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LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

MOTTINGHAM

Report to

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Architects: Design and project management services which cover all stages of design, from feasibility and planning through to construction on site and completion.

Acoustic Consultants: Expertise in planning and noise, the control of noise and vibration and the sound insulation and acoustic treatment of buildings.

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Contents

Page No.

This report has been redacted to remove identifiable details of the survey location to comply with GDPR

1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) were commissioned by London City Airport (LCA) to carry out an aircraft noise survey on Hartsmead Road, Mottingham, SE9 [redacted]. The purpose of the survey was to measure the noise level under the flight path of LCA arrivals and also to assess the effect of aircraft using London Heathrow Airport (LHA). The survey was undertaken from 30th August 2019 to 3rd October 2019.

The survey location is around 7.5 km due south of LCA and is overflown by easterly arrivals to LCA, before the aircraft turn over central London onto their final approach into the airport. It is also overflown by some aircraft using London Heathrow Airport (LHA). This report presents a summary of noise measurements relating to the aircraft activity.

A glossary of acoustic terminology is provided in Appendix 1.

2.0 SURVEY METHODOLOGY

A long-term unattended noise monitor was set up in the back garden of a house on the south side of Hartsmead Road, where environmental noise measurements were carried out in general accordance with BS 7445-1:2003[1].

The equipment used comprised a tripod mounted 01dB DUO Smart Noise Monitor, which was checked for correct calibration before and after the survey and no significant drift was observed. The monitor was positioned 4 m above ground level and away from reflecting surfaces. This is illustrated below in Figure 1.

Noise data was recorded continuously for a period of 35 days from 30th August 2019 to 3rd October 2019. This measurement period was chosen as a mixture of easterly and westerly winds were forecast, and measurements could therefore be taken of both easterly arrivals to LCA and easterly departures from LHA, as well westerly arrivals to LHA. Easterly winds occurred for at least some part of 15 days during the measurement period.

Aircraft movement and radar track data for the monitoring period was provided by LCA and LHA for the purpose of correlating measured noise data with aircraft noise events.

[1] British Standards Institute, BS 7445-1:2003 Description and measurement of environmental noise, 2003

[redacted]

Figure 1: Noise monitor location, view facing south

3.0 SURVEY RESULTS

3.1 Background Noise Levels

The main background noise source at the survey location, other than aircraft, was road traffic. The survey location lies approximately 150 m from the busy A20, however the survey location in the back garden was shielded by the property and other intervening buildings. Measured background noise levels were relatively low throughout the survey. During the daytime, the average noise level from all sources was 50 dB $L_{Aeq,16h}$ and the background noise level was around 40 dB $L_{A90,T}$.

3.2 London City Airport

The long-term noise survey data was processed by BAP to correlate the measured noise levels with aircraft movements using radar track data provided by LCA.

Figure 2 shows LCA easterly arrival (Runway 09) radar tracks during the monitoring period, with the measurement location marked in green. It can be seen that most arrivals using Runway 09 pass directly, or close to directly, above Hartsmead Road. From a review of the track data the aircraft are typically at an altitude of between 2,000 and 2,500 ft above sea level at this location.

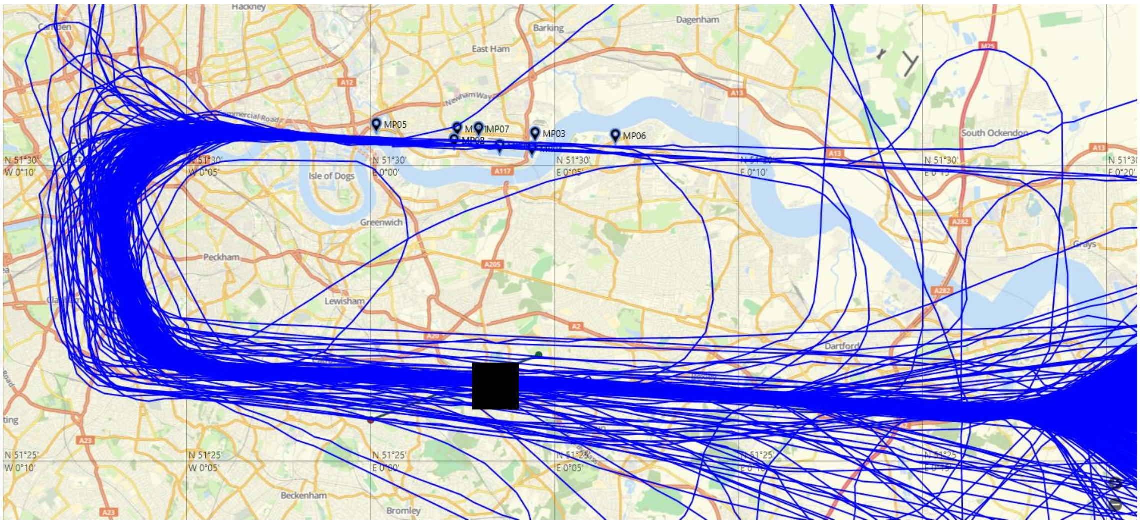

Figure 2: LCA Runway 09 arrivals tracks 30th August 2019 – 3rd October 2019

During the measurement period there were 924 arrivals to LCA using Runway 09. Of these, 64 occurred at the same time as an LHA flight. These were excluded from the L_{Amax} analysis, as it is not possible to differentiate the noise contribution from each flight in these cases. Their exclusion did not significantly effect the results of the survey as they only form a small proportion of the total. These flights have been allowed for in the daytime $L_{Aeq,16h}$ levels reported in Section 4.0.

Of the remaining 860 flights, 840 (98%) were correlated with a noise event. This is a very good rate of correlation and is sufficient to give representative noise levels for the most common aircraft operations. The correlated LCA aircraft noise events were caused by aircraft approaching LCA Runway 09. Other aircraft using LCA do not pass close to this location and are therefore unlikely to be audible. The correlated aircraft noise events are summarised in Table 1.

Aircraft Type	No. Correlated	Average† L_{ASmax} (dB)
Airbus A220	39	68
Avro RJ85	33	66
De Havilland Dash 8 Q400	118	66
Embraer E170	76	67
Embraer E190	482	68
Other††	92	66
Total	840	67

† Arithmetic average.
†† Aircraft types with less than 25 correlated movements have been categorised as 'Other'.

Table 1: Summary of correlated noise measurements, LCA aircraft Runway 09 arrivals.

3.3 London Heathrow Airport

Hartsmead Road is also overflown by westerly arrivals (Runways 27L/27R) to LHA. Figure 3 shows the westerly arrival distribution for LHA, which has been generated with LHA's publicly available 'WebTrak' tool[2]. It can be seen that Hartsmead Road is at the edge of this distribution. At this location westerly arrivals to LHA are typically at an altitude of around 5,000 ft above sea level.

Figure 3: LHA westerly arrivals distribution

[2] http://myneighbourhood.bksv.com/lhr/

In addition to the LHA westerly arrivals, Hartsmead Road is also overflown by a small number of LHA easterly departures (Runways 09L/09R). However these are typically at an altitude of around 8,000 ft above sea level and did not generally register reliable noise events.

During the measurement period there were 2,408 LHA westerly arrivals that passed within 2 km of the measurement position, excluding the 64 flights that occurred at the same time as LCA flights. The exclusion of these flights did not significantly effect the results of the survey as they only form a small proportion of the total. These flights have been allowed for in the daytime $L_{Aeq,16h}$ levels reported in Section 4.0.The unattended noise monitoring data was processed by BAP to correlate the measured noise levels with these LHA movements.

The correlated LHA aircraft noise events were caused in particular by those aircraft approaching from the south, passing close to the measurement position, and then turning onto the extended centrelines of the runways. As the aircraft approaching LHA were at significantly higher altitudes then LCA aircraft, some of the quieter aircraft did not register reliable noise events (at least 51 dB L_{ASmax}) at the measurement location. In total, 1,943 arrivals (81%) were correlated which is sufficient to give representative noise levels for the most common aircraft types. The correlated aircraft noise events from LHA for westerly arrivals are summarised in Table 2.

Aircraft	No. Correlated	Average† L_{ASmax} (dB)
Airbus A220	51	60
Airbus A319	240	58
Airbus A320	437	59
Airbus A320neo	82	58
Airbus A321	195	59
Airbus A321neo	39	59
Airbus A330	100	61
Airbus A340	44	62
Airbus A380	34	63
Boeing 747	143	63
Boeing 767	47	60
Boeing 777	275	60
Boeing 787	179	59
Other††	77	59
Total	1943	59

† Arithmetic average.
†† Aircraft types with less than 25 movements have been categorised as 'Other'.

Table 2: Summary of correlated noise measurements, LHA westerly arrivals

4.0 ANALYSIS OF RESULTS

The average maximum noise level for individual LCA aircraft (easterly arrivals) during the measurement period was 67 dB L_{ASmax}. The most common and loudest aircraft type among the LCA aircraft was the Embraer E190, which averaged 68 dB L_{ASmax}.

LHA aircraft (westerly arrivals) averaged a lower maximum noise level of 59 dB L_{ASmax}. The most common aircraft type among the LHA aircraft was the Airbus A320, which averaged 59 dB L_{ASmax}. The loudest aircraft types among the LHA aircraft were the Airbus A380 and Boeing 747 which both averaged 63 dB L_{ASmax}.

Aircraft noise in the UK is commonly assessed in terms of the $L_{Aeq,16h}$ metric for the average summer day, which is the average noise level produced by aircraft over a 16 hour daytime period (07:00 – 23:00) for the 92 day summer period, defined as 16th June to 15th September inclusive. This is consistent with LCA's sound insulation scheme eligibility criteria, and is the metric used to rate community response to air noise in the UK, as recommended by the Government[3].

The noise level of the correlated daytime aircraft movements, allowing for those that occurred at the same time, for the measurement period was 44 dB $L_{Aeq,16h}$ for LCA aircraft and 41 dB $L_{Aeq,16h}$ for LHA aircraft. The lower contribution of the LHA aircraft is largely due to them being at a higher altitude than the LCA aircraft and hence generally quieter at the survey location.

During the measurement period, 22% of LCA aircraft used Runway 09 and 81% of LHA aircraft used runway 27L or 27R. The long-term average (5 year) runway usage at LCA has 34% of aircraft using Runway 09, and at LHA the long-term average (20 year) has 72% of aircraft using runway 27L or 27R. Therefore, the noise level over the measurement period is considered to be lower for LCA aircraft and higher for LHA aircraft than is typical. If the measured results are adjusted to average runway usage, this would result in a noise level of 46 dB $L_{Aeq,16h}$ for LCA aircraft and 41 dB $L_{Aeq,16h}$ for LHA aircraft. This gives a combined noise exposure level from aircraft of 47 dB $L_{Aeq,16h}$.

This means that the aircraft noise level at the survey location is significantly below LCA's sound insulation scheme First Tier eligibility criterion of 57 dB $L_{Aeq,16h}$ daytime aircraft noise level. It is, however, recognised that some people will be annoyed by levels lower than this, and conversely that others may find higher noise levels acceptable[3].

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[3] Department for Transport, Aviation Policy Framework, 2013

Although at times during the survey there were relatively short periods where Runway 09 at LCA and Runways 27L/27R at LHA were being used at the same time, it is rare for this to occur over an entire 16 hour daytime period. If this were to occur, this would represent a worst case. The noise level would be 50 dB $L_{Aeq,16h}$ from LCA aircraft and 42 dB $L_{Aeq,16h}$ from LHA aircraft, for a combined noise level from aircraft of 51 dB $L_{Aeq,16h}$ on that day.

The results discussed above are summarised in Table 3 below.

Scenario	Airport	Runway Split (09%/27%)	Daytime Noise Level $L_{Aeq,16h}$ (dB)
Survey Period 30/08/2019 - 03/10/2019	London City	22/78	44
	Heathrow	19/81	41
	Combined	-	46
Long-Term Average†	London City	34/66	46
	Heathrow	28/72	41
	Combined	-	47
Worst Case	London City	100/0	50
	Heathrow	0/100	42
	Combined	-	51

† The long-term average at LCA is calculated over a 5 year period, whereas the long-term average at LHA is calculated over a 20 year period.

Table 3: Daytime $L_{Aeq,16h}$ aircraft noise level results

5.0 SUMMARY

BAP have measured the noise levels over a 35 day period on Hartsmead Road, Mottingham, SE9 [redacted] This is a location overflown by both aircraft using London City Airport (LCA) and aircraft using London Heathrow Airport (LHA).

Maximum noise levels from individual LCA flights were higher than for LHA flights, largely due to LCA aircraft being at a lower altitude at this location.

The 16 hour daytime aircraft noise level, from the combination of LCA and LHA flights, measured was 46 dB $L_{Aeq,16h}$. When taking account of long-term conditions over an average day, as is used to rate community response in the UK, the combined noise level from LCA and LHA flights would be 47 dB $L_{Aeq,16h}$.

On the worst case assumption that all LCA aircraft operate in an easterly direction, this equates to a noise level of 50 dB $L_{Aeq,16h}$ due to them. On the worst case assumption that all LHA aircraft operate in a westerly direction, this equates to a noise level of 42 dB $L_{Aeq,16h}$ due to them.

The combined worst case situation for this location is when LCA is operating under easterly conditions and LHA is operating under westerly conditions, although this condition would rarely occur for an entire 16 hour daytime period. In this case, the total noise level would be 51 dB $L_{Aeq,16h}$ and the contribution of LHA flights would be relatively insignificant, equating to an increase in the overall noise level of 1 dB versus LCA flights alone.

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APPENDIX 1

GLOSSARY OF ACOUSTIC TERMINOLOGY

Sound

This is a physical vibration in the air, propagating away from a source, whether heard or not.

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w, is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB.

Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation, however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

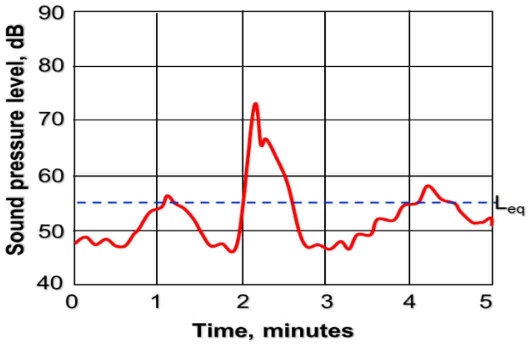
Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradients are variable and difficult to predict.

Environmental Noise Descriptors

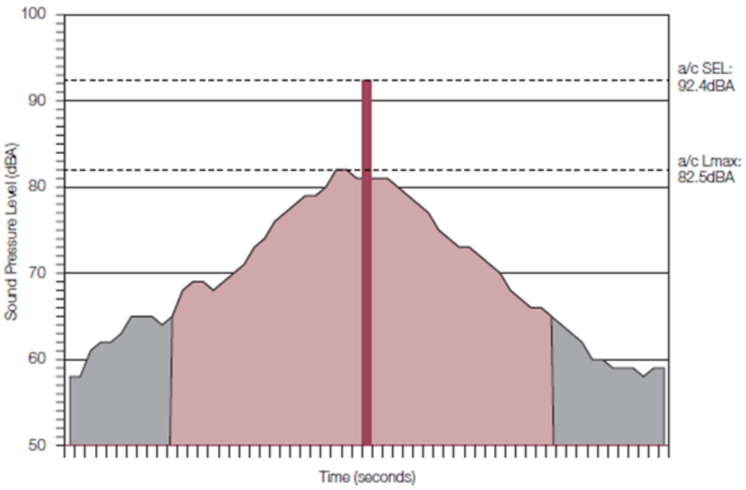
Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

Statistical Term	Description
$L_{Aeq,T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq, T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.



Statistical Term	Description
L_{A90}	The level exceeded for 90% of the time is normally used to describe background noise.
$L_{Amax,T}$	The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)
SEL	A Sound Exposure Level (SEL) is a measure of the total noise from an aircraft movement.
	The SEL noise level for an aircraft movement is the sum of all the noise energy for the event expressed as an average noise level for 1 second.
	This is shown in the graph below:

Figure 3.1: Aircraft time history, showing maximum level L_{Amax} and associated Sound Exposure Level (SEL)[41]



Source: CAA data