SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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The Honourable Society of Lincoln's Inn

Environmental noise survey report

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Version	Date	Comments	Author	Reviewer
A	18 Mar 15		Ben Southgate	Stephen Stringer
B	22 Jul 15	Minor update	Steven Wheeler	Stephen Stringer

Summary

Sandy Brown Associates LLP (SBA) has been commissioned to provide acoustic advice in relation to the proposed development works at The Honourable Society of Lincoln's Inn, London, WC2A 3TL.

An environmental noise survey has been carried out to determine the existing background noise levels in the area to use as a basis for setting appropriate plant noise limits in line with the requirements of the London Borough of Camden (LBC).

The noise survey was performed between 11:00 on 25 February 2015 and 11:00 on 3 March 2015 at three locations around the site.

The representative background noise levels measured during the survey were:

- Gatehouse Court facades: $L_{A90,5min}$ 42/42/41 dB during the day/evening/night
- Old Square facades: $L_{A90,5min}$ 50/49/49 dB during the day/evening/night
- West-facing facades of southern Stone buildings: $L_{A90,5min}$ 46/45/43 dB during the day/evening/night

Based on the requirements of the LBC and on the results of the noise survey, all plant must be designed such that the cumulative noise level at 1 m from the worst affected windows of the nearby noise sensitive premises does not exceed:

- Gatehouse Court facades: $L_{A90,5min}$ 37/37/36 dB during the day/evening/night
- Old Square facades: $L_{A90,5min}$ 45/44/44 dB during the day/evening/night
- West-facing facades of southern Stone buildings: $L_{A90,5min}$ 41/40/38 dB during the day/evening/night

These limits are cumulative and apply with all plant in operation under normal conditions. If plant items contain tonal or attention catching features, a 5 dB penalty will be applied, and the limits will be more stringent than those set.

Contents

1 Introduction

The Honourable Society of Lincoln's Inn (HSLI) seek to refurbish and improve existing kitchen and catering facilities which are currently inadequate for the needs of the Inn. There is also a need to provide expansion space for the existing library alongside new advocacy training and educational facilities to enhance the function of the Inn. In providing these new facilities, the existing Under Treasurer's residence will need be relocated to another part of the Inn.

To achieve the above proposals, planning and listed building consent are sought for five separate applications proposed at Lincoln's Inn:

- Application 1 – Old Hall Kitchen Refurbishment (Submitted to LB Camden Ref 2015/2413/P & 2015/2517/L)
- Application 2 – Great Hall Refurbishment Works (including Old Hall Temporary Kitchen Works)
- Application 3 – East Terrace Development (Excavation to create a two storey basement containing a lecture theatre, advocacy rooms and study areas)
- Application 4 – Library Extension (including demolition of Under Treasurer's House)
- Application 5 – 15 New Square (Change of use from Office B1 to Residential C3)

This report has been prepared as part of application 1, 2, 3 and 4.

Sandy Brown Associates LLP (SBA) has been commissioned to provide acoustic advice in relation to the proposed development works. As part of this, an environmental noise survey is required, the purpose of which is to establish the existing background noise levels in the vicinity of nearby noise sensitive premises in order to set appropriate limits for noise egress from building services plant.

This report presents the survey method, results of the environmental noise survey, and a discussion of acceptable limits for noise emission from building services plant.

2 Site description

2.1 The site and its surroundings

Lincoln's Inn is located in Holborn, in the London Borough of Camden (LBC). Today it stands as one of the four Inns of Court in London.

Lincoln's Inn is a thriving society of lawyers with a very long history situated in a tranquil enclave of around 11 acres. 'Lincoln's Inn' thus refers both to the Society and the place.

As well as housing the Society's own facilities, Lincoln's Inn is the location of many barristers' chambers and some solicitors' offices. It faces the Royal Courts of Justice and the Lincoln's Inn Fields across the road to the west. The Inn is bounded by Chancery Lane to the east and Carey Street to the south. The south-facing rears of buildings along High Holborn overlook Lincoln's Inn.

As well as the general facilities, there are also residences located around the site in the following locations:

- 1-8 Stone buildings
- 8-15 Old square
- Hardwick building
- 16-26 Old buildings
- 3 New square

The site location in relation to its surroundings is shown in Figure 1.

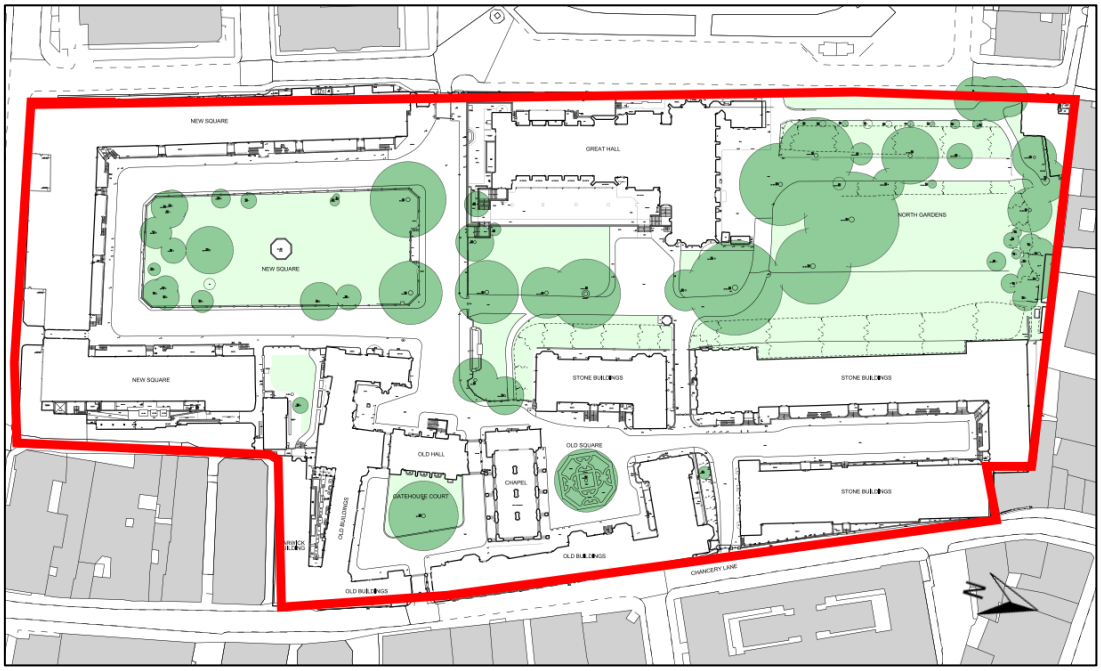


Figure 1 Site plan in relation to its surroundings

3 Method

Unattended noise monitoring was undertaken at three different locations around the site over several days to determine the existing background noise levels in the vicinity of nearby noise sensitive premises.

The unattended measurements were performed over 5 minute periods between 11:00 on 25 February 2015 and 11:00 on 3 March 2015. The equipment was installed and collected by Steven Wheeler and Ben Southgate.

Three locations were chosen to represent three different areas of the site that could be affected by the proposed developments:

- Logger A was used to represent the levels at the facades overlooking Gatehouse court
- Logger B was used to represent the levels at the facades overlooking Old Square
- Logger C was used to represent the levels at the west-facing facades of the southern Stone Buildings

The loggers were set to measure at 5 minute intervals and were all placed at least 1 metre away from large reflecting surfaces.

Logger A was placed on the roof of Old Hall, overlooking the eastern facade and approximately 7 m above ground.

Logger B was placed on the balcony at the front of the chapel, pointing out over the northern edge approximately 8 m above ground.

Logger C was placed at roof level to the south-western corner of the stone buildings approximately 12 m above ground.

The three different measurement positions used during the survey are indicated in Figure 2, denoted by the letters ‘A’, ‘B’ and ‘C’. Photographs showing the measurement locations are provided in Figure 3 to Figure 5.

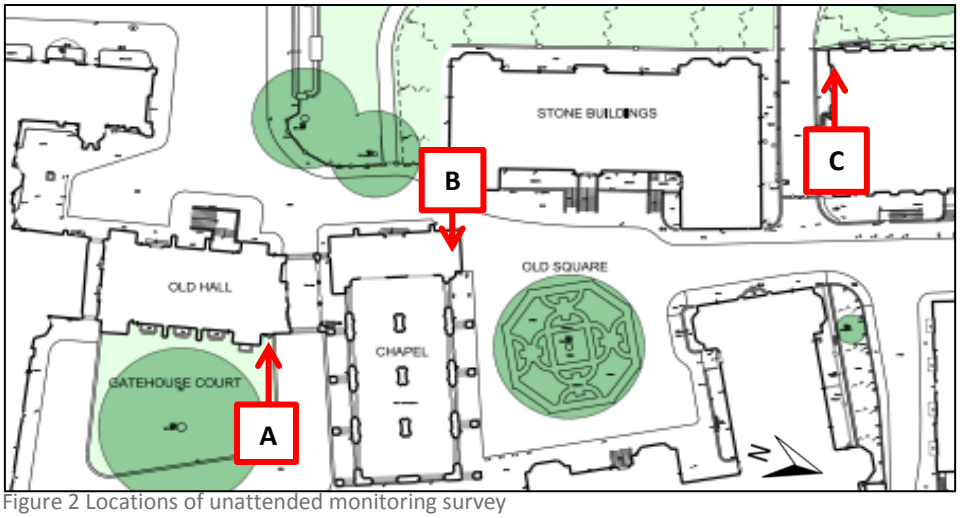


Figure 2 Locations of unattended monitoring survey


Figure 3 Photograph showing logger set up at Location A, overlooking Gatehouse Court

Figure 4 Photograph showing logger set up at Location B, overlooking Old Square

Figure 5 Photographs showing logger set up at Location C, looking onto Great Hall

4 Measurement results

4.1 Observations

The dominant noise sources observed at the site during the survey consisted of ambient noise from building services, vehicles around the site and pedestrians. Less significant noise sources included distant road traffic from outside of the site and ambient noise.

At location B, a fan located towards the opposite end of the balcony contributed to the noise climate at the measuring position. A photograph of this item can be seen in Figure 6.

Figure 6 Noticeable plant item situated near measurement location B

4.2 Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. Graphs showing the results of the unattended measurements are provided in Appendices B, C and D.

4.2.1 Unattended measurement results from location A

The day and night time ambient noise levels measured at location A during the unattended survey are presented in Table 1.

Table 1 Ambient noise levels measured during the survey at location A

Date	Daytime (07:00-19:00) $L_{Aeq,12h}$ (dB)	Evening (19:00-23:00) $L_{Aeq,4h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
25 Feb 2015	-	57	44
26 Feb 2015	53	57	51
27 Feb 2015	54	57	46
28 Feb 2015	51	56	47
1 Mar 2015	60	57	46
2 Mar 2015	54	58	46
Average	55	57	47

The minimum background noise levels measured at location A during the unattended survey are given in Table 2.

Table 2 Minimum background noise levels measured during the survey at location A

Date	Daytime (07:00-19:00) $L_{A90,5min}$ (dB)	Evening (19:00-23:00) $L_{A90,5min}$ (dB)	Night (23:00-07:00) $L_{A90,5min}$ (dB)
25 Feb 2015	42 *	42	41
26 Feb 2015	43	42	41
27 Feb 2015	42	42	43
28 Feb 2015	45	46	43
1 Mar 2015	44	42	41
2 Mar 2015	45	44	41
3 Mar 2015	45 *	-	-

* Measurement not made over full period due to monitoring start and end time

The lowest background noise levels measured at location A during the survey were $L_{A90,5min}$ 42 dB during the daytime, $L_{A90,5min}$ 42 dB during the evening and $L_{A90,5min}$ 41 dB at night.

4.2.2 Unattended measurement results from location B

The day and night time ambient noise levels measured at location B during the unattended survey are presented in Table 3.

Table 3 Ambient noise levels measured during the survey at location B

Date	Daytime (07:00-19:00) $L_{Aeq,12h}$ (dB)	Evening (19:00-23:00) $L_{Aeq,4h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
25 Feb 2015	-	56	51
26 Feb 2015	55	55	52
27 Feb 2015	55	55	51
28 Feb 2015	54	55	52
1 Mar 2015	58	55	51
2 Mar 2015	56	57	51
Average	56	55	51

The minimum background noise levels measured at location B during the unattended survey are given in Table 4.

Table 4 Minimum background noise levels measured during the survey at location B

Date	Daytime (07:00-19:00) $L_{A90,5min}$ (dB)	Evening (19:00-23:00) $L_{A90,5min}$ (dB)	Night (23:00-07:00) $L_{A90,5min}$ (dB)
25 Feb 2015	50 *	49	49
26 Feb 2015	50	49	49
27 Feb 2015	50	49	49
28 Feb 2015	51	51	49
1 Mar 2015	50	50	49
2 Mar 2015	50	50	49
3 Mar 2015	51 *	-	-

* Measurement not made over full period due to monitoring start and end time

The lowest background noise levels measured at location B during the survey were $L_{A90,5min}$ 50 dB during the daytime, $L_{A90,5min}$ 49 dB during the evening and $L_{A90,5min}$ 49 dB at night.

4.2.3 Unattended measurement results from location C

The day and night time ambient noise levels measured at location C during the unattended survey are presented in Table 5.

Table 5 Ambient noise levels measured during the survey at location C

Date	Daytime (07:00-19:00) $L_{Aeq,12h}$ (dB)	Evening (19:00-23:00) $L_{Aeq,4h}$ (dB)	Night (23:00-07:00) $L_{Aeq,8h}$ (dB)
25 Feb 2015	-	53	48
26 Feb 2015	54	50	49
27 Feb 2015	54	50	48
28 Feb 2015	52	51	49
1 Mar 2015	54	51	48
2 Mar 2015	55	53	48
Average	54	52	48

The minimum background noise levels measured at location C during the unattended survey are given in Table 6.

Table 6 Minimum background noise levels measured during the survey at location C

Date	Daytime (07:00-19:00) $L_{A90,5min}$ (dB)	Evening (19:00-23:00) $L_{A90,5min}$ (dB)	Night (23:00-07:00) $L_{A90,5min}$ (dB)
25 Feb 2015	47 *	45	44
26 Feb 2015	48	45	44
27 Feb 2015	46	46	45
28 Feb 2015	48	49	46
1 Mar 2015	47	46	44
2 Mar 2015	48	47	43
3 Mar 2015	49 *	-	-

* Measurement not made over full period due to monitoring start and end time

The lowest background noise levels measured at location C during the survey were $L_{A90,5min}$ 46 dB during the daytime, $L_{A90,5min}$ 45 dB during the evening and $L_{A90,5min}$ 43 dB at night.

5 Building services noise egress limits

5.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 '*Methods for rating and assessing and commercial sound*'.

BS 4142 provides a method for assessing noise from items such as building services plant against the existing background noise levels at the nearest noise sensitive.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background noise level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background noise level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

5.2 Local Authority criteria

The development is located within the London Borough of Camden and therefore will need to comply with Table E of policy DP28. Table E has been reproduced in full in Table 7.

Table 7 Local authority noise emission criteria

Noise description and location of measurement	Period	Time	Noise level
Noise at 1 metre external to a sensitive facade	Day, evening and night	00:00 – 24:00	5 dBA < L_{A90}
Noise that has a distinguishable, discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive facade	Day, evening and night	00:00 – 24:00	10 dBA < L_{A90}
Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive facade	Day, evening and night	00:00 – 24:00	10 dBA < L_{A90}
Noise at 1 metre external to sensitive facade where L_{A90}>60 dB	Day, evening and night	00:00 – 24:00	5 dBA < L_{A90}

5.3 Plant noise limits

Based on the above local authority criteria and the measurement results, the cumulative noise level resulting from the operation of all new plant at 1 m from the worst affected windows of the nearest noise sensitive premises should not exceed the limits set out in Table 8.

Table 8 Plant noise limits at 1 m from the nearest noise sensitive premises

Area of site	Maximum sound pressure level at 1 m from noise sensitive premises (L_{A90} dB)*		
	Daytime (07:00-19:00)	Evening (19:00-23:00)	Night (23:00-07:00)
Facades overlooking Gatehouse Court	37	37	36
Facades overlooking Old Square	45	44	44
West-facing facades of southern Stone Buildings	41	40	38

* LBC guidance does not state which L_{A90} the assessment should be based on, so these limits are on the lowest measured L_{A90} during each time period

Table 8 does not include any allowance for the plant noise to contain attention catching features. If specific plant does contain these features (eg tonality or impulsivity) then a further 5 dB penalty will be imposed and this will be the basis of any performance specification.

5.4 Assessment

Noise assessments of the proposed installations of building services plant associated with the various parts of the development will be carried out in due course. All plant will be designed to achieve the noise limits set out above.

6 Conclusion

A noise survey has been carried out to determine the existing background noise levels in the vicinity of the site and surrounding noise sensitive premises. The representative background noise levels were:

- Gatehouse Court facades: $L_{A90,5min}$ 42/42/41 dB during the day/evening/night
- Old Square facades: $L_{A90,5min}$ 50/49/49 dB during the day/evening/night
- West-facing facades of southern Stone Buildings: $L_{A90,5min}$ 46/45/43 dB during the day/evening/night

On the basis of the requirements of the Local Authority, the relevant plant noise limits at the worst affected existing noise sensitive premises would be:

- Gatehouse Court facades: $L_{A90,5min}$ 37/37/36 dB during the day/evening/night
- Old Square facades: $L_{A90,5min}$ 45/44/44 dB during the day/evening/night
- West-facing facades of southern Stone Buildings: $L_{A90,5min}$ 41/40/38 dB during the day/evening/night

These limits are cumulative and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, a 5 dB penalty will be applied, and the limits will be more stringent than those set out above.

Appendix A

Survey details

Equipment

The three sound level meters used to undertake the unattended measurements at measurement locations 'A', 'B' and 'C' were two Svantek 957s and a Rion NL-52, respectively. The calibration data for the equipment used during the survey is provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Sound level meter	SVAN957/12326	Svantek	18 Dec 15	1312599
Microphone	ACO7052H/36733	Svantek	18 Dec 15	1312599
Pre-amp	SV12L/13571	Svantek	18 Dec 15	1312599
Calibrator	SV30A/10931	Svantek	16 Dec 15	1312592
Sound level meter	SVAN957/12327	Svantek	25 Oct 15	1310490
Microphone	ACO7052H/43273	Svantek	25 Oct 15	1310490
Pre-amp	SV12L/13569	Svantek	25 Oct 15	1310490
Calibrator	SV30A/7451	Svantek	24 Oct 15	1310484
Sound level meter	NL-52/00320633	Rion	22 Apr 16	1404200
Microphone	UC-59/03382	Rion	22 Apr 16	1404200
Pre-amp	NH-25/10641	Rion	22 Apr 16	1404200
Calibrator	N7-74/34125430	Rion	16 Apr 16	1404194

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background noise level.

The L_{A90} is considered most representative of the background noise level for the purposes of complying with any local authority requirements.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures.*

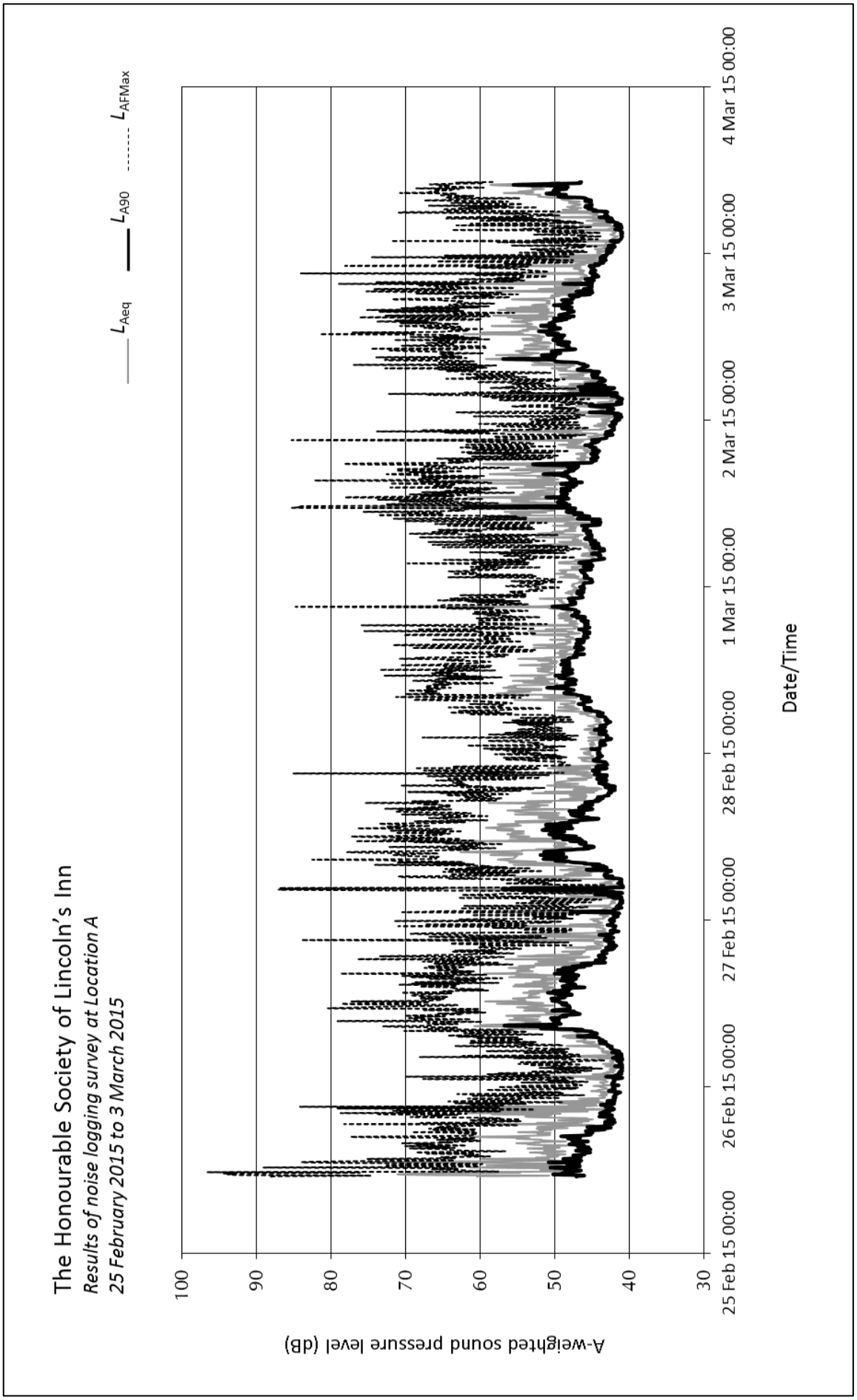
Weather conditions

During the unattended noise measurements between 25 February 2015 and 3 March 2015, weather reports for the area indicated that temperatures varied between 3°C at night and 11°C during the day, and the wind speed was less than 9 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

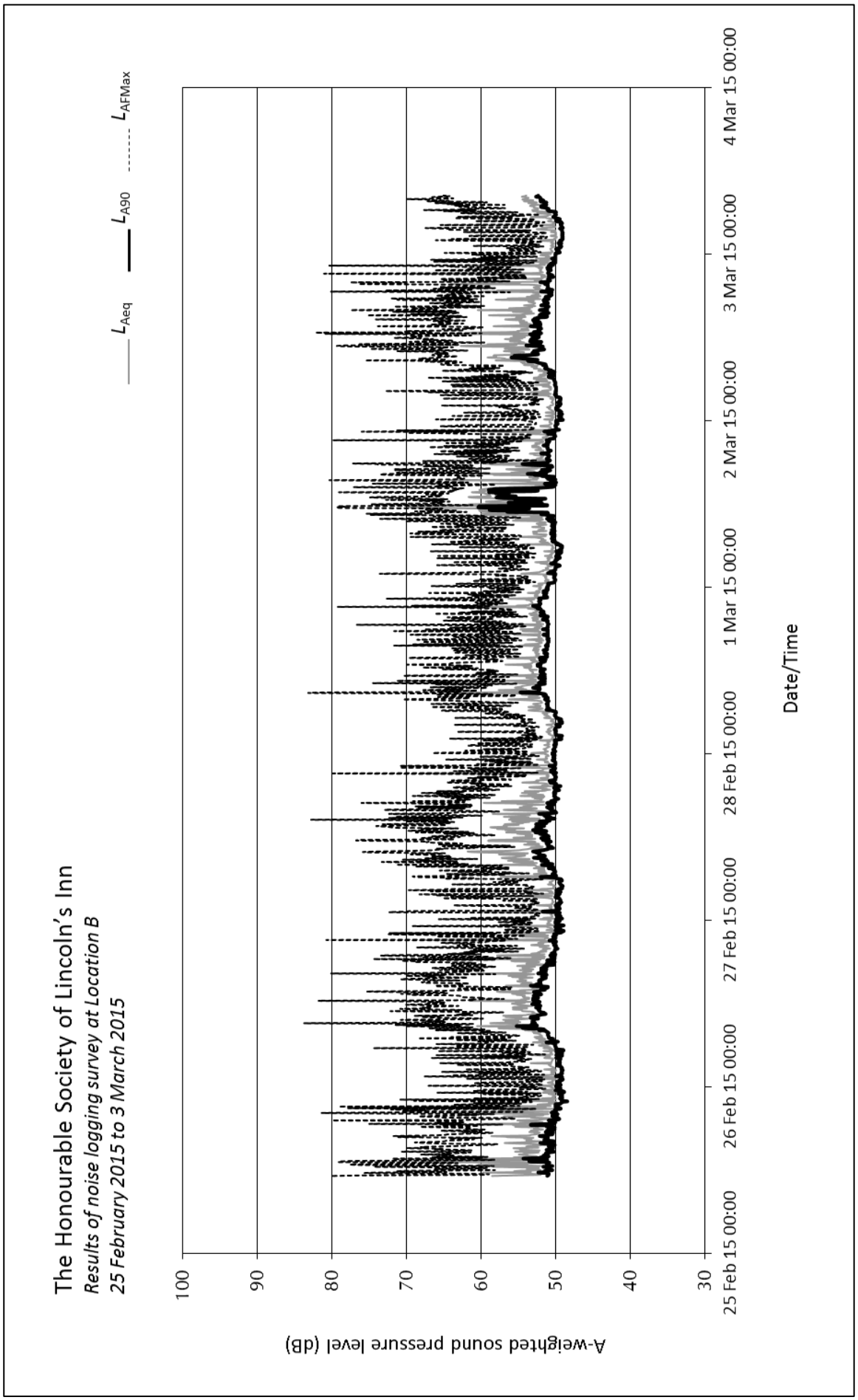
Appendix B

Results of unattended measurements at Location A


The Honourable Society of Lincoln's Inn
Results of noise logging survey at Location A
25 February 2015 to 3 March 2015
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
25 Feb 15 00:00
26 Feb 15 00:00
27 Feb 15 00:00
28 Feb 15 00:00
1 Mar 15 00:00
2 Mar 15 00:00
3 Mar 15 00:00
4 Mar 15 00:00
Date/Time

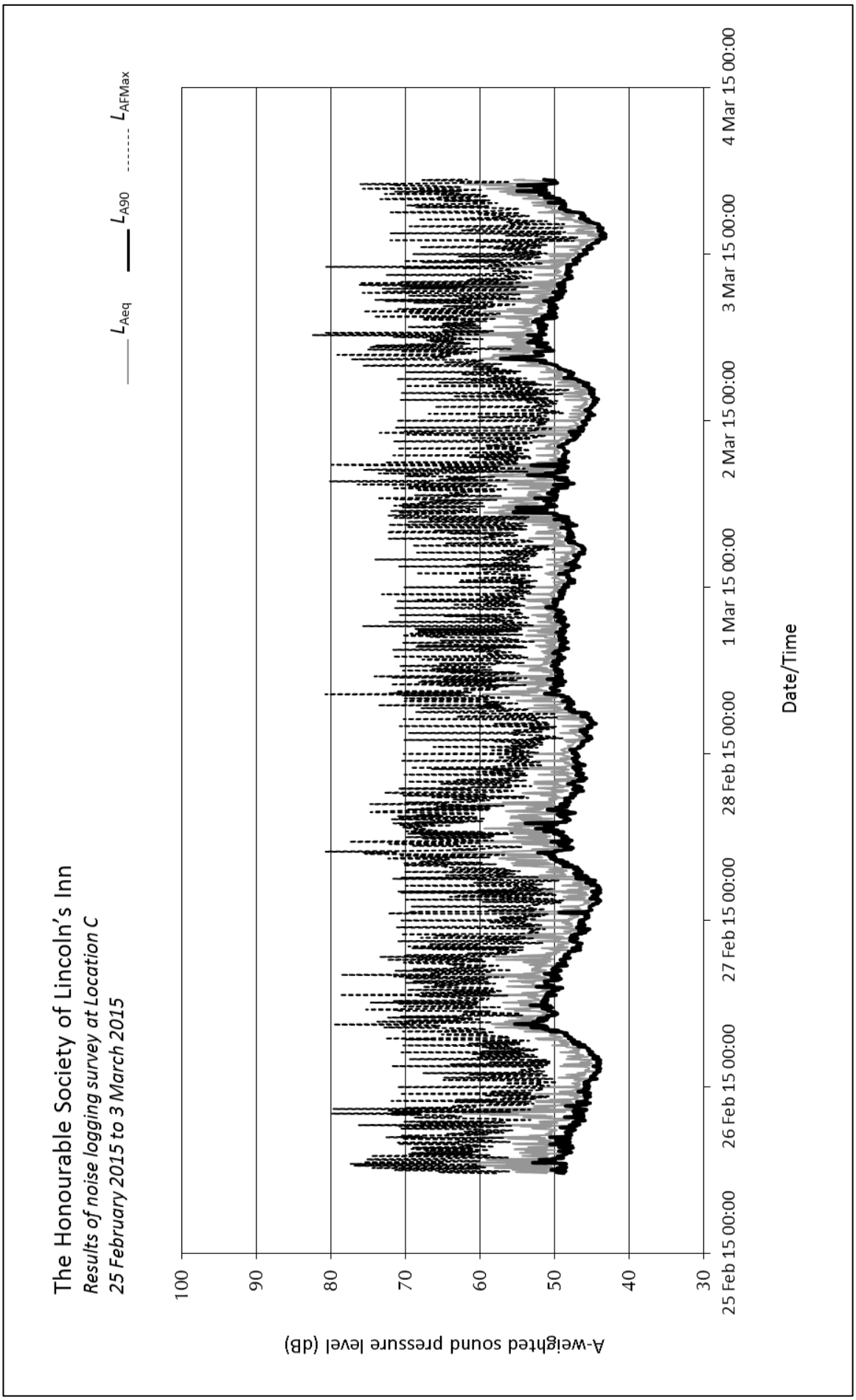
Appendix C

Results of unattended measurements at Location B


The Honourable Society of Lincoln's Inn
Results of noise logging survey at Location B
25 February 2015 to 3 March 2015
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
25 Feb 15 00:00
26 Feb 15 00:00
27 Feb 15 00:00
28 Feb 15 00:00
1 Mar 15 00:00
2 Mar 15 00:00
3 Mar 15 00:00
4 Mar 15 00:00
Date/Time

Appendix D

Results of unattended measurements at Location C


The Honourable Society of Lincoln's Inn
Results of noise logging survey at Location C
25 February 2015 to 3 March 2015
L_{Aeq}
L_{A90}
L_{AFMax}
A-weighted sound pressure level (dB)
100
90
80
70
60
50
40
30
25 Feb 15 00:00
26 Feb 15 00:00
27 Feb 15 00:00
28 Feb 15 00:00
1 Mar 15 00:00
2 Mar 15 00:00
3 Mar 15 00:00
4 Mar 15 00:00
Date/Time