Appendix 4
ASHP Noise Assessment

3 ASHP enclosures are proposed to the roof of 80-90 South Hill Park. The current proposal consists of 2 ASHP units per enclosure resulting in a total of 6 ASHPs across the terrace.

However, this report was prepared to consider a worst case scenario of 3 ASHPs per enclosure, resulting in a total of 9 ASHPs. The noise assessment results were considered acceptable and show that the predicted noise levels are within Camden Council's noise criteria of 10dB below night-time background noise.

As such, we anticipate that the updated configuration will result in the improvement of the overall acoustic impact of the proposal.

AŁN
acoustic design

80-90 South Hill Park

Plant Noise Assessment

Report Reference: J626_R02

22nd February 2024

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Revision	Date	Description	Author
-	22/02/2024	1st Issue	Arthur Lewis-Nunes

CONTENTS

1 INTRODUCTION

ALN Acoustic Design has been appointed to carry out a noise assessment in relation to the proposed installation of external plant equipment at 80-90 South Hill Park in the London Borough of Camden.

The building is a three-storey terrace of six house. It is proposed to install nine air-source heat pumps (ASHPs) on the roof to provide heating to the residential units as part of a wider refurbishment of the block. There are houses to either side of the terrace, and also on the opposite side of South Hill Park. Hampstead Heath lies to the rear. This report assesses the likely impact of noise generated by the proposed ASHPs on the nearby receptors. A plan of the proposed roof layout and surrounding area is provided in Figure 1.

This report has been prepared by Arthur Lewis-Nunes MSc who is a corporate member of the Institute of Acoustics.

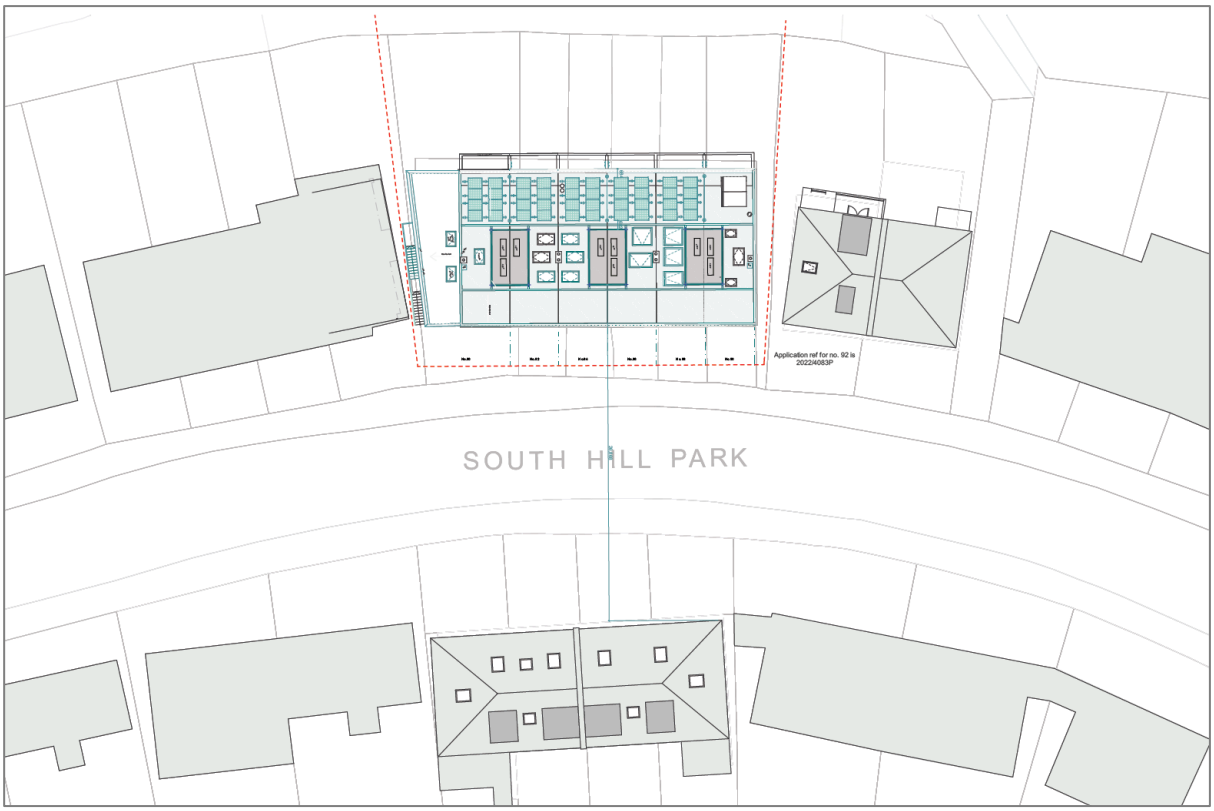

Figure 1: Proposed roof and surrounding area

2 ASSESSMENT CRITERIA

2.1 Local Authority Planning Requirements

The site is located within the London Borough of Camden. The Camden Council Local Plan (2017) sets out the criteria for noise and vibration used to determine applications for planning permission.

Policy A4: Noise and Vibration is reproduced below:

> The Council will seek to ensure that noise and vibration is controlled and managed.
>
> Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:
>
> a. development likely to generate unacceptable noise and vibration impacts; or
> b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.
>
> We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.

Appendix 3 of the Local Plan sets out the thresholds that will be considered by the council when assessing applications. The relevant section which is applicable to the assessment of plant and machinery noise at dwellings is reproduced below:

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

The thresholds evaluate impact in terms of various 'effect levels' as described in the National Planning Policy Framework and Planning Practice Guidance. There are corresponding design criteria which guide applicants as to the degree of detailed consideration needed to be given to noise in any planning application. The thresholds and design criteria are as set out below:

- Green – where noise is considered to be at an acceptable level.
- Amber – where noise is observed to have an adverse effect level, but which may be considered acceptable when assessed in the context of other merits of the development.
- Red – where noise is observed to have a significant adverse effect.

Appendix 3 of the Local Plan indicates that it is expected that the BS4142:2014 assessment methodology will be used.

2.2 BS4142:2014

British Standard BS4142:2014 '*Methods for rating and assessing industrial and commercial sound*' provides a well-established methodology for the assessment of the impact of noise from fixed mechanical and electrical plant and equipment.

The degree of adverse impact for a particular noise source is dependent upon factors including the extent by which it exceeds the background noise level, the character of the noise and its time of occurrence.

A ‘Rating Level’ for the specific source is established, which has been corrected to account for the characteristics of the sound, including having noticeable tonality, being intermittent / impulsive, or having any other distinct characteristics which would make it more noticeable.

Levels of impact are defined in terms of the Rating Level relative to the background noise level, as set out in Table 1 below.

Rating Level relative to background level	Assessment
0dB or less than background	‘An indication of the specific sound source having a low impact, depending on context’
5dB or more than background	‘Likely to be in indication of an adverse impact, depending on context’
10dB or more than background	‘Likely to be in indication of a significant adverse impact, depending on context’

Table 1: BS4142 defined levels of impact

3 NOISE SURVEY

3.1 Methodology

A survey of background noise levels was carried out over a three-day period from Monday 30th October to Thursday 2nd November 2023.

A weather-protected Class 1 sound level meter and tripod-mounted microphone were installed near the centre of the roof as indicated in Figure 2 (further details of the instrumentation used are provided in Appendix B). The microphone was mounted on a tripod at a height of 1.6m above the roof level. The sound level meter was set up to record noise levels over consecutive 15-minute intervals throughout the survey period.

Local weather station data indicates that wind speeds were generally low during the first two days of the survey period with occasional periods of light rain. High winds and heavy rain occurred on the third day of the survey period which may have affected the measured levels, therefore data after the second day has been excluded from the analysis.

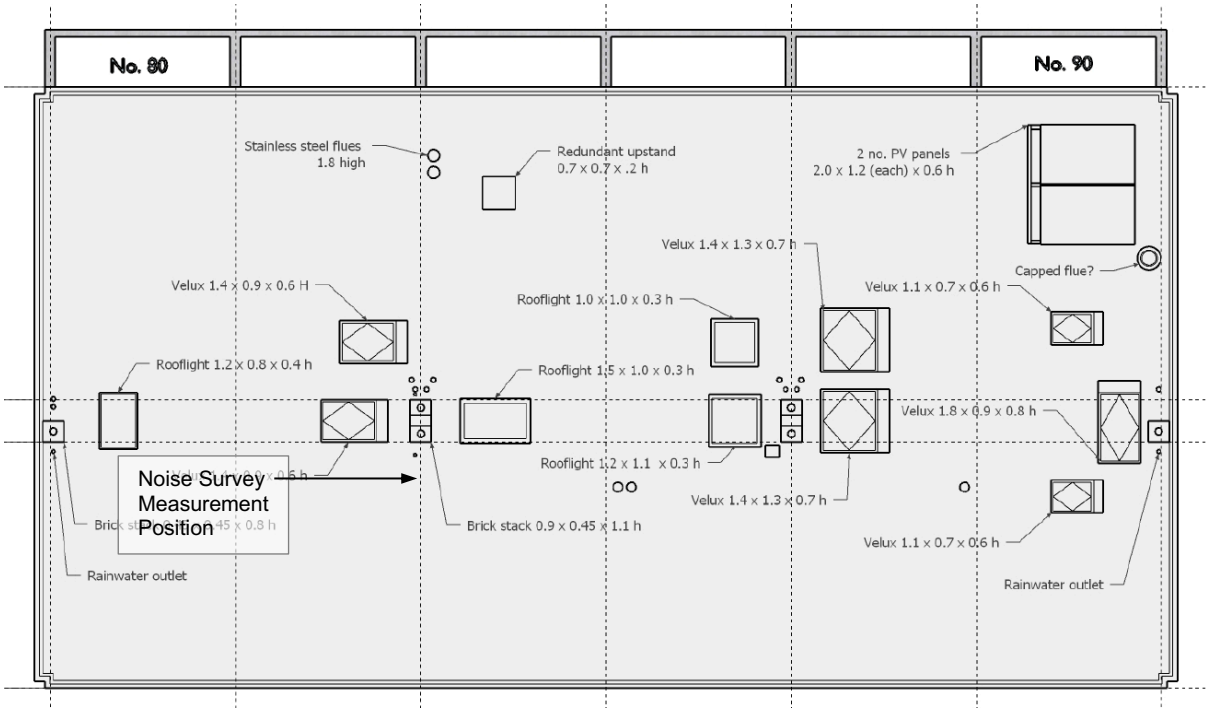

Figure 2: Noise survey measurement position

3.2 Survey Results

The time history plot of the noise survey data ($L_{Aeq,15min}$ and $L_{AF90,15min}$) is presented below in Figure 3. The representative background noise level at night is considered to be 38dB $L_{AF90,15min}$.

The noise levels at the measurement position were observed to comprise mainly distant road traffic and are considered to be representative of those occurring at the various properties which surround the site.

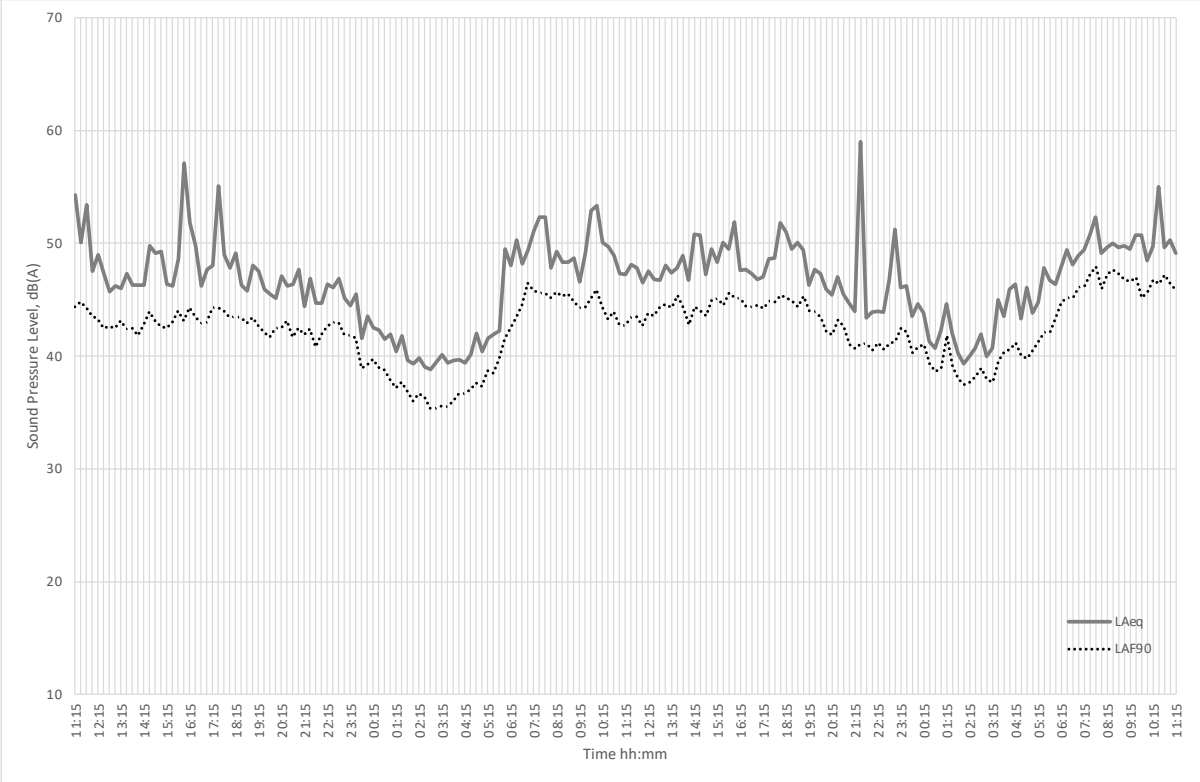

Figure 3: Noise survey time history

4 PLANT NOISE ASSESSMENT

4.1 Plant Equipment

A total of nine ASHPs are to be installed on the roof in three clusters of three units (see proposed roof plan in Figure 4). The units will be mounted on a steel structure which is decoupled from the main roof structure.

The project M&E consultant has provided details of five ASHP models which may be specified for the project (subject to availability, lead times and cost at the time of order). Calculations assume that each of the nine units will be the worst-case option in terms of noise, which is the Mitsubishi PUZ-HJWM140VHA which emits a sound pressure level at 1m of 53dB(A) according to the manufacturer data.

Each cluster of ASHPs is to be enclosed by acoustic screens with a height of 1,550mm.

It is assumed that the ASHP may be running during the daytime or night-time, subject to heating demand.

Figure 4: Proposed plant arrangement

4.2 Plant Noise Calculations

The noise level has been calculated based on the noise emission data for the proposed ASHP units. Appropriate corrections to account for source directivity, distance attenuation and the attenuation provided by the acoustic screens have been included where applicable. The

individual noise contributions from each ASHP have been combined logarithmically to calculate an overall noise level (i.e. the calculation assumes simultaneous operation of all units as a worst case).

The resultant noise level due to the operation of the ASHP units has been calculated at 92 South Hill Park, 78 South Hill Park and 14 South Hill Park.

There are no windows on the side elevations of the adjacent residential buildings at 92 South Hill Park and 78 South Hill Park. The ASHPs are to be located such that there is no direct line of sight from the front and rear windows of these properties.

It is understood that it is intended to carry out works at 92 South Hill Park which will include the addition of windows on the south elevation, however as these windows will be in a stairwell the noise criteria set out in Section 2.1 is not applicable.

The noise attenuation provided by the acoustic screens has been calculated at each receptor using the Maekawa formula. There will also be attenuation at the windows of 92 and 78 South Hill Park which do not have a line of sight to the ASHPs by virtue of their orientation.

The calculated noise levels are set out in Table 2. The detailed calculations are set out in Appendix C.

Receptor	**Plant Noise Level**
92 South Hill Park	27dB(A)
78 South Hill Park	24dB(A)
14 South Hill Park	28dB(A)

Table 2: Calculated plant noise levels

4.3 Assessment

The representative background noise level is 38dB $L_{AF90,15min}$ (see Section 3). The plant noise level at all residential receptors is calculated to be 28dB(A) or lower, i.e. 10dB below the background noise level. This therefore meets the Local Authority noise criteria. The Camden Locla Plan indicates that this is considered to be an acceptable level.

BS4142:2014 states the following:

"*The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context*."

This provides a clear indication that noise from the proposed plant equipment will have minimal impact on the residential receptors.

4.4 Noise to Dwellings within Terrace

As part of the refurbishment of the terrace, the existing roof build-up is to be acoustically enhanced by adding layers of mineral wool insulation and high-density cement particle board to minimise airborne noise transmission to the dwellings below. The ASHPs are to be mounted on a new metal frame which will be supported via anti-vibration isolators on the tops of the masonry walls and will be decoupled from the main roof structure. This will avoid transmission of any vibration or structure-borne noise generated by the ASHPs to the dwellings below.

It is expected that these measures will prevent any disturbance within the dwellings within the terrace from noise or vibration generated by the proposed ASHP units.

5 SUMMARY

The operational noise level from nine proposed air-source heat pumps has been calculated based on data provided by the manufacturers of the proposed units. Corrections to account for source directivity, distance attenuation and attenuation provided by the proposed acoustic enclosures have been applied.

Noise levels of up to 28dB(A) are calculated at bedroom windows of the neighbouring properties.

The noise impact has been assessed by comparing the calculated plant noise level to the typical background noise level as established by an unattended environmental noise survey. The noise survey results indicate that the representative background noise level at night is 38dB L_{AF90}, therefore the plant noise level is expected to be at least 10dB less than the background noise level.

This indicates that noise emitted by the proposed plant equipment will meet local authority planning requirements and will not have any significant adverse impact on the neighbouring residential properties.

APPENDIX A - GLOSSARY OF ACOUSTIC TERMINOLOGY

SOUND PRESSURE LEVEL, SPL or L_P

A measure of the pressure caused by a sound wave at a point in space, given by:

$SPL(dB)=20.\log_{10}(\text{Sound Pressure (Pa)}/P_0)$

P_0 is the reference sound pressure of 20μPa, which corresponds to the approximate threshold of hearing at 1kHz.

SOUND POWER LEVEL, SWL or L_W

A measure of is the total sound energy radiated by a source in all directions, given by

$SWL(dB)=10.\log(\text{Sound Power(W)}/W_0)$

W_0 is the reference sound power of 1pW.

EQUIVALENT CONTINUOUS A-WEIGHTED, $L_{Aeq,T}$

The level of a notional continuous sound that contains the same sound energy as the actual fluctuating sound over the time period, T. Weighted over frequencies to approximate the sensitivity curve of human hearing (A-weighted).

BACKGROUND NOISE LEVEL, $L_{AF90,T}$

The A-weighted sound pressure level of a fluctuating sound that is exceed for 90% of the time interval, T.

A-WEIGHTED MAXIMUM NOISE LEVEL, L_{AFmax}

The maximum A-weighted sound pressure level in a given period, measured using the “fast” time constant.

SOUND REDUCTION INDEX, R

The quantity which describes the level by which a material or building element reduces noise transmission at a given frequency, derived from laboratory measurement.

WEIGHTED SOUND REDUCTION INDEX, R_W

Single Integer number found by comparing the measured Sound Reduction Index spectrum with the 'standard' curves for airborne sound insulation, according to a weighting method described in BS EN ISO 717-1.

ELEMENT NORMALIZED LEVEL DIFFERENCE, $D_{n'e'w}$

A measure of the sound reduction of a particular element, with the equivalent area of acoustic absorption in the receiver room normalized to the reference absorption area ($10m^2$).

SPECTRUM ADAPTATION TERMS, C and C_{tr} (dB)

These are the values to be added to D_w, R_w or $D_{n'e'w}$ values to take account of the characteristics of a particular sound spectra. C corresponds to pink noise spectra and C_{tr} corresponds to typical urban traffic noise spectra.

APPENDIX B - NOISE MONITORING EQUIPMENT

The measurements were made with an NTi XL2 acoustic analyser, using a GRAS weather protection kit. This equipment complies with BS EN IEC 61672 class 1. The meter used a NTi MC230 free-field response microphone and NTi MA220 microphone pre-amplifier.

The calibration of the sound level meter was checked at the beginning and end of measurements with a Larson David CAL200 sound calibrator, complying with BS EN IEC 60942 class 1. No significant calibration deviation occurred.

The table below lists the serial numbers and last calibration dates of the equipment used.

Description	Serial No.	Calibration Date
NTi XL2 Sound Level Meter	A2A-16249-E0	08/09/2023
NTi MC230A Condenser Microphone	A17342	08/09/2023
NTi MA220 Pre-Amplifier	8450	08/09/2023
Larson David CAL200 Sound Calibrator	16795	08/09/2023

Figure 5: Noise survey equipment on roof of 80-90 South Hill ark

APPENDIX C - PLANT NOISE CALCULATIONS

92 South Hill Park	Frequency, Hz		63	125	250	500	1000	2000	4000	8000	A
ASHP 1											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-6	-6	-8	-9	-12	-14	-17	
SPL receptor, dB:			27	20	17	15	10	2	-5	-16	16
ASHP 2											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-6	-6	-8	-9	-12	-14	-17	
SPL receptor, dB:			27	20	17	15	10	2	-5	-16	16
ASHP 3											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	27	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-6	-6	-8	-9	-12	-14	-17	
SPL receptor, dB:			27	21	17	16	10	3	-5	-16	16
ASHP 4											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	20	m	-26	-26	-26	-26	-26	-26	-26	-26	
Screening Effects, dB:			-6	-6	-8	-9	-12	-14	-17	-20	
SPL receptor, dB:			29	22	18	17	10	3	-5	-16	17
ASHP 5											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	19	m	-26	-26	-26	-26	-26	-26	-26	-26	
Screening Effects, dB:			-6	-6	-8	-9	-12	-14	-17	-20	
SPL receptor, dB:			30	23	19	17	11	3	-5	-15	18
ASHP 6											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	19	m	-26	-26	-26	-26	-26	-26	-26	-26	
Screening Effects, dB:			-6	-6	-8	-9	-12	-14	-17	-20	
SPL receptor, dB:			30	23	19	17	11	3	-5	-15	18
ASHP 7											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	13	m	-22	-22	-22	-22	-22	-22	-22	-22	
Screening Effects, dB:			-6	-8	-9	-12	-14	-17	-20	-23	
SPL receptor, dB:			32	25	20	18	12	4	-4	-15	19
ASHP 8											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	12	m	-22	-22	-22	-22	-22	-22	-22	-22	
Screening Effects, dB:			-6	-8	-9	-12	-14	-17	-20	-23	
SPL receptor, dB:			33	26	21	19	12	4	-3	-14	19
ASHP 9											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	11	m	-21	-21	-21	-21	-21	-21	-21	-21	
Screening Effects, dB:			-6	-8	-9	-12	-14	-17	-20	-23	
SPL receptor, dB:			34	26	22	20	13	5	-3	-14	20
Total SPL at receptor, dB			40	33	29	27	21	13	5	-6	**27**

78 South Hill Park	Frequency, Hz		63	125	250	500	1000	2000	4000	8000	A
ASHP 1											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	9	m	-19	-19	-19	-19	-19	-19	-19	-19	
Screening Effects, dB:			-8	-10	-12	-15	-18	-21	-24	-27	
SPL receptor, dB:			34	26	20	18	11	3	-5	-16	19
ASHP 2											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	10	m	-20	-20	-20	-20	-20	-20	-20	-20	
Screening Effects, dB:			-8	-10	-12	-15	-18	-21	-24	-27	
SPL receptor, dB:			33	25	20	17	10	2	-6	-17	18
ASHP 3											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	11	m	-21	-21	-21	-21	-21	-21	-21	-21	
Screening Effects, dB:			-8	-10	-12	-15	-18	-21	-24	-27	
SPL receptor, dB:			32	24	19	16	9	1	-7	-18	17
ASHP 4											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	17	m	-25	-25	-25	-25	-25	-25	-25	-25	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			27	19	14	11	4	-4	-12	-23	12
ASHP 5											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	17	m	-25	-25	-25	-25	-25	-25	-25	-25	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			27	19	14	11	4	-4	-12	-23	12
ASHP 6											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	18	m	-25	-25	-25	-25	-25	-25	-25	-25	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			27	19	13	10	4	-4	-12	-23	11
ASHP 7											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	24	m	-28	-28	-28	-28	-28	-28	-28	-28	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			24	16	11	8	1	-7	-15	-26	9
ASHP 8											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	24	m	-28	-28	-28	-28	-28	-28	-28	-28	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			24	16	11	8	1	-7	-15	-26	9
ASHP 9											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	25	m	-28	-28	-28	-28	-28	-28	-28	-28	
Screening Effects, dB:			-9	-11	-14	-16	-19	-22	-25	-28	
SPL receptor, dB:			24	16	10	8	1	-7	-15	-26	9
Total SPL at receptor, dB			39	31	26	23	16	8	0	-11	**24**

14 South Hill Park	Frequency, Hz		**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**A**
ASHP 1											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 2											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 3											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 4											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 5											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 6											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 7											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 8											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
ASHP 9											
SPL 1m, dB			61	55	52	52	48	43	38	30	53
Distance attenuation, dB:	28	m	-29	-29	-29	-29	-29	-29	-29	-29	
Screening Effects, dB:			-5	-5	-5	-6	-6	-7	-9	-11	
SPL receptor, dB:			27	21	18	18	13	7	0	-10	18
Total SPL at receptor, dB			37	31	27	27	22	16	10	0	**28**