Bickerdike Allen Partners
Architecture
Acoustics
Technology

LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

CATHOLIC PARISH OF CORPUS CHRISTI, ROMFORD

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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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 in Romford. The survey was undertaken from 13th February 2020 to 24th March 2020.

The survey was conducted in the grounds of the Catholic Parish of Corpus Christi, Lowshoe Lane, Romford RM5 2AP. This church is located just over 12 kilometres to the north-east of the airport. This report provides a summary of the noise measurements relating to aircraft activity.

A glossary of acoustic terminology is provided in Appendix 1.

2.0 SURVEY DETAILS

2.1 Methodology

A long-term unattended noise monitor was set up in the grounds of the Catholic Parish of Corpus Christi in Romford, where environmental noise measurements were carried out in general accordance with BS 7445-1:2003[1].

BAP visited the church and set up the noise monitor approximately 10m from the nearest building in a grassy area to the south of the church. The monitor recorded continuously for 41 days between approximately 1:15 pm on 13th February and 12:00 pm on 24th March.

2.2 Equipment

The equipment used for the long-term survey was an 01dB DUO Smart Noise Monitor, with the microphone mounted approximately 3 m above the ground, in a free field position away from reflecting surfaces. The monitor installation is shown in Figure 1. The monitor was checked for correct calibration at the start and end of the measurements, and no significant drift was observed.

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

Figure 1: Noise Monitor Installation

3.0 SURVEY RESULTS

3.1 Flight Tracks

LCA has provided BAP with the aircraft movement data and flight track data for the monitoring period. The routes of departures from runway 27 split into three main swathes; one which turns north a long way to the west of the survey location, one which branches off and passes around 2 km to the south of the survey location, and one which flies almost directly over the survey location. A sample of the radar tracks for runway 27 departures is shown below in Figure 2, the green circle indicates the survey location.

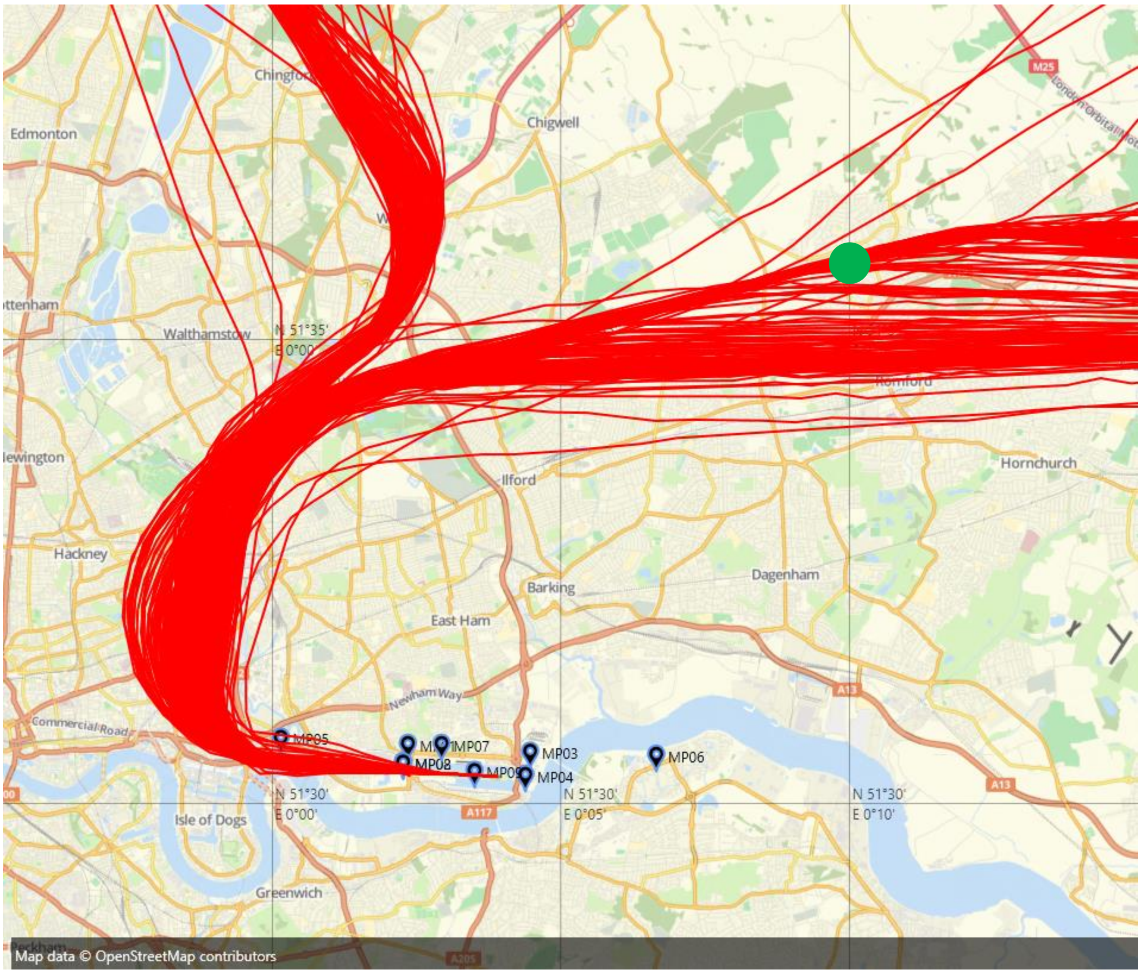

Figure 2: Sample of Radar Tracks - Runway 27 Departures

BAP have reviewed the flight tracks, and found that during the measurement period, approximately a quarter of all runway 27 departures followed the swathe that passes over the survey location. Departures from runway 09 and arrivals to both runway ends do not routinely fly close to the survey location.

3.2 Noise Measurements

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

The loudest aircraft events were caused by a subset of aircraft departing LCA using runway 27, i.e. those flying closest to the survey location. Some of the more distant aircraft were also detectable, although at a significantly lower noise level such that they were not clearly distinct from non-aircraft noise sources and therefore it was not possible to determine the specific noise levels for these quieter aircraft events.

During the 41-day measurement period, there were 2,999 departures using runway 27. Of these, 636 (21%) were correlated with a noise event at the monitor. This rate of correlation is due to most runway 27 departures flying routes which do not pass close to the survey location. The correlated aircraft noise events are summarised in Table 1.

Aircraft Type	No. Correlated	Average† L_{ASmax} (dB)
Avro RJ85	14	69
De Havilland Dash 8-Q400	31	67
Embraer E170	103	66
Embraer E190	382	68
Other Aircraft††	106	68
Overall	**636**	**68**

† Arithmetic average.

†† Aircraft types with less than 12 correlated movements have been categorised as 'Other'.

Table 1: Summary of Noise Results

4.0 ANALYSIS OF RESULTS

The average maximum noise level for individual LCA aircraft during the measurement period was 68 dB L_{ASmax}. The loudest aircraft type among the LCA aircraft was the Avro RJ85, which averaged 69 dB L_{ASmax}.

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

The survey period was affected by the COVID-19 pandemic, with fewer flights than normal operating. However the fleet mix was broadly similar, so the spread of noise levels from individual flights is considered representative. Over the survey period there were an average of 82 flights per day, compared to around 228 on average in the 2019 summer period. During the 41-day measurement period, 89% of the departures used runway 27. The long-term average (5 year) runway usage at LCA has 67% of aircraft using runway 27.

The average daytime noise level of the aircraft movements over the 41-day measurement period was 41 dB $L_{Aeq,16h}$. Allowing for the greater number of flights in summer 2019 and the average long term runway usage would result in a noise level of 45 dB $L_{Aeq,16h}$ for LCA aircraft.

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[2].

5.0 SUMMARY

BAP have measured the noise levels in the church grounds of Catholic Parish of Corpus Christi in Romford over a 41-day period. The average aircraft noise level measured over the 41 days was 41 dB $L_{Aeq,16h}$. Allowing for the greater number of flights in summer 2019 and the average long term runway usage would result in a level of 45 dB $L_{Aeq,16h}$. This level is significantly below LCA's sound insulation scheme First Tier eligibility criterion of 57 dB $L_{Aeq,16h}$ daytime aircraft noise level.

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

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APPENDIX 1
GLOSSARY OF ACOUSTIC TERMINOLOGY

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).

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 (LAeq, 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.
$L_{Amax,T}$	The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)

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.