Bickerdike Allen Partners
Architecture Acoustics Technology

FARNBOROUGH AIRPORT

NOISE MONITORING REPORT

WOKING

4 JUNE 2025 – 4 SEPTEMBER 2025

Report to

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 60 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) were instructed by Farnborough Airport Ltd. (FAL) to analyse measured noise data from a survey undertaken in Woking, with the aim of quantifying and understanding the typical noise levels created in the community by aircraft operations at Farnborough Airport.

An unattended noise monitoring terminal (NMT) was installed by FAL at a residence in Horsell, Woking, Surrey, GU21 4SJ. The NMT is part of the noise and track monitoring system at the airport and operated at the location from 4 June 2025 to 4 September 2024.

A threshold is set for the NMT to try and distinguish aircraft noise events from other non-aircraft noise sources. The threshold needs to be set appropriately to the local conditions, reflecting both the noise level from aircraft and background noise levels. For this survey the NMT's threshold for triggering a noise event was set to 54 dB(A) with a minimum duration of 5 seconds.

The measurement location, illustrated in Figure 1, is situated approximately 8 mi (13 km) northeast of the airport.

FAL provided BAP with the schedule of flights that occurred in the measurement period, the flight track radar data from the airport's permanent track-keeping system and noise measurements from the NMT.

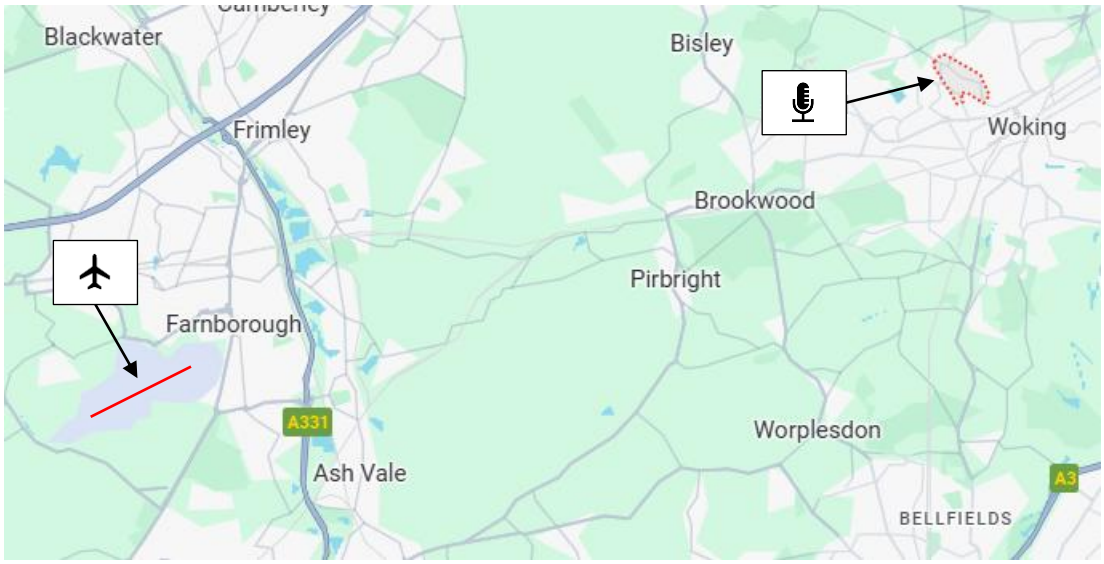

Figure 1: Noise monitoring location ( ) relative to Farnborough Airport ( ) and Runway ( ). Map data: Google, © 2025.

2.0 AIRCRAFT OPERATIONS

2.1 Direction

Aircraft operations at Farnborough Airport are either easterly operations using Runway 06 (R06) or westerly operations using Runway 24 (R24). During easterly operations aircraft approach from west of the airport and take-off to the east. During westerly operations the situation is reversed. The wind direction determines when easterly or westerly operations occur, as aircraft take-off and land into the wind for performance and safety reasons. Consequently, the split between easterly and westerly operations varies with time and the areas overflown by aircraft can correspondingly change.

During the noise monitoring period there were a total of 9,386 flights logged at Farnborough Airport, distributed 18%/82% between R06/R24. Figure 2 shows the distribution of operations week by week over the noise monitoring period. This is broadly similar to the annual average for 2024 of 22%/78%.

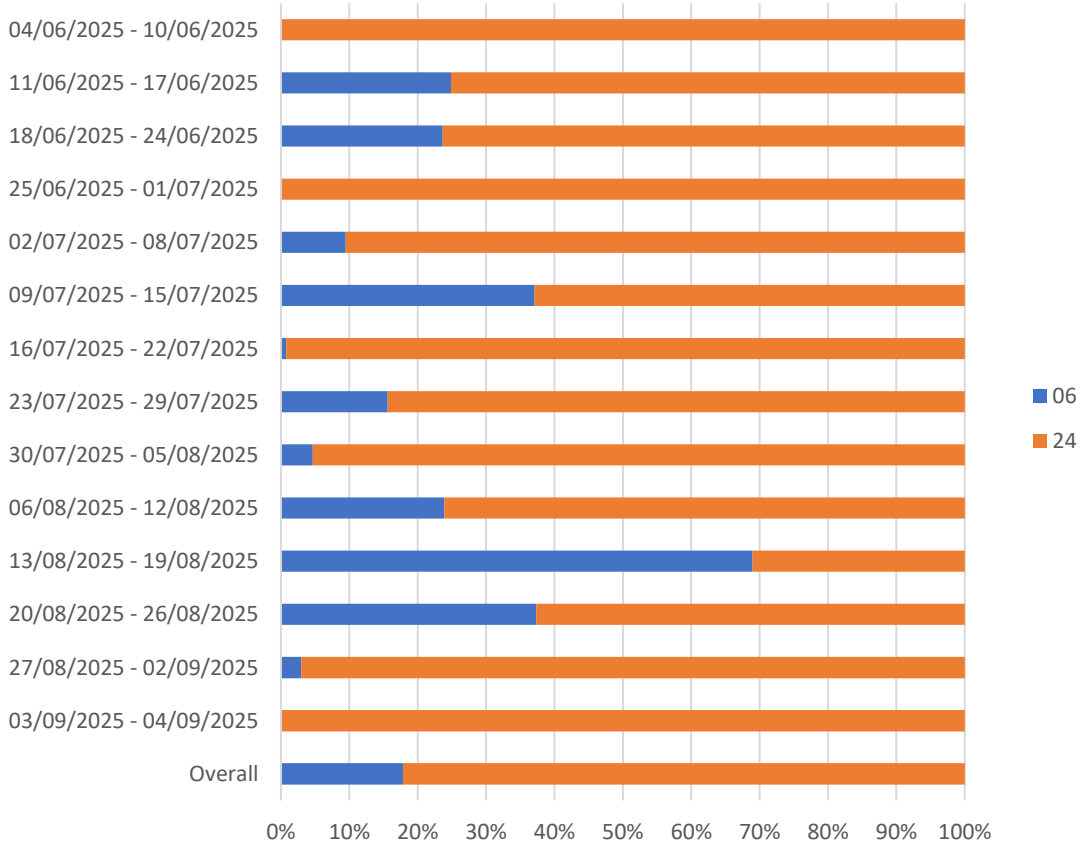

Figure 2: Distribution of aircraft operations by runway.

2.2 Overflights

An overflight was taken to be any Farnborough aircraft passing the measurement location at an elevation angle (approximately the angle between the horizon and the aircraft) of at least 48.5 degrees, as shown in Figure 3. This is generally in accordance with the Civil Aviation Authority (CAA) definition (CAP 1498), the difference being that any aircraft above 7,000 ft were also included. An angle of 48.5 degrees was used in preference to the alternative 60 degree angle detailed in CAP 1498, as using an angle of 48.5 results in a larger "cone" and therefore more Farnborough aircraft measurements being included in the survey results.

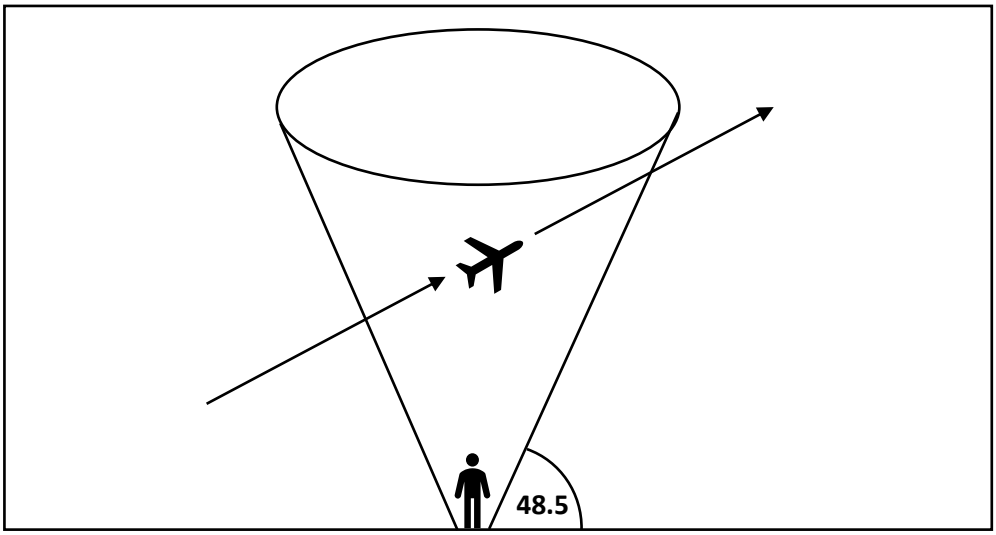

Figure 3: Illustration of an overflight. Any aircraft passing through the cone defined by the 48.5° angle was classed as an overflight.

Of the 9,386 flights logged at Farnborough Airport during the noise monitoring period, 1,841 Farnborough flights were identified as overflights of the measurement location, the vast majority of which were Runway 24 arrivals. Table 1 summarises the total number of overflights. Figure 4 shows the number of overflights that occurred each day.

Runway	Arrivals	Departures	Total
06	0	1	1
24	1,838	2	1,840
Total	**1,838**	**3**	**1,841**

Table 1: Number of flights identified as overflights of the measurement location.

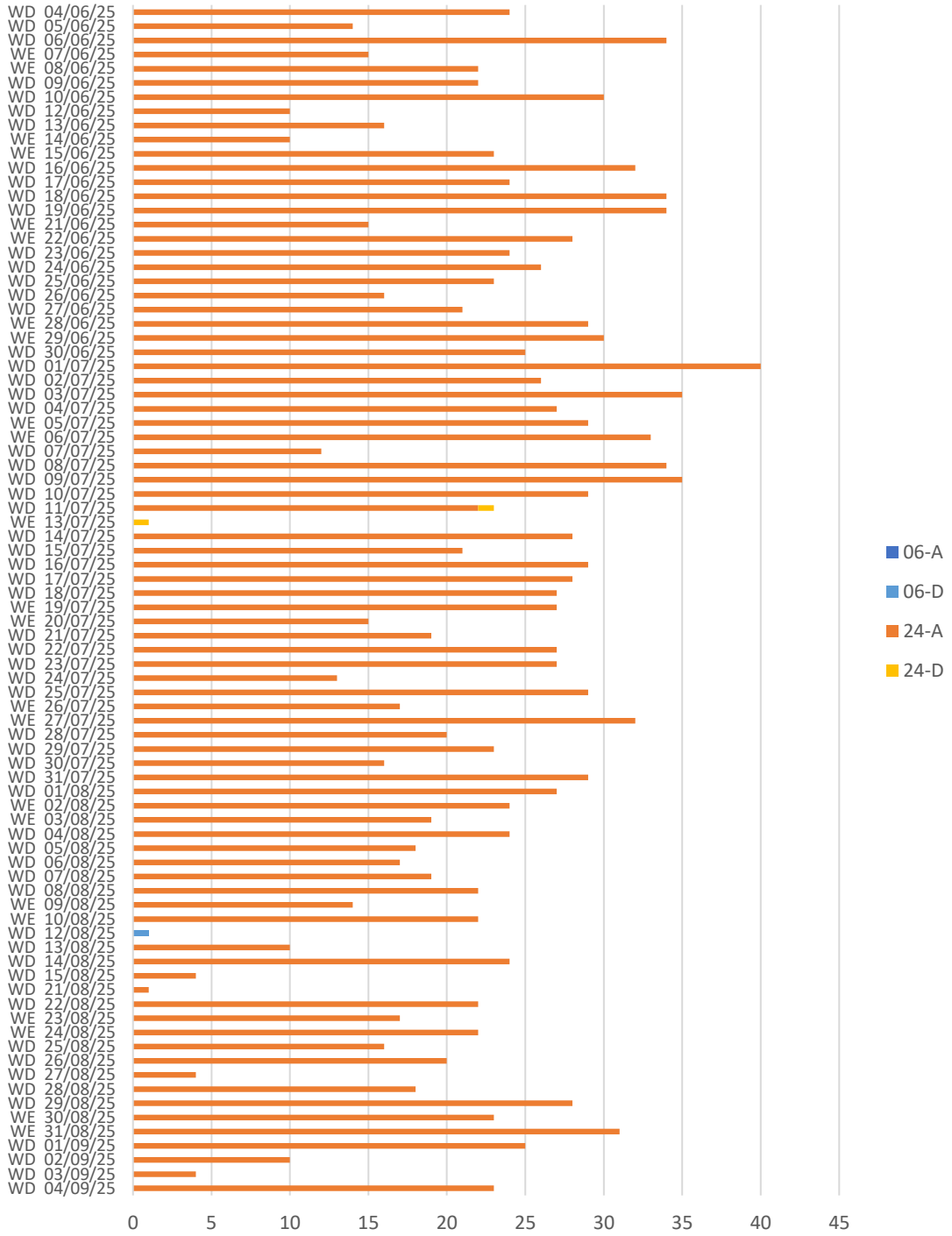

Figure 4: Number of overflights per day. WD is Weekday, WE is Weekend.

Figure 5 shows the average number of overflights per hour across the seven-day week. During the airport's operational hours (07:00 – 22:00 weekday and 08:00 – 20:00 weekend) there were generally on average between 1-2 overflights per hour. There were no overflights recorded outside those hours.

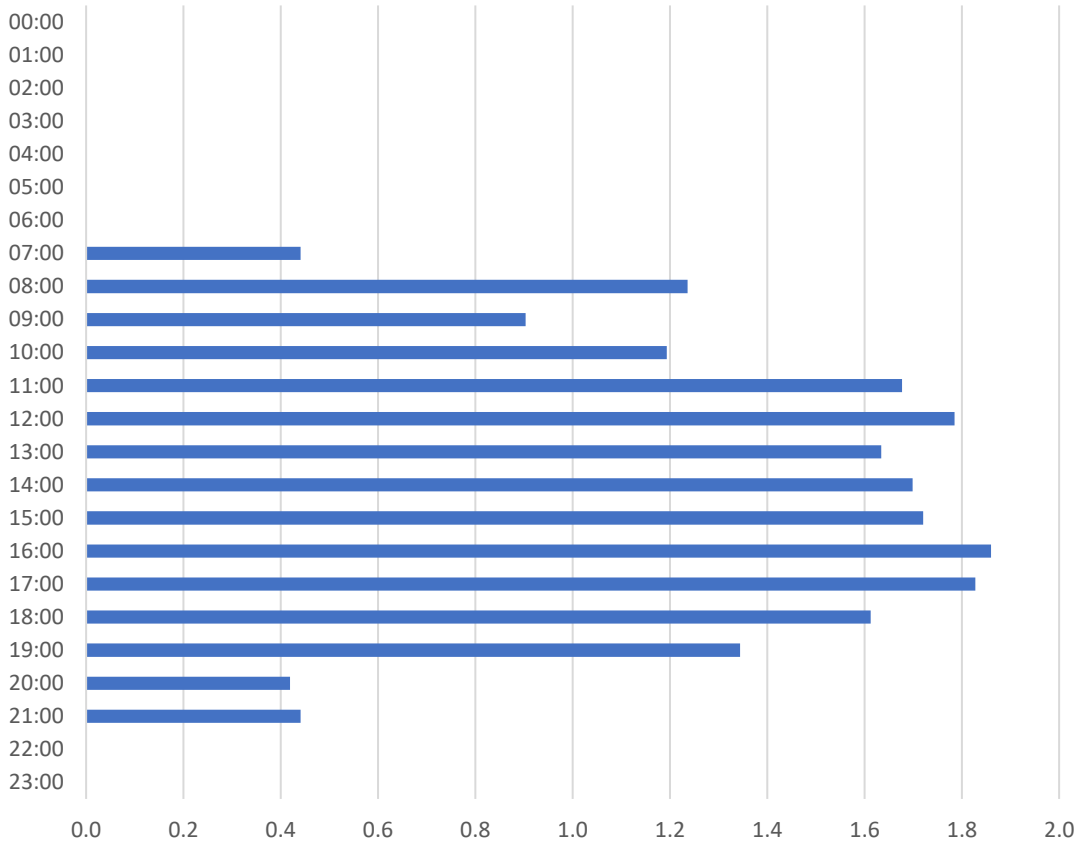

Figure 5: Average number of overflights per hour.

NB: The time stated is the start of the hour, e.g. 07:00 refers to 07:00 – 07:59.

Figure 6 shows the actual number of overflights per hour that occurred on the busiest day (01/07/25) in the monitoring period excluding the day of install. On the busiest day there were a total of 40 overflights and a maximum of 5 in any hour. As the survey location is generally only overflown by westerly arrivals, there were nine days during the monitoring period with no overflights, when the airport was operating in an exclusively easterly direction.

On average, arrivals to Runway 24 were at a height above the airport of around 2,300 ft at their closest lateral distance to the measurement location. In the 3 instances where an overflight occurred which wasn't a Runway 24 arrival, the altitudes were between 6,000 and 8,000 ft.

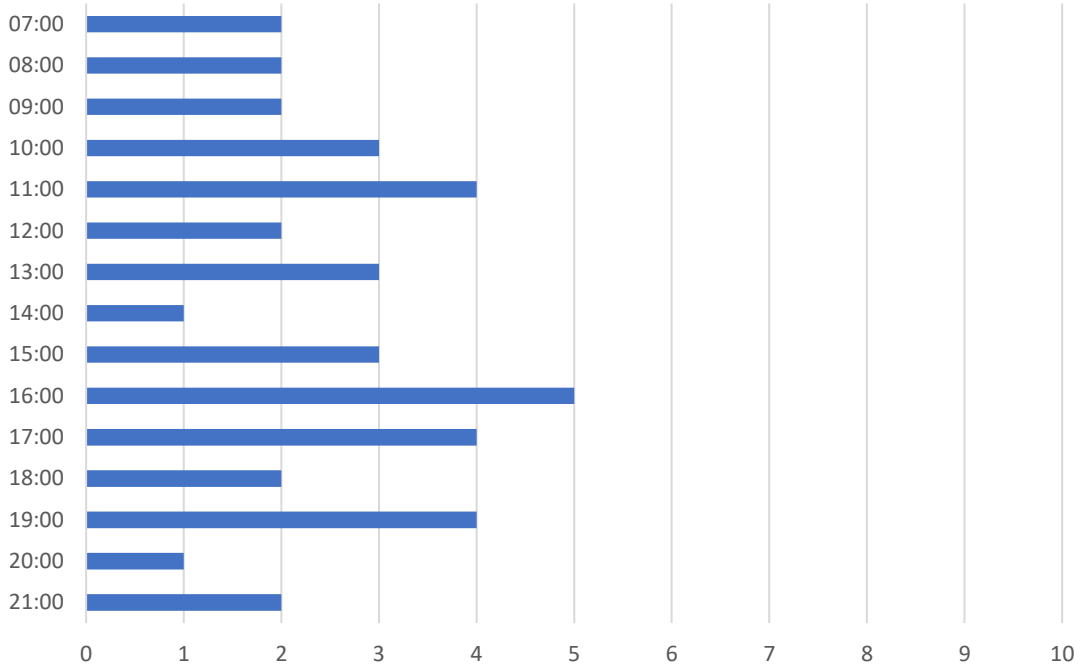

Figure 6: Actual number of overflights per hour, busiest day (01/07/25).

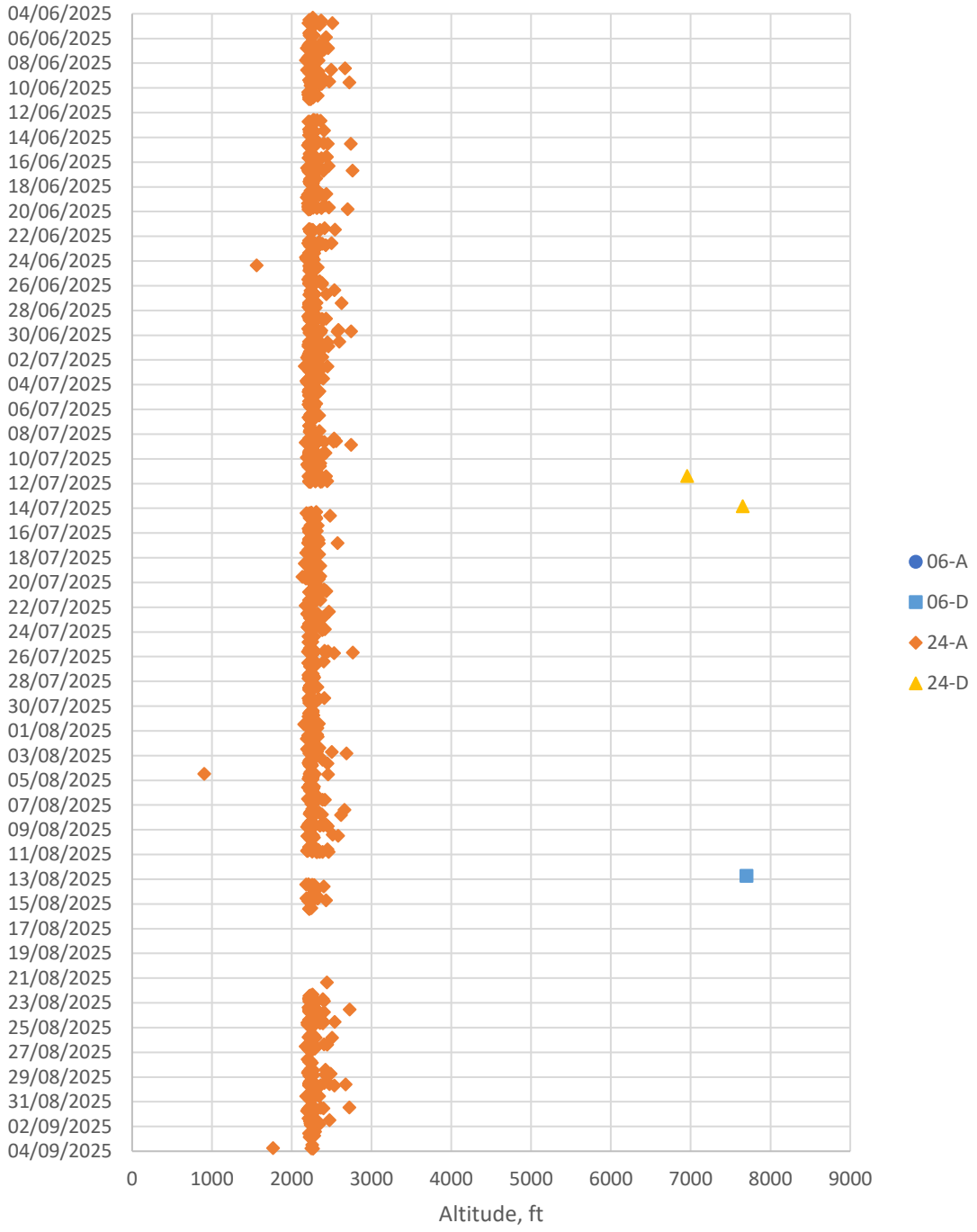

Figure 7: Height above the airport of overflights at their closest lateral distance to the NMT.

3.0 AIRCRAFT NOISE

Noise data was logged continuously over the measurement period and the overflights identified were correlated with measured noise events. For each overflight the time was determined when the aircraft was at its closest lateral distance to the measurement position. This time was then used to analyse the noise data and find the corresponding noise event. Where there were multiple possible noise events around the time of the overflight it was assumed that the event with the highest maximum noise level corresponded to the overflight.

It is not practical to achieve a 100% correlation rate with an unattended noise monitor. Factors such as high wind speeds and local noise events introduce measurement uncertainty and aircraft that are particularly quiet may not produce a distinct noise event relative to ambient noise levels. However in total, 1,710 of the 1,841 overflights (93%) were correlated with a measured noise event. This is comfortably above the requirement[1] for an automatic sound-monitoring system to correctly classify 50% of aircraft sound events. It is also above the target of 80% applied to the permanent monitoring system around London City Airport.

The noise monitor was situated in a suburban location at a property in Woking. Sources contributing to the noise environment, besides airborne aircraft, therefore included road traffic and domestic activities. The daytime average noise level from all sources throughout the measurement period was 50 dB $L_{Aeq,16h}$ and the corresponding background daytime noise level was 37 dB L_{A90}. Of the overflights that were correlated with a noise event, the average maximum noise level was 63 dB L_{ASmax}.

Aircraft noise is often reported in terms of the Sound Exposure Level (SEL). Whereas the L_{ASmax} level refers to the single highest noise level of the event, the SEL represents the total sound energy of the whole event and accounts for the duration of the event as well as its intensity. The numerical value is typically around 10 dB higher than the equivalent L_{ASmax} value. In this case the average overflight produced an SEL of 73 dB(A).

While the propagation of noise, including aircraft noise, can be affected by the weather the survey was conducted over a relatively long period to capture a representative range of weather conditions. The reported noise levels for the correlated aircraft overflights are those measured by the monitor and as such have not been modified with respect to weather or distance.

Table 2 summarises the number of overflights that were correlated with a noise event by aircraft type, runway and operation. Aircraft types with fewer than 10 measurements have been grouped as ‘Other’ aircraft.

[1] BS ISO 20906:2009+A1:2013 Acoustics — Unattended monitoring of aircraft sound in the vicinity of airports

Figure 8 shows the measured noise maximum of the overflights correlated with noise events against the ambient and background daytime noise levels.

The radar data shows that the measurement location is overflown most often by Runway 24 arrivals, and this is reflected in the number of noise measurements collected. The results for Runway 24 arrivals for aircraft types that were measured at least 10 times are presented in detail in Table 3 and Figure 9.

Due to the survey location, there were no aircraft types with at least 10 measurements for Runway 06 arrivals or departures or Runway 24 departures.

As can be seen in Figure 9, there is a wide spread of measured noise levels for each aircraft type. This variation is down to many factors that are unique to each individual aircraft operation; the exact position of each aircraft and its distance to the monitor, how each aircraft is being operated, and atmospheric conditions such as temperature, wind speed and direction. The results presented are those measured at the survey location and have not been modified to attempt to allow for these factors. Results for aircraft types with few measurements may not be representative.

Figure 10 summarises the number of overflights that were measured to exceed 65 dB L_{ASmax} each day (N65). N65 has become a commonly used aircraft noise metric, as it is considered potentially easier to understand for the public than average L_{eq} noise levels. Approximately 22% of all correlated overflights (369 out of 1,710) exceeded this level. On average there were 5 and on occasion up to 12 correlated overflights producing this noise level per day.

Figure 11 shows representative sound levels for a number of non-aircraft activities and situations to aid in comparison with the measured aircraft noise levels.

Aircraft Type			Runway 06		Runway 24	
Code	Description	MTOW[2]	Arrivals	Departures	Arrivals	Departures
B737	Boeing 737-700 (BBJ)	77.6T	0	0	15	0
BE20	Beechcraft Super King Air 200	5.7T	0	0	22	0
C25A	Cessna Citation CJ2	5.6-5.7T	0	0	15	0
C25B	Cessna Citation CJ3	5.7-6.3T	0	0	14	0
C525	Cessna 525 CitationJet	3.9T	0	0	17	0
C56X	Cessna Citation Excel	9.1-9.2T	0	0	121	0
C68A	Cessna Citation Latitude	14.0T	0	0	80	0
CL30	Bombardier Challenger 300	17.5-17.6T	0	0	23	0
CL35	Bombardier Challenger 350	18.4T	0	0	123	0
CL60	Bombardier Challenger 600	17.2-21.9T	0	0	95	0
CRJ2	Bombardier CRJ200	20.6-24.0T	0	0	32	0
E145	Embraer ERJ-145	20.0-22.0T	0	0	26	0
E190	Embraer E190	40.8 – 54.5T	0	0	15	0
E35L	Embraer Legacy 600	22.2-22.5T	0	0	72	0
E550	Embraer Legacy 500	17.2-19.4T	0	0	102	0
E55P	Embraer Phenom 300	8.2-8.3T	0	0	159	0
F2TH	Dassault Falcon 2000	16.2-19.4T	0	0	52	0
F900	Dassault Falcon 900	20.6-22.2T	0	0	16	0
FA7X	Dassault Falcon 7X	31.3-31.8T	0	0	66	0
FA8X	Dassault Falcon 8X	33.1T	0	0	24	0
G280	Gulfstream G280	18.0T	0	0	19	0
GA5C	Gulfstream G500	36.1-38.6T	0	0	12	0
GA6C	Gulfstream G600	42.9T	0	0	31	0
GL5T	Bombardier Global 5000	39.8-42.0T	0	0	46	0
GL7T	Bombardier Global 7000	52.1T	0	0	32	0
GLEX	Bombardier Global Express	42.4-45.1T	0	0	122	0
GLF4	Gulfstream IV	32.2-33.8T	0	0	23	0
GLF5	Gulfstream V	34.0-47.0T	0	0	47	0
GLF6	Gulfstream G650	39.8-42.0T	0	0	91	0
H25B	Hawker 800	12.2-12.7T	0	0	11	0
PC12	Pilatus PC-12	4.1-4.7T	0	0	14	0
PC24	Pilatus PC-24	8.0-8.5T	0	0	70	0
Other			0	0	103	0
Total			**0**	**0**	**1,710**	**0**

Table 2: Number of correlated overflight noise events at the measurement location.

[2] MTOW can vary between specific variants of the same aircraft type, ranges given where this is the case

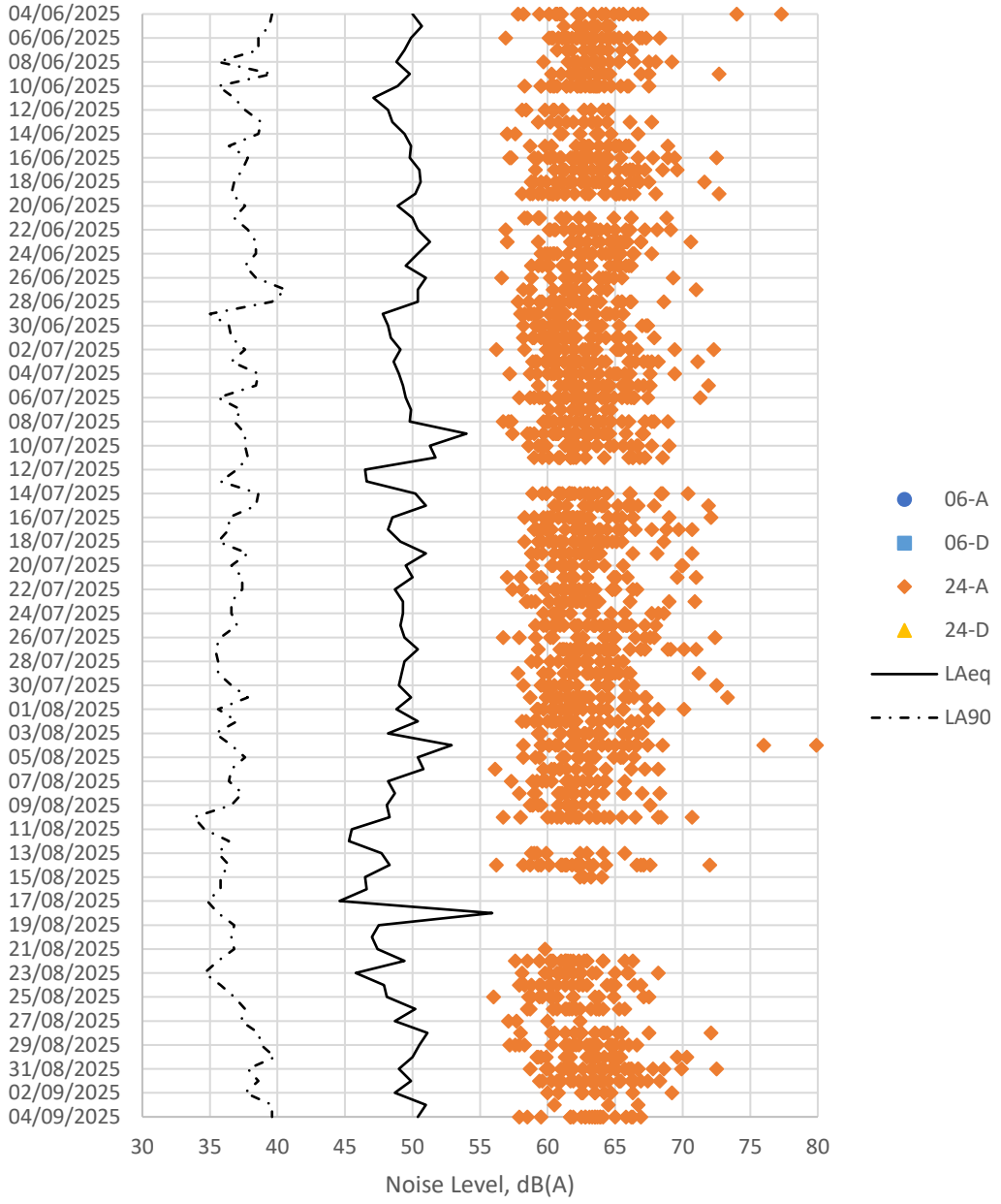

Figure 8: All correlated aircraft noise maxima against average ambient and background noise levels.

Figure 8 shows that the noise levels from the aircraft that were correlated are well above the background noise level (L_{A90}) shown as a dashed line, this means these aircraft were likely to be clearly audible.

Figure 8 also shows that the average noise level ($L_{Aeq,16h}$) shown as a solid line does not necessarily correlate with either the frequency of relative loudness of aircraft events. For instance, on 1st July there were many more overflights than on average and on 4th June there were two particularly loud overflights, but the average noise levels on these days were not particularly high. Similarly, on 18th August the average noise level at the monitor was at its highest during the monitoring period, but there were no overflights on this day. This suggests that aircraft, while clearly audible, are not the only and potentially not the primary source of noise at the survey location.

Aircraft Type		MTOW[2]	Number	Sound Exposure Level, dB(A)		
Code	Description			Average	Minimum	Maximum
B737	Boeing 737-700 (BBJ)	77.6T	15	77	75	81
BE20	Beechcraft Super King Air 200	5.7T	22	72	66	79
C25A	Cessna Citation CJ2	5.6-5.7T	15	70	65	75
C25B	Cessna Citation CJ3	5.7-6.3T	14	70	63	84
C525	Cessna 525 CitationJet	3.9T	17	70	64	74
C56X	Cessna Citation Excel	9.1-9.2T	121	73	68	79
C68A	Cessna Citation Latitude	14.0T	80	71	67	77
CL30	Bombardier Challenger 300	17.5-17.6T	23	73	69	75
CL35	Bombardier Challenger 350	18.4T	123	73	68	82
CL60	Bombardier Challenger 600	17.2-21.9T	95	72	67	77
CRJ2	Bombardier CRJ200	20.6-24.0T	32	72	66	78
E145	Embraer ERJ-145	20.0-22.0T	26	72	67	77
E190	Embraer E190	40.8 – 54.5T	15	79	77	84
E35L	Embraer Legacy 600	22.2-22.5T	72	71	67	77
E550	Embraer Legacy 500	17.2-19.4T	102	71	65	82
E55P	Embraer Phenom 300	8.2-8.3T	159	72	63	78
F2TH	Dassault Falcon 2000	16.2-19.4T	52	72	66	77
F900	Dassault Falcon 900	20.6-22.2T	16	74	68	79
FA7X	Dassault Falcon 7X	31.3-31.8T	66	75	65	80
FA8X	Dassault Falcon 8X	33.1T	24	74	67	81
G280	Gulfstream G280	18.0T	19	72	70	79
GA5C	Gulfstream G500	36.1-38.6T	12	73	69	76
GA6C	Gulfstream G600	42.9T	31	72	68	76
GL5T	Bombardier Global 5000	39.8-42.0T	46	76	73	85
GL7T	Bombardier Global 7000	52.1T	32	76	73	79
GLEX	Bombardier Global Express	42.4-45.1T	122	76	64	79
GLF4	Gulfstream IV	32.2-33.8T	23	72	67	77
GLF5	Gulfstream V	34.0-47.0T	47	72	65	79
GLF6	Gulfstream G650	39.8-42.0T	91	74	69	77
H25B	Hawker 800	12.2-12.7T	11	72	66	81
PC12	Pilatus PC-12	4.1-4.7T	14	74	72	77
PC24	Pilatus PC-24	8.0-8.5T	70	71	64	77

Table 3: Measured noise levels (SEL) of Runway 24 arrivals for common aircraft types.

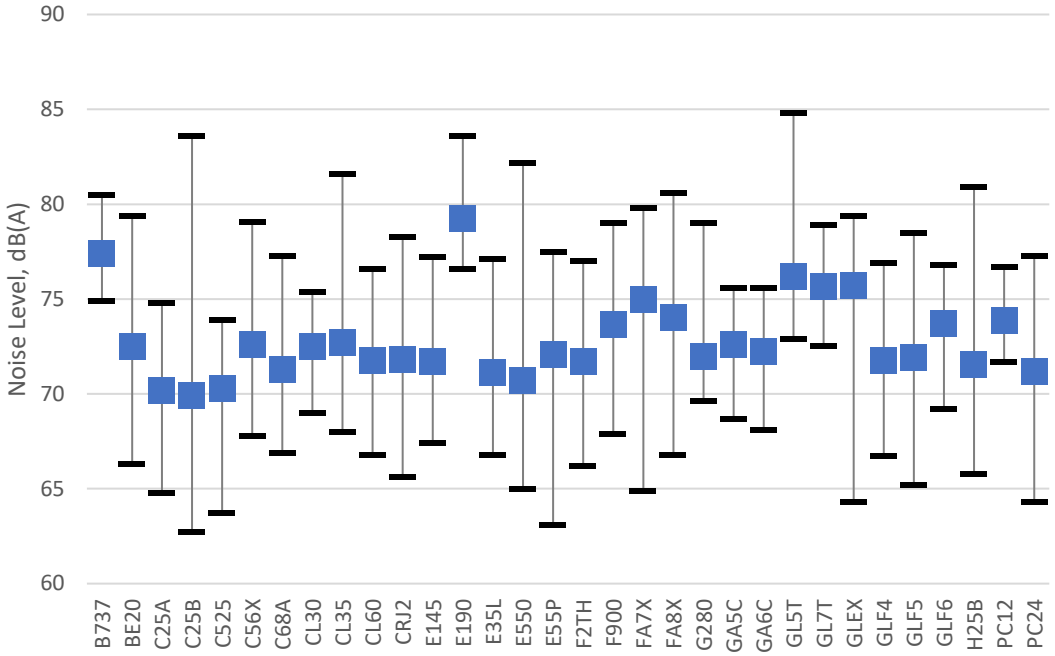

Figure 9: Measured noise levels (SEL) of Runway 24 arrivals for common aircraft types. Blue: average SEL. Black: minimum SEL and maximum SEL.

Figure 9 indicates a range of measured noise results for each aircraft type, each aircraft type typically shows a distribution around the average. These average noise levels are representative of all overflights which are Runway 24 arrivals, due to the high correlation rate. The measured events for this survey show the range of sound produced by aircraft overflights in Woking. However, there may also be contributions from non-aircraft noise sources and in some cases this may affect the maximum levels.

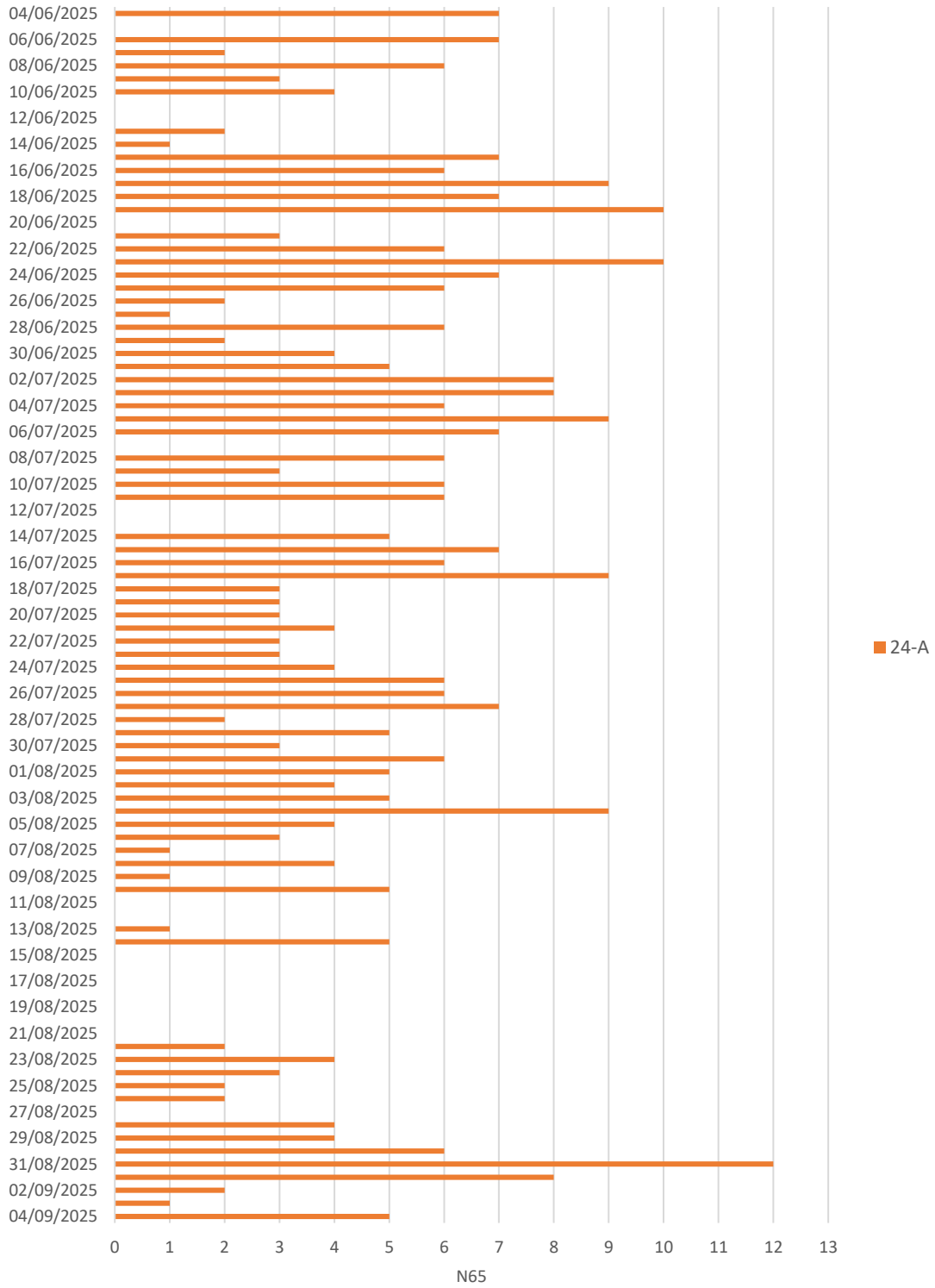

Figure 10: Number of overflights measured as exceeding 65 dB L_{ASmax} per day (N65).

Situation	Sound Pressure Level LpA dB(A)
Threshold of pain	130
Threshold of discomfort	120
Chainsaw, 1m distance	110
Disco, 1m from speaker	100
Diesel truck pass-by, 10m away	90
Kerbside of busy road, 5m away	80
Vacuum cleaner, distance 1m	70
Conversational speech, 1m	60
Quiet office	50
Room in quiet, suburban area	40
Quiet library	30
Background in TV studio	20
Rustling leaves in the distance	10
Hearing threshold	0

Source: Airports Commission, based substantially on http://www.sengpielaudio.com/TableOfSoundPressureLevels.htm

Figure 11: Approximate sound pressure levels (LpA) for different activities or situations.

4.0 SUMMARY

Aircraft operations and noise levels were monitored in Woking from 4 June 2025 to 4 September 2025. This was conducted using an NMT set to trigger events based on a threshold of 54 dB with a minimum duration of 5 seconds. This found that:

- The vast majority of overflights (1,838 of 1,841) were Runway 24 arrivals.
- The overall runway usage during the measurement period was 18%/82% between R06/R24. There were only 3 cases where an overflight wasn't a Runway 24 arrival, which shows that Runway 24 arrivals are most likely to overfly Woking compared to any other operation.
- There were a total of 3,804 Runway 24 arrivals in the measurement period. 48% of these were identified as overflying the survey location in Woking. The remainder were generally too far to the north of the survey location to be within the CAA's definition of "overflight".
- Across the airport's operational hours (07:00 – 22:00 on weekdays and 08:00-20:00 at the weekend) there were on average between 1 and 2 overflights per hour and none recorded outside those hours.
- Of the overflights that were correlated with a noise event the average maximum noise level was around 63 dB L_{ASmax}, compared to the average ambient noise level of 50 dB $L_{Aeq,16h}$. The corresponding SEL, accounting for the duration of each overflight, was 73 dB(A) SEL.
- On average there were 5 and on occasion up to 12 overflights per day that were correlated with a noise event producing a maximum noise level of 65 dB L_{ASmax} or greater.

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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_{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	The Sound Exposure Level (SEL) is the constant sound level that has the same amount of sound energy in one second as the total sound energy of an event over its entire duration. This is equal to $L_{Aeq,T}$ + 10 Log(T), where T is the duration in seconds.
N65	The number of aircraft noise events with a maximum noise level of 65 dB L_{ASmax} or greater at a specific location and in a defined time period. Typically, contours ranging from 10 events to 500 events are plotted.