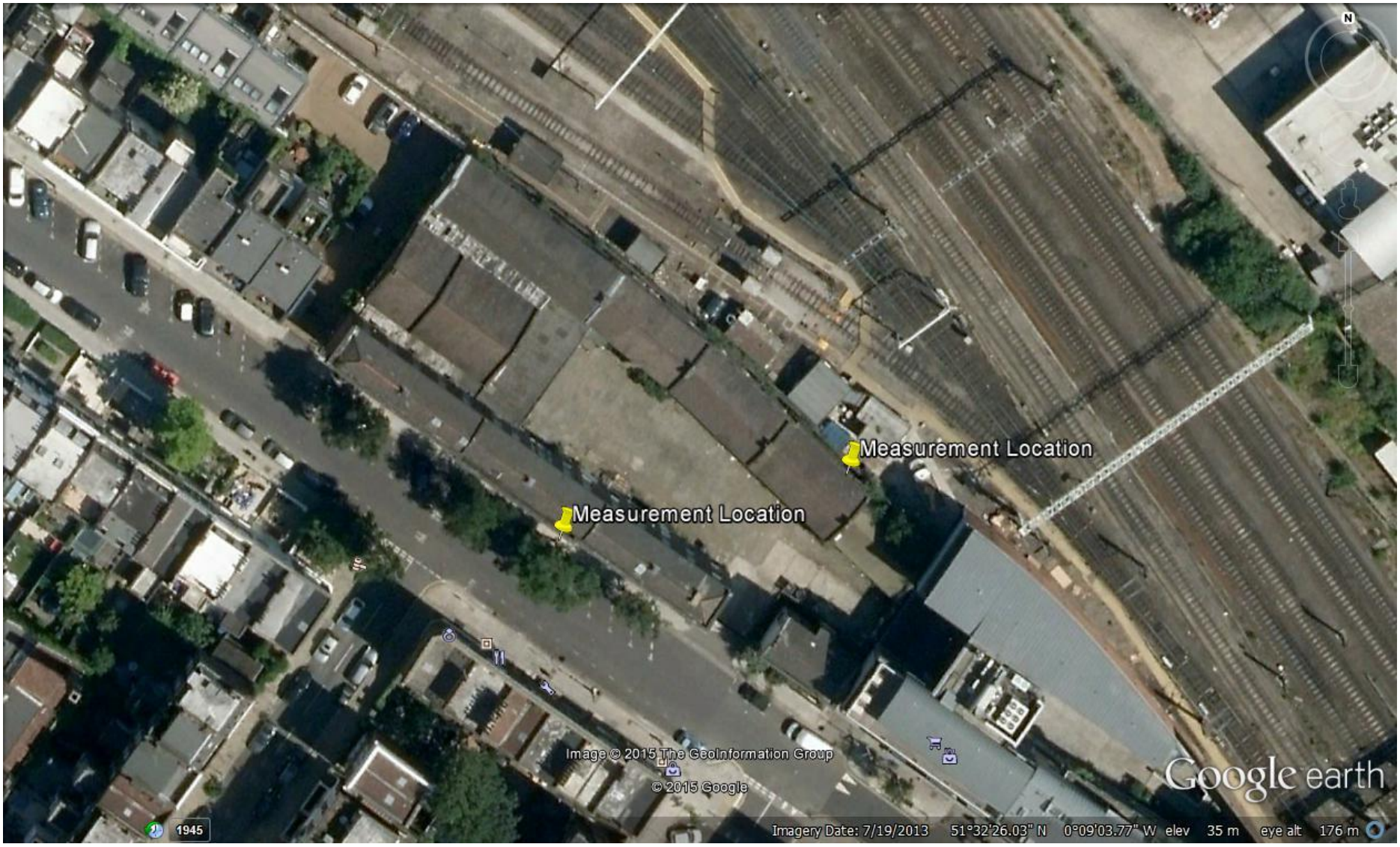
8.5 Adverse comment from vibration would not be expected from future residents given the low levels measured at the site and the Camden Policy DP28 levels would not be reached.

8.6 Noise from the commercial elements, along with plant and machinery noise emissions, can be controlled by way of planning condition where appropriate.

8.7 The development can, therefore, be designed to achieve acceptable standards for future and existing residents, in accordance with national standards and Local Policy DP28.

APPENDIX A

SITE PLAN AND MEASUREMENT LOCATIONS


Measurement Location
Measurement Location
Image © 2015 The GeoInformation Group
© 2015 Google
Google earth
1945
Imagery Date: 7/19/2013 51°32'26.03" N 0°09'03.77" W elev 35 m eye alt 176 m

APPENDIX B

NOISE SURVEY RESULTS

Railway Noise Measurements

Day

Date	LAeq	LAF(max)	LAF(min)	LAF,10	LAF,90
(2014/12/10 15:00:01.00)	62.1	79.6	49.8	64.2	51.5
(2014/12/10 15:15:01.00)	63.2	85.1	46.0	65.2	48.0
(2014/12/10 15:30:01.00)	65.6	92.5	46.2	63.7	47.5
(2014/12/10 15:45:01.00)	67.2	87.2	42.6	65.5	45.6
(2014/12/10 16:00:01.00)	72.4	92.1	43.1	73.4	44.5
(2014/12/10 16:15:01.00)	68.5	88.8	42.6	69.0	44.9
(2014/12/10 16:30:02.00)	61.0	83.9	45.3	64.2	46.7
(2014/12/10 16:45:01.00)	62.5	83.9	44.6	64.4	45.9
(2014/12/10 17:00:01.00)	67.8	88.1	44.6	71.0	45.8
(2014/12/10 17:15:01.00)	60.7	77.9	44.6	62.8	46.1
(2014/12/10 17:30:01.00)	63.0	82.0	44.4	67.0	45.9
(2014/12/10 17:45:01.00)	60.3	78.9	42.0	63.2	44.0
(2014/12/10 18:00:01.00)	68.3	86.0	43.2	72.7	45.2
(2014/12/10 18:15:01.00)	68.2	95.6	42.5	69.6	44.6
(2014/12/10 18:30:01.00)	71.3	87.3	42.3	75.3	44.3
(2014/12/10 18:45:02.00)	71.4	92.2	42.0	71.3	43.6
(2014/12/11 07:00:01.00)	65.0	81.8	41.9	68.6	43.3
(2014/12/11 07:15:01.00)	68.8	88.6	42.4	71.2	44.0
(2014/12/11 07:30:01.00)	65.0	83.8	42.7	70.3	44.7
(2014/12/11 07:45:01.00)	67.5	88.4	43.3	71.0	45.5
(2014/12/11 08:00:01.00)	65.5	84.7	43.9	68.8	45.7
(2014/12/11 08:15:02.00)	67.2	85.5	43.2	72.3	45.4
(2014/12/11 08:30:01.00)	67.3	89.5	44.0	71.5	45.8
(2014/12/11 08:45:01.00)	66.5	88.1	43.9	70.5	46.4
(2014/12/11 09:00:01.00)	68.3	85.3	44.0	71.9	46.3
(2014/12/11 09:15:01.00)	65.1	83.8	45.2	69.7	47.9
(2014/12/11 09:30:01.00)	69.1	88.4	46.3	73.2	49.8
(2014/12/11 09:45:01.00)	68.3	85.3	45.5	72.4	48.3
(2014/12/11 10:00:01.00)	71.2	102.6	47.5	65.7	50.9
(2014/12/11 10:15:01.00)	58.6	72.1	48.4	62.3	51.2
(2014/12/11 10:30:01.00)	59.1	75.2	48.3	63.8	50.4
(2014/12/11 10:45:01.00)	59.2	76.2	48.2	63.2	50.9
(2014/12/11 11:00:01.00)	61.2	81.6	49.0	64.8	51.5
(2014/12/11 11:15:01.00)	56.7	69.1	48.8	58.6	52.0
(2014/12/11 11:30:01.00)	61.0	82.0	48.1	64.2	50.5
(2014/12/11 11:45:01.00)	56.9	67.9	48.0	60.4	50.3
	66.8				47.1

Railway Noise Measurements
Evening

Date	LAeq	LAF(max)	LAF(min)	LAF,10	LAF,90
(2014/12/10 19:00:01.00)	67.3	90.0	42.4	68.9	44.4
(2014/12/10 19:15:01.00)	70.1	90.4	43.6	75.0	45.6
(2014/12/10 19:30:01.00)	65.9	83.5	42.1	69.0	44.0
(2014/12/10 19:45:01.00)	66.0	86.2	41.6	69.6	43.2
(2014/12/10 20:00:01.00)	69.2	90.1	41.6	72.7	43.7
(2014/12/10 20:15:01.00)	67.8	85.9	40.4	68.2	42.9
(2014/12/10 20:30:01.00)	65.0	87.3	41.0	61.9	43.5
(2014/12/10 20:45:02.00)	63.7	83.1	39.8	60.3	42.5
(2014/12/10 21:00:01.00)	68.1	86.8	40.6	70.9	43.4
(2014/12/10 21:15:01.00)	66.7	89.4	40.4	70.3	42.2
(2014/12/10 21:30:01.00)	65.5	81.5	43.3	65.6	55.0
(2014/12/10 21:45:01.00)	68.7	91.8	42.0	63.3	43.8
(2014/12/10 22:00:01.00)	70.7	91.0	39.9	65.3	41.7
(2014/12/10 22:15:01.00)	59.5	77.9	40.0	57.2	41.9
(2014/12/10 22:30:02.00)	71.5	94.0	39.9	49.4	41.4
(2014/12/10 22:45:01.00)	70.8	90.8	40.0	63.1	41.7
	68.1				43.8

Railway Noise Measurements
Night

Date	LAeq	LAF(max)	LAF(min)	LAF,10	LAF,90
(2014/12/10 23:00:01.00)	70.4	92.9	39.5	59.8	41.1
(2014/12/10 23:15:01.00)	66.9	87.0	39.3	59.0	40.8
(2014/12/10 23:30:01.00)	63.5	87.5	39.5	50.7	41.1
(2014/12/10 23:45:01.00)	65.8	84.9	39.6	66.3	41.1
(2014/12/11 00:00:02.00)	64.8	87.8	38.7	54.4	40.1
(2014/12/11 00:15:01.00)	70.1	94.3	38.0	59.3	41.2
(2014/12/11 00:30:01.00)	60.1	84.8	37.6	45.6	39.5
(2014/12/11 00:45:01.00)	61.7	83.2	38.6	56.8	40.3
(2014/12/11 01:00:01.00)	60.0	83.0	37.6	45.3	39.2
(2014/12/11 01:15:01.00)	52.2	73.6	38.0	45.0	39.1
(2014/12/11 01:30:01.00)	67.3	92.3	38.3	47.1	39.7
(2014/12/11 01:45:01.00)	58.9	80.6	37.9	53.3	39.2
(2014/12/11 02:00:01.00)	45.8	64.6	37.3	47.3	39.1
(2014/12/11 02:15:01.00)	51.9	71.5	37.7	47.8	38.9
(2014/12/11 02:30:01.00)	43.1	65.3	36.9	43.0	38.6
(2014/12/11 02:45:01.00)	46.3	63.7	37.0	49.9	38.7
(2014/12/11 03:00:01.00)	45.4	69.6	37.1	48.1	38.7
(2014/12/11 03:15:01.00)	56.5	79.0	37.3	48.1	39.0
(2014/12/11 03:30:01.00)	44.3	64.9	36.8	44.7	38.3
(2014/12/11 03:45:01.00)	58.3	77.5	37.8	48.6	39.7
(2014/12/11 04:00:01.00)	57.1	76.3	37.3	52.3	38.8
(2014/12/11 04:15:02.00)	49.5	73.7	37.2	44.2	38.5
(2014/12/11 04:30:01.00)	41.7	56.6	37.1	44.3	38.9
(2014/12/11 04:45:01.00)	40.3	51.3	37.4	41.7	38.6
(2014/12/11 05:00:01.00)	66.1	87.5	37.9	59.3	39.6
(2014/12/11 05:15:01.00)	58.5	82.5	37.9	49.5	39.8
(2014/12/11 05:30:01.00)	59.8	76.4	40.3	57.8	42.3
(2014/12/11 05:45:01.00)	59.7	76.8	39.2	54.6	40.6
(2014/12/11 06:00:01.00)	58.9	82.3	39.4	55.5	41.4
(2014/12/11 06:15:01.00)	64.7	86.6	40.9	56.6	42.8
(2014/12/11 06:30:01.00)	64.9	82.0	40.9	67.2	43.0
(2014/12/11 06:45:01.00)	64.7	83.2	41.6	68.3	43.3
	63				40.0

APPENDIX C

ACOUSTIC TERMINOLOGY

Acoustic Terminology

1. *Noise, defined as unwanted sound, is measured in units of decibels, dB. The range of audible sound is from 0 dB to 140 dB. Two equal sources of sound, if added together will result in an increase of 3 dB, i.e. 50 dB + 50 dB = 53 dB. A 10 dB increase in sound is perceived as a doubling of loudness.*

2. *Frequency (or pitch) of sound is measured in units of Hertz. 1 Hertz = 1 cycle/second. The range of frequencies audible to the human ear is around 20Hz to 1800Hz (or 18kHz). The capability of a person to hear higher frequencies will reduce with age. The ear is more sensitive to medium frequency than high or low frequencies.*

3. *To take account of the varying sensitivity of people to different frequencies a weighting scale has been universally adopted called "A-weighting". The measuring equipment has the ability to automatically weight (or filter) a sound to this A scale so that the sound level it measures best correlates to the subjective response of a person. The unit of measurement thus becomes dBA (decibel, A-weighted).*

4. *The second important characteristic of sound is amplitude or level. Two units are used to express level a) sound power level – L_W and b) sound pressure level – L_P. Sound power level is an inherent property of a source whilst sound pressure level is dependent on surroundings/distance/directivity etc. The sound level that is measured on a meter is the sound pressure level, L_P.*

5. *External sound levels are rarely steady but rise or fall in response to the activity in the area – cars, voices, planes, birdsong, etc. A person's subjective response to different noises has been found to vary dependent on its temporal distribution (i.e. its variation with time). For this reason a set of statistical indices have been developed.*

6. There are four main statistical indices in use in the UK:

L_{A90}: *the sound level (in dBA) exceeded for 90% of the time. This unit gives an indication of the sound level during the quieter periods of time in any given sample. It is used to describe the "background noise level" of an area.*

L_{AeqT}: *The equivalent continuous sound level over a period of time, T. this unit may be described as "the notional steady noise level that would provide, over a period, the same energy as the varying noise in questions". In other words, the energy average level. This unit is now used to measure a wide variety of different types of noise of an industrial or commercial nature, as well as road traffic, aircraft and trains.*

L_{A10}: *The sound level (in dBA) exceeded for 10% of the time. This level gives an indication of the sound level during the noisier periods of time in any given sample. It has been used over many years to measure and assess road traffic noise.*

L_{AMAX}: *The maximum level of sound, i.e. the peak level of sound measured in any given period. This unit is used to measure and assess transient noises, i.e. gun shots, individual vehicles etc.*