Bickerdike Allen Partners
Architecture Acoustics Technology

LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

[redacted] GARVARY ROAD, LONDON

Report to

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 50 years of continuous practice.

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.

Construction Technology Consultants: Expertise in building cladding, technical appraisals and defect investigation and provision of construction expert witness services.

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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) have been commissioned by London City Airport (LCA) to carry out a survey to monitor aircraft noise outside [redacted] Garvary Road, London E16 [redacted]. This property is located around 1 kilometre to the west and around 750 metres to the north of the airport. This report provides a summary of the noise measurements. A glossary of acoustic terminology is provided in Appendix 1.

2.0 SURVEY DETAILS

2.1 Methodology

Environmental noise measurements were carried out in accordance with BS 7445[1].

BAP visited the property and set up a long term unattended noise monitor in the rear garden of the property, which faces to the north. This recorded continuously for 14 days between approximately 12:15 pm on 14th November 2017 and 09:15 am on 28th November 2017.

As the resident was concerned that noise levels at the front of the property would be higher, short term attended measurements were also taken on 28th November, both at a location close to the long term monitor and at the front of the property, in order to assess any difference between them.

The property is primarily affected by aircraft departures using runway 27, i.e. those departing to the west. This is the most common direction of departure and occurs approximately two thirds of the time on average.

2.2 Equipment

The equipment used for the long term unattended survey was an 01dB DUO Smart Noise Monitor, mounted on a tripod approximately 3 m above the ground, in a free field position in the garden of the property. The equipment used for the short term attended survey was a Norsonic 140 Sound Level Meter.

The monitor locations are shown in Figure 1 and Figure 2. The monitors were calibrated at the start and end of the measurements, and no significant drift was observed.

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[1] BS 7445-1:2003 *Description and measurement of environmental noise*

[redacted]

Figure 1: Noise monitor locations at rear of property, facing north

[redacted]

Figure 2: Noise monitor location at front of property, facing west

3.0 SURVEY RESULTS AND DISCUSSION

3.1 Flight Tracks

The airport have provided BAP with the aircraft movement data and flight track data for the monitoring period. Figure 3 shows the flight tracks for runway 27 departures during the monitoring period, with the approximate property location marked by a blue spot. As can be seen, all departures using runway 27 pass around 750m to the south of the property.

Runway 09 arrivals fly in a similar location, but these are both less frequent (runway 27 is used two thirds of the time) and less noisy. Therefore it is clear that the main aircraft noise impact at the property will be caused by runway 27 departures.

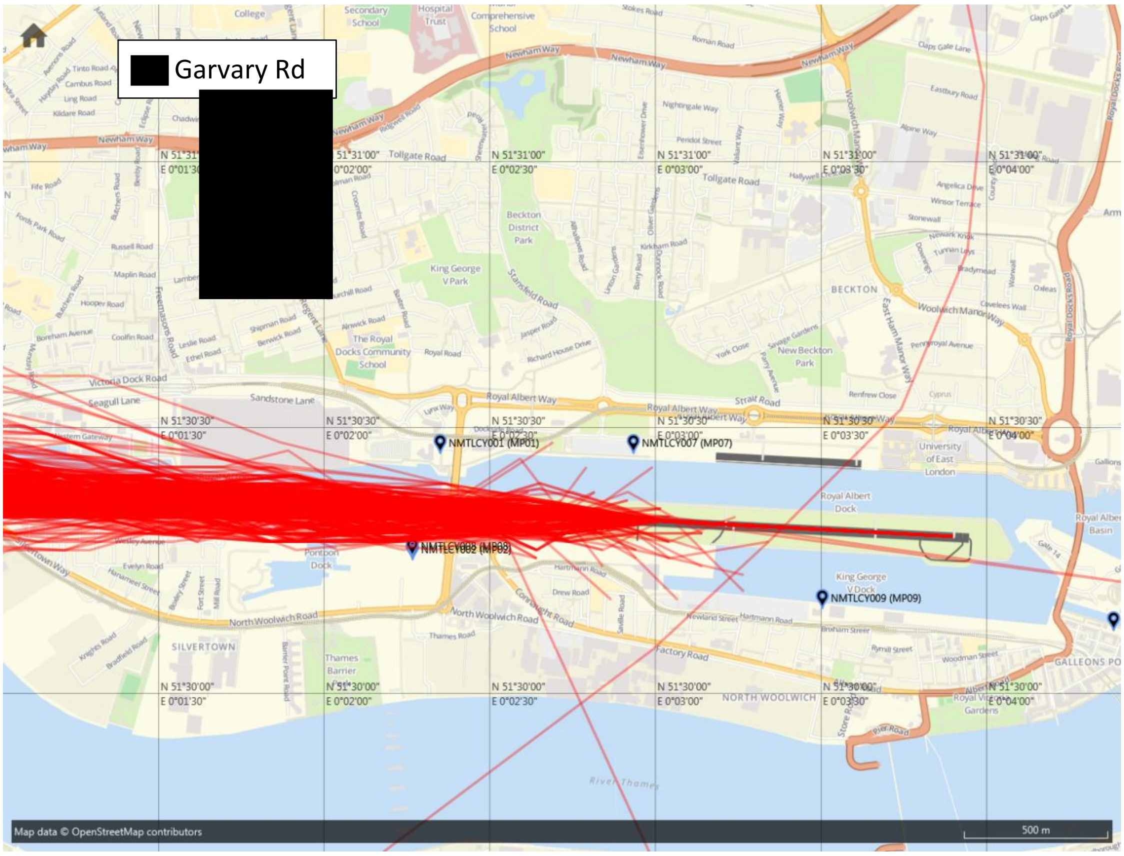

Figure 3: Runway 27 Departure Tracks During Measurement Period

3.2 Noise Measurements

3.2.1 Unattended Noise Survey

The noise monitoring data was processed by BAP to correlate the measured noise levels with the aircraft movement data, provided by the airport.

The correlation focused on runway 27 departures, since these were expected to be the most significant noise impact. Other recorded noise events are also summarised to ensure that this was the case.

During the 14 day measurement period, there were 1518 departures using runway 27. Of these, 1471 (97%) were correlated with a noise event. This represents a high rate of correlation.

The aircraft noise events are summarised in Table 1.

Aircraft	No. Correlated	Avg L_{Amax} (dB)
Avions de Transport ATR72	19	68
De Havilland Dash 8-Q400	242	67
Embraer E170	233	77
Embraer E190	671	78
Avro RJ85	93	74
Fokker 50	35	65
Saab 2000	34	64
Bombardier CS100	25	74
Cessna C56X	20	66
Dornier 328 Jet	18	69
Other Aircraft	81	71
Total	1471	74

Table 1: Summary of Unattended Noise Results

3.2.2 Attended Noise Survey

In order to confirm that noise levels did not vary significantly between the long term position in the rear garden and a position at the front of the property, attended measurements were taken at two locations. The long term monitor was running continuously during the attended survey and was used as a reference. 10 aircraft events were measured at the front and the rear of the property. On inspection, two of the measurements at the front were affected by other noise sources and therefore these results were not used. A summary of the results is given in

	Rear of Property	Front of Property
No. Aircraft Measured	10	8
Average Noise Level, dB L_{ASmax}	73.2	77.0
Average Corresponding Noise Level at Long Term Position, dB L_{ASmax}	73.9	76.8 (at rear)
Difference, dB L_{ASmax}	-0.7	-0.2

Table 2: Summary of Attended Noise Results

The above results show that the measurements at the front of the property were louder by 0.5 dB L_{ASmax}. This is considered to be an insignificant difference and therefore the long term results are considered representative of both the front and the rear of the property.

4.0 DISCUSSION OF RESULTS

Aircraft noise in the UK, and at LCA, 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 the 16-hour daytime period (07:00 to 23:00) for the 92-day "summer", defined as 16th June to 15th September inclusive. This is consistent with the government policy as stated in its Aviation Policy Framework (March 2013).

As LCA operates from 06:30 to 22:30, the full extent of operations is deemed as daytime for this purpose.

During the 14 day measurement period, LCY operations occurred for 100% of the time on runway 27 and therefore the noise exposure at this receptor during this period would be greater than over an average summer day (the average activity on runway 27 over the last 5 summer periods is 67%).

In addition, the calculation of noise contours do not take into account the effect of sound reflections from nearby buildings and therefore there will tend to be a difference between what is measured in a suburban setting, in a garden surrounded by housing, as compared to what is predicted and shown on noise contours. Increases due to reflection effects can typically vary between 1 dB to 3 dB depending on the location of the microphone relative to surrounding reflecting objects.

The noise level of the aircraft movements averaged over the measurement period was 60 dB $L_{Aeq,16h}$. If this is adjusted to account for the fact that 100% of the departures in the measurement period used runway 27, rather than the typical 67%, then the equivalent average summer day level would be 58 dB $L_{Aeq,16h}$. To put this into context, the average measured noise level from non-aircraft sources was 52 dB $L_{Aeq,16h}$.

The contours produced by LCA use noise modelling software, which assumes "free field" positions (i.e. not near buildings which can interfere with the measurements due to screening and/or reflections), and therefore real-world measurements are not a true like for like comparison. These measured results are slightly higher than the airport's latest published noise contours, which show this property as approximately 55 dB $L_{Aeq,16h}$ based on an average summer day in 2016[2].

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[2] A1125.57-APR16-01 "*Actual Noise Contours Summer 2016 (57, 66 and 69 dB $L_{Aeq,16h}$ Average Mode*"

When allowing for localised reflection effects however, the noise exposure level would be expected to lie somewhere between 55 to 57 dB $L_{Aeq,16h}$ average summer daytime aircraft noise level.

5.0 SUMMARY

BAP have measured the noise levels at [redacted] Garvary Road, London E16 [redacted] over a 14 day period. The average aircraft noise level measured over the 14 days was 60 dB $L_{Aeq,16h}$. This is equivalent to 58 dB $L_{Aeq,16h}$ on an average summer day. The predicted level using the noise contours produced for the airport is 55 dB $L_{Aeq,16h}$. Some difference is expected as noise contours are produced using noise modelling software, which assumes “free field” positions (i.e. not near buildings which can interfere with the measurements due to screening and/or reflections), and therefore real-world measurements are not a true like for like comparison. When allowing for localised reflection effects, the noise exposure level would be expected to lie somewhere between 55 to 57 dB $L_{Aeq,16h}$ average summer daytime aircraft noise level.

Nick Williams	**Peter Henson**
for Bickerdike Allen Partners LLP	**Partner**

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.

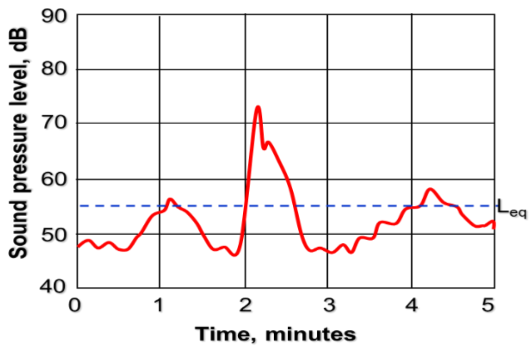
Meteorological Effects

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.

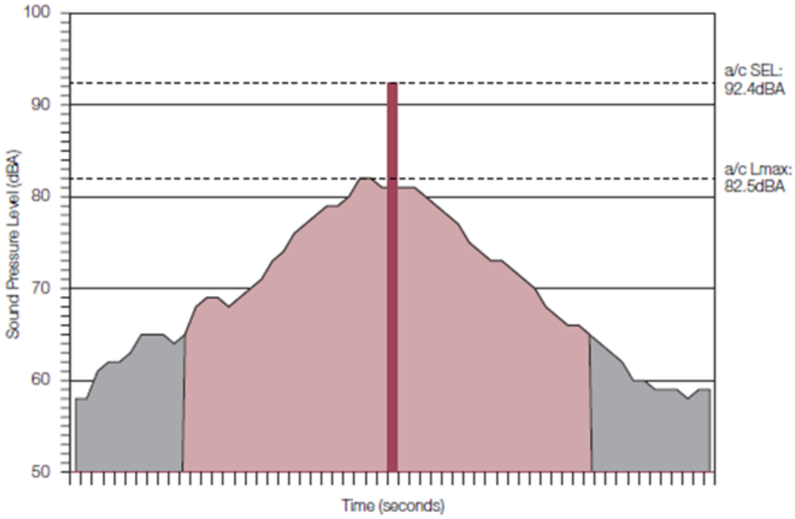
Statistical Term	Description
$L_{Aeq,T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound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



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)

Sound Exposure Level (SEL)	An SEL is a measure 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