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A REPORT OF MONITORING OF
AIRCRAFT NOISE FROM STANSTED AIRPORT
AT HATFIELD HEATH, ESSEX
BETWEEN OCTOBER AND DECEMBER 2009

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Executive Summary

A mobile Noise Monitoring Terminal (NMT) was deployed by Stansted Airport on 29th September 2009. The site is approximately 10 km south south-west the airport, at Hatfield Heath in Essex. On days when aircraft are taking off from Stansted to the west, the site lies under the flight paths of departing aircraft.

The aim of this report is to present the results of the three months of noise monitoring at this site (October, November and December 2009) and to interpret the results in a way that places the contribution of the noise from aircraft using Stansted in the context of the overall noise climate from all other sources. It is the intention that the monitor will remain in place for 12 months and then a further report will present the results over the 12 month period and a comparison with the results over the first three months, with the aim of informing policy decisions about the duration of future community noise monitoring exercises.

The NMT records noise data relating to all noise events which exceed a selected threshold noise level for a selected minimum period of time. These selected conditions were 62 dBA for 10 seconds.

These noise events are then compared by the airport's ANOMS (Airport Noise and Operations Monitoring System) noise and track keeping computer system with radar tracks of aircraft arriving at or departing from Stansted Airport. Only those noise events which are matched with Stansted aircraft tracks are called aircraft noise events, and those that are not matched are designated as residual noise events. The remainder of the noise at the site, i.e. that noise which is not captured as noise events, (because it fails to meet the capture conditions of being above 62 dBA for 10 seconds) is also classified as residual noise.

Therefore wherever reference is made to aircraft noise events within this document it should be understood that these relate only to aircraft using Stansted airport. Any noise arising from aircraft travelling to or from any other airport will be included as residual noise.

In addition to gathering data about noise events the NMT also collects and stores, on an hourly basis, information about the total level of noise at the site from all sources.

A total of 7169 aircraft noise events occurred during the three month survey period. All but two of these aircraft noise events were due to departing aircraft, using routes 23CLN and 23DVR in more or less equal numbers. The number of aircraft noise events per day ranged from zero or one per day (on 15 days) to 128 (on one day), with an average of 80 events per day, reflecting changes in runway usage depending on wind direction.

The numbers of aircraft noise events per day did not show any obvious correlation with day of the week or weekends. The highest numbers of aircraft noise events per hour occurred in the early evening between 18.00 and 19.00 hours and in the morning between 07.00 and 09.00 hours (local time). During these 'peak' hours there were, on average, between 8 and 11 events per hour.

The maximum noise level (L_{ASmax}) of aircraft noise events ranged from 62 dBA to 87 dBA, but for most of the events was between 70 and 75 dBA, with an overall average of 71 dBA, and with 31 events greater than 80 dBA.

The average noise level (L_{Aeq} value) during aircraft noise events, which have an average duration of about 25 seconds, is 67 dBA.
The total noise climate at the site may be characterised by average hourly values of various noise percentile levels, and by the average (or equivalent) noise level (L_{Aeq}). These values were fairly constant during the daytime, between 07.00 and 19.00 hours (with average values of L_{AS10} of 54 dBA, L_{AS90} of 46 dBA and L_{Aeq} of 56 dBA), but falling to lower levels in the late evening, night-time and early morning periods. The average value over the night-time period from 23.00 to 07.00 hours (L_{Aeq} values) was 50 dBA, and for the evening period from 19.00 to 23.000 hours was 54 dBA.

The daily average (L_{Aeq}) level of the total noise at the site is a combination of that due to aircraft noise events and that due to residual noise. The aircraft noise provides the major component, generally about 2 to 3 dBA below that of the total noise level, with the average level due to residual noise being typically about 1 dBA below the aircraft average (L_{Aeq}) level and 3 to 4 dBA below the level of the total noise at the site

It is possible to convert the hourly L_{Aeq} values into the 24 hour L_{den} noise index (day evening night level) used by Defra for noise mapping purposes, giving, on the basis of the data collected at this site over the three months period, an L_{den} value for the total noise of 58 dBA and of 56 dBA for the aircraft noise.

In order to place the noise climate at the site in a wider UK context the noise levels from the NMT have been compared with the results of the National Noise Index survey of noise levels in the UK in 2000, with World Health Organisation Guidelines, and with Stansted Airport aircraft noise contours.

The average maximum noise level (L_{ASmax}) during aircraft noise events does not vary significantly with aircraft type for the aircraft types which make up most of the aircraft noise events.

The information presented in this report will serve as a baseline for comparison with any future noise level surveys in this format that may be undertaken at this location.

1.0 Introduction

1.1 A mobile Noise Monitoring Terminal (NMT) has been deployed by Stansted Airport for a twelve-month period commencing 29th September 2009.

1.2 The noise monitor is located about 3 metres away from a detached bungalow in the village immediately surrounded by grassland and shrubs. A minor road about 60 m away runs past the property which is also about 100m from a school. Noise at the site is from road traffic, from the school and from birdsong and occasionally noise from grass cutting at the property. The site is approximately 10 km south south-west of the airport, at Hatfield Heath in Essex. A map showing the location (indicated by an arrow) is presented in Appendix 1. On days when aircraft are taking off from Stansted to the west, the site lies under the flight paths of aircraft using departure routes 23DVR and 23 CLN.

1.3 The aims of this report are:

- to present the results of the three month noise monitoring survey, and
- to interpret the results in a way that places the contribution of the noise from passing aircraft using Stansted airport in the context of the overall noise climate from all other sources, and
- To provide a baseline for comparison with any future noise surveys in this format that may be undertaken at this location.

1.4 A glossary of technical terms used in this report is given in the Appendix 3.

2.0 Data from the Noise Monitoring Terminal

2.1 The Noise monitoring Terminal (NMT) gathers data about the number and level of aircraft noise events, and also data about the total level of noise at the site, on an hourly basis. The hourly values of total noise are a combination of the noise from the aircraft noise events and from all other noise sources, called residual noise.

2.2 Further details about the way the NMT gathers and processes noise data is given in Appendix 2.

3.0 Analysis of Noise Monitoring Survey Results

3.1 <u>The numbers of aircraft noise events</u>

3.1.1 A total of 7169 aircraft noise events were recorded at the site during the three month period; 2375 in October, 2782 in November, and 2012 in December. The number of aircraft noise events per day ranged from zero to 128, with an average of 80 events per day over the three month period.

3.1.2 Almost all of these aircraft noise events were due to departing aircraft, more or less evenly divided between those following route 23DVR (3472 events) and those following route 23CLN (3695 events). There were two events arising from aircraft arrivals.

3.1.3 Figure 1 shows the total number of aircraft noise events occurring each day during the 3 months period from October to December 2009, also showing the relative numbers following each departure route. The number of aircraft noise events varied from 0 to 128 per day. There was no obvious correlation between the number of aircraft noise events and the day of the week or weekend. For most days there were more than 60

events per day, but for 15 days there was either just one event per day or none at all. This distribution almost certainly reflects the breakdown between easterly and westerly departure directions, determined by wind direction.

3.1.4 Figure 2 indicates the average distribution of numbers of aircraft noise events throughout the 24 hour day, showing that the highest number of events per hour occurred in the early evening between 18.00 and 19.00 hours and in the morning between 07.00 and 09.0hours. During these 'peak' hours there were on average between 8 and 11 events per hour.

3.2 Maximum noise levels of aircraft noise events

3.2.1 The NMT recorded the maximum noise level (measured using the 'A' frequency weighting and the Slow (S) time weighting) produced by each aircraft noise event, (L_{ASmax}). These values ranged from 62 dBA to 87 dBA, but more than 99% of the events have maximum noise levels of less than 80 dBA, with an overall average of 71 dBA. There are 31 events (out of a total of 7169) with a maximum noise level greater than 80 dBA. Figure 3 indicates the average L_{ASmax} value of aircraft noise events recorded each day during the three month monitoring period, for days where there were more than 1 event per day. Figure 4 shows the variation of average hourly value of L_{ASmax} value for the three month period. Figure 5 shows a statistical distribution of L_{ASmax} values for the three month period.

3.2.2 It can be seen from Figure 3 that average maximum level per day range between 67 dBA and 73 dBA. There does not appear to be any noticeable pattern to the variation from day to day. In addition, and not shown in Figure 3, on October 12th there was just one aircraft noise event, at 01.50 hours, with a maximum noise level of 80.3 dBA. This event is discussed again later in this report in paragraph 3.7.4.

3.2.3 The variation by hour of day (Figure 4) shows that for all but five early morning hours the average levels varied by less than 2 dB, between 70 and 72 dBA. Figure 5 shows that the maximum noise level of most events lies between 70 and 75 dBA.

3.3 Durations and average noise levels of aircraft noise events

3.3.1 The duration of 90% of the aircraft noise events was between 10 seconds and 31 seconds, with an average value for all events of 25 seconds.

3.3.2 In addition to L_{ASmax} values the NMT also recorded the Single Event Noise Level (SEL) for each aircraft noise event. This parameter relates to the amount of sound energy in each event, and may be used to calculate the average noise level, or L_{Aeq} value, over the event duration. These L_{Aeq} values range from 60 to 80 dBA but with more than half between 66 and 70 dBA and with an overall average value of 67 dBA.

3.3.3 Thus a typical aircraft noise event might represent an average noise level of about 67 dBA for about 25 seconds, but varying within the 25 seconds, between the trigger level of 62 dBA and the average maximum value of 71 dBA.

3.4 The total noise climate at the site

3.4.1 The NMT also recorded the total noise level (i.e. from all sources, including aircraft and residual noise events) each hour, measured in terms of the hourly values of L_{Aeq} (representing the average noise level over the hour) and the following statistical percentile levels: L_{AS1}, L_{AS10}, L_{AS50}, L_{AS90} and L_{AS99}, where, for example L_{AS10} is the noise

level (measured using the 'A' frequency weighting (i.e. in dBA) and the Slow (S) time weighting) exceeded for 10% of the 1 hour measurement time interval. Figure 6 shows these values averaged over the three month noise survey period for each hour of the day.

3.4.2 It can be seen from Figure 6 that the value of each index is fairly constant from about 07.00 hours to 19.00 hours but then falls off outside these times (i.e. in the late evening, night-time and early morning periods).

3.4.3 The average values of the various noise indices over various parts of the 24 hour day (day, evening, night etc.) are shown below. For all these periods the indices were calculated from the relevant hourly levels, using arithmetic averages in the case of the statistical levels and logarithmic averages for the L_{Aeq} indices.

Noise climate index	Noise level, dBA				
	Day (07.00-19.00)	Evening (19.00-23.00)	Night (23.00-07.00)	Day and Evening (07.00-23.00)	24 hours
L_1	65	63	54	65	61
L_{10}	54	51	46	53	51
L_{50}	49	46	42	48	46
L_{90}	46	43	40	46	44
L_{99}	45	41	38	44	42
L_{Aeq}	56	54	50	55	54

3.4.4 Since Figure 6 shows that, on average, the noise levels at the site do not vary much from hour to hour in the daytime they are unlikely to vary much within each hour, and so the data shown in Figure 6, and particularly the L_{Aeq} values, could be used as a good indication of 30 minute L_{Aeq} values, required in Building Bulletin 93 for the assessment of noise climates near to schools in the vicinity.

3.4.5 For a period of one hour the value of the L_{AS10} noise index is the noise level exceeded for 6 minutes in that hour, and value of the L_{AS90} noise index is the noise level exceeded for 54 minutes in the hour, so that noise levels at or below the L_{AS90} value occur for 6 minutes in the hour. Thus Figure 6 shows that for a typical hour in the daytime (07.00 to 19.00 hours) the total noise level over the entire hour at this site would exceed 54 dBA (L_{A10} value) for 6 minutes, and would be below 46 dBA (L_{A90} value) for 6 minutes, and would therefore be between 46 and 54 dBA for 48 minutes of the hour.

3.4.6 The UK Government Department, Defra, has used the 24 hour L_{den} noise index (day evening night level) for noise mapping purposes. This index is based on average levels of aircraft noise (LAeq values) throughout the day but with a weighting penalty of 5 dB applied to noise in the evening (19.00 hours to 23.00 hours) and a 10 dB penalty at night-time (23.00 hours to 07.00 hours). It is possible to convert the hourly L_{Aeq} values displayed in Figure 6 and in the above Table into an L_{den} value for the total noise at the site, of 58 dBA.

3.5 <u>The contribution of aircraft noise events to the total noise climate at the site</u>

3.5.1 By using the Single Event Noise Level (SEL) for each aircraft noise event it is possible to calculate the average, or equivalent aircraft noise level (L_{Aeq}) due to aircraft noise events over a period of time (hour, day or month). Although this average noise level bears little relationship to the aircraft noise as heard, which occurs in short bursts of

noise at higher levels rather than as a lower continuous average level, it is, nevertheless, a useful parameter for comparative purposes.

3.5.2 Since the NMT also records hourly L_{Aeq} values of the total noise from the site it is possible, by subtracting the aircraft noise level from the total noise level (using the decibel (or logarithmic) subtraction process which is appropriate in this case) to calculate the remaining component of the total noise, i.e. the residual noise.

3.5.3 The residual noise is a combination of the noise from residual noise events (i.e. those captured noise events which did not match with aircraft movements) and from other residual noise, not captured as noise events, i.e. all other noise recorded by the monitor that did not exceed the trigger level for the required minimum time period.

3.5.4 Figure 7 shows the variation of average hourly level (L_{Aeq} values) of the total noise, aircraft noise and residual noise, and the Table below shows the average values of the these parameters over the various parts of the 24 hour day (day, evening, night etc.).

	Average Noise level (LAeq value), dBA				
	Day (07.00-19.00)	Evening (19.00-23.00)	Night (23.00-07.00)	Day and Evening (07.00-23.00)	24 hours
Total noise	56	54	50	55	54
Aircraft noise	53	51	48	53	51
Residual noise	52	50	46	52	51

3.5.5 It can from Figure 7 and from the above table that for most of the day and evening when most of the aircraft noise events occur, the level of total noise at the site is on average between 54 and 56 dBA with aircraft noise, levels, on average 2 to 3 dB lower than this, and residual noise a further 1 dB lower still. During the late night and early morning periods (from midnight to 06.00 hours) when there are very few aircraft noise events the level of aircraft noise is much lower than both the total and residual noise levels.

3.5.6 Figure 7 shows that when the noise from aircraft noise events is cumulatively averaged over an extended period of time (of hours days or weeks) they make a significant but not a dominant contribution to the average level of total noise at the site, with noise from all other sources, i.e. the residual noise, making an almost equal contribution. However each individual aircraft noise event is likely to be clearly audible and distinguishable from the residual noise because, in addition to being different in character, it results in an increase in the level of the ambient noise by about 10 dBA or more for a period of about 30 seconds

3.6 Putting the noise climate at the site into a wider UK context

National Noise Incidence Study

3.6.1 The National Noise Incidence Study of noise levels in England and Wales in 2000 carried out by the Building Research Establishment for Defra gave a breakdown of the proportion of residents exposed to noise, as follows:

Proportion of the population of England and Wales living in dwellings exposed to daytime noise levels ($L_{Aeq,\ 16\ hour}$) in 5 dB bands, in the 2000 National Noise Incidence Study	
5 dB noise exposure level bands*	Proportion in band
Less than 50 dBA	30%
50 dBA < L < 55 dBA	37%
55 dBA < L < 60 dBA	18%
Greater than 60 dBA	15%

*The noise level exposure bands in the above Table are for 'free field ' noise levels, i.e. noise levels unaffected by sound reflections from nearby surfaces. All the noise levels from the NMT are also free field values.

3.6.2 From the Table in Figure 3.4.2 data the 16 hour L_{Aeq} value for total noise at this site is 55 dBA, which puts the site in the '55 to 60 dBA' noise exposure band, occupied by 18 % of dwellings in England and Wales. It can also be seen that without the contribution from aircraft noise the 16 hour L_{Aeq} value for residual noise at this site is 52 dBA, which would put the site in the '50 to 55 dBA' noise exposure band, occupied by 37 % of dwellings in England and Wales.

3.6.3 The National Noise Incidence Study of noise levels was extended in 2002 to cover the entire UK and also to include the L_{den} index as shown below:

Proportion of UK population living in dwellings exposed to noise levels in 5 dB bands, according to the L_{den} noise index, in the National Noise Incidence Study 2002	
5 dB noise exposure level bands**	Proportion in band
Less than 55 dBA	33%
55 dBA < L < 60 dBA	38%
60 dBA < L < 65 dBA	16%
Greater than 65 dBA	13%

**The noise level exposure bands in the above Table are for noise levels measured at 1m from a building facade, and so will include a contribution (assumed to be 3 dBA) from sound reflected from the facade of the building. All the noise levels from the NMT are free field values and therefore 3 dB must be added for them to be comparable with the exposure bands in the above Table.

3.6.4 Since the L_{den} value for the total noise at this site is 58 dBA (from paragraph 3.4.4) the addition of 3dB puts the site in the '60 to 65 dBA' noise exposure band, occupied by 16% of dwellings in the UK.

World Health Organisation and PPG 24 Guidance on Community Noise

3.6.5 In 2000 the World Health Organisation issued 'Guidelines for Community Noise', which are reflected in the UK Planning Policy Guidance Note 24 (Annex 2, paragraph 4): that "general daytime outdoor noise levels of less than 55 dBA are desirable to prevent significant community annoyance" and that "at night, sound pressure levels at the outside façades of living spaces should not exceed 45 dB (L_{Aeq}) so that people may sleep with bedroom windows open."

3.6.6 The National Noise Incidence Study 2000 has estimated that 55% of the population of England and Wales live in dwellings exposed to day-time noise levels above the WHO level of 55 dB $L_{Aeq,16h}$, and that 68% are exposed to night-time levels above the WHO level of 45 $L_{Aeq,\ 8h}$.

3.6.7 The total noise exposure levels at this site based on the data collected during the 3 month noise survey period (an $L_{Aeq,16h}$ of 55 dBA in the daytime and 50 dBA at night-time) are just above the WHO Guidelines of 55 dBA in the daytime, and also above the night-time Guideline value of 45 dBA. Without the contribution from aircraft noise events the noise at the site would be the residual noise level, of 52 dBA in the daytime and 46 dBA at night-time (from paragraph 3.5.4), i.e. just below the WHO daytime guideline level but just above the night-time guideline level.

Aircraft noise contours

3.6.8 The UK government produces annual contours of predicted aircraft noise levels around various UK airports, including Stansted. The contours show the predicted values of the daytime 16 hour (07.00 to 23.00 hours) LAeq values produced by aircraft in flight, in 3 dB bands, from 73 dBA (closest to the airport) to an outer contour value of 57 dBA.

3.6.9 Based on research the Government has used 57dBA Leq as the level of daytime noise marking the approximate onset of significant community annoyance. The relationship between noise and annoyance is of course not an exact one, and varies according to individuals and locations.

3.6.10 Although it is interesting to compare the Aircraft noise levels derived from the NMT data at this site with the published contours for Stansted, in making any such comparisons it must be borne in mind that the contours are based on the average summer day, where 'summer' is the 92-day period from 16 June to 15 September, and 'day' is the 16-hour period 0700-2300 (local time), whereas the aircraft noise levels in this report are for the three month period, from October to December 2009.

3.6.11 The published contours for Stansted Airport for 2007 and 2008 (ERCD Report 0903) show that the site at Hatfield Heath lies well outside the outermost 57 dBA contour, by approximately 2 to 3 kilometres, which is consistent with the data from this study which shows that the measure 16 hour daytime L_{Aeq} value for the three month period (paragraph 3.5.4) is 53 dBA.

3.6.12 Contours of L_{den} were also produced for the year 2006 (ERCD Report 0708) to meet the requirements of the first round noise mapping exercise Under EU Directive 2002/49/EC. These contours were produced in 5 dB steps with the lowest (outermost contour) being for L_{den} of 55 dBA and were based on data for an average day over the whole year (2006). The contours show that Hatfield Heath lies just outside the 55 dBA contour, by between approximately 1 and 2 kilometres. Although it is interesting to compare the L_{den} value for aircraft noise, calculated from the values presented in this report with the published contours, it should be noted that the contours and the measured values are based on two different periods of time, for which the modal split may be different, and which will involve different numbers and types of aircraft noise events. The value of L_{den} calculated from the values given in paragraph 3.5.4 for the three month period October to December 2009 is 56 dBA.

3.6.13 It is intended that the next round of noise mapping and L_{den} contours will be carried out for the year 2011.

3.7 The contribution of different aircraft types to aircraft noise at the site

3.7.1 Sixty six different aircraft types, together with three aircraft classified as 'unknown type' contributed to the total number of 7169 aircraft noise events which occurred during the

three month period. Figure 8 shows the numbers of events from the different types of aircraft. Each aircraft type shown in Figure 8 is described by a 3 character source code. A list of these codes is given in Appendix 4.

3.7.2 Although 66 different aircraft types were involved in total, one aircraft type accounted for more than 50% of the events, and 84% of events arose from only two types of aircraft: Boeing 737-800: 4809 events (67%), Airbus A319: 1209 events (17%).

3.7.3 Figure 9 shows the average L_{ASmax} value for each aircraft type, and it can be seen that there is very little variation among the most commonly occurring aircraft types. Although there are some aircraft types which produce significantly higher values of L_{ASmax} there are only very small numbers of these types of events.

3.7.4 The single aircraft noise event which occurred at 01.50 hours on 12 October 2009, with a maximum noise level of 80.3 dBA, previously mentioned in paragraph 3.2.2, is worthy of consideration. This event was due to an Airbus A340-300. There were 65 events from this type of aircraft during the three month noise monitoring period, mostly occurring between 23.00 and 02.00 hours. The average maximum noise level from these events was 71 dBA (which is also the overall average for all types of aircraft), but there were three events with levels over 80 dBA (80.3 dBA, 81.4 and 82.7 dBA). This was therefore a rather rare and unusual event.

4.0 Summary and Conclusions

4.1 A total of 7169 aircraft noise events occurred during the three month survey period. All but two of these aircraft noise events were due to departing aircraft, using routes 23CLN and 23DVR in more or less equal numbers. The number of aircraft noise events per day ranged from zero or one per day (on 15 days) to 128 (on one day), with an average of 80 events per day, reflecting changes in runway usage depending on wind direction.

4.2 The numbers of aircraft noise events per day did not show any obvious correlation with day of the week or weekends. The highest numbers of aircraft noise events per hour occurred in the early evening between 18.00 and 19.00 hours and in the morning between 07.00 and 09.0hours. During these 'peak' hours there were on average between 8 and 11 events per hour.

4.3 The maximum noise level (L_{ASmax}) of aircraft noise events ranged from 62 dBA to 87 dBA, but for most of the events was between 70 and 75 dBA, with an overall average of 71 dBA, and with 31 events greater than 80 dBA.

4.4 The average noise level (L_{Aeq} value) during aircraft noise events, which have an average duration of about 25 seconds, is 67 dBA.

4.5 The total noise climate at the site may be characterised by average hourly values of various noise percentile levels, and by the average (or equivalent) noise level (L_{Aeq}). These values were fairly constant during the daytime, between 07.00 and 19.00 hours (with average values of L_{AS10} of 54 dBA, L_{AS90} of 46 dBA and L_{Aeq} of 56 dBA), but falling to lower levels in the late evening, night-time and early morning periods. The average value over the night-time period from 23.00 to 07.00 hours (L_{Aeq} values) was 50dBA, and for the evening period from 19.00 to 23.000 hours was 54 dBA.

4.6 The daily average (L_{Aeq}) level of the total noise at the site is a combination of that due to aircraft noise events and that due to residual noise. The aircraft noise provides the

major component, generally about 2 to 3 dBA below that of the total noise level, with the average level due to residual noise being typically about 1 dBA below the aircraft average (L_{Aeq}) level and 3 to 4 dBA below the level of the total noise at the site

4. 7 The average maximum noise level (L_{ASmax}) during events does not vary significantly with aircraft type for the relatively few aircraft types which make up most of the aircraft noise events.

4.8 The information presented in this report will serve as a baseline for comparison with any future noise level surveys at this location.

Figure 1: Number of aircraft noise events at Hatfield Heath, Essex, each day duringOctober November and December 2009 using departure routes 23 DVR lower blue) and 23 CLN (Upper , RED)

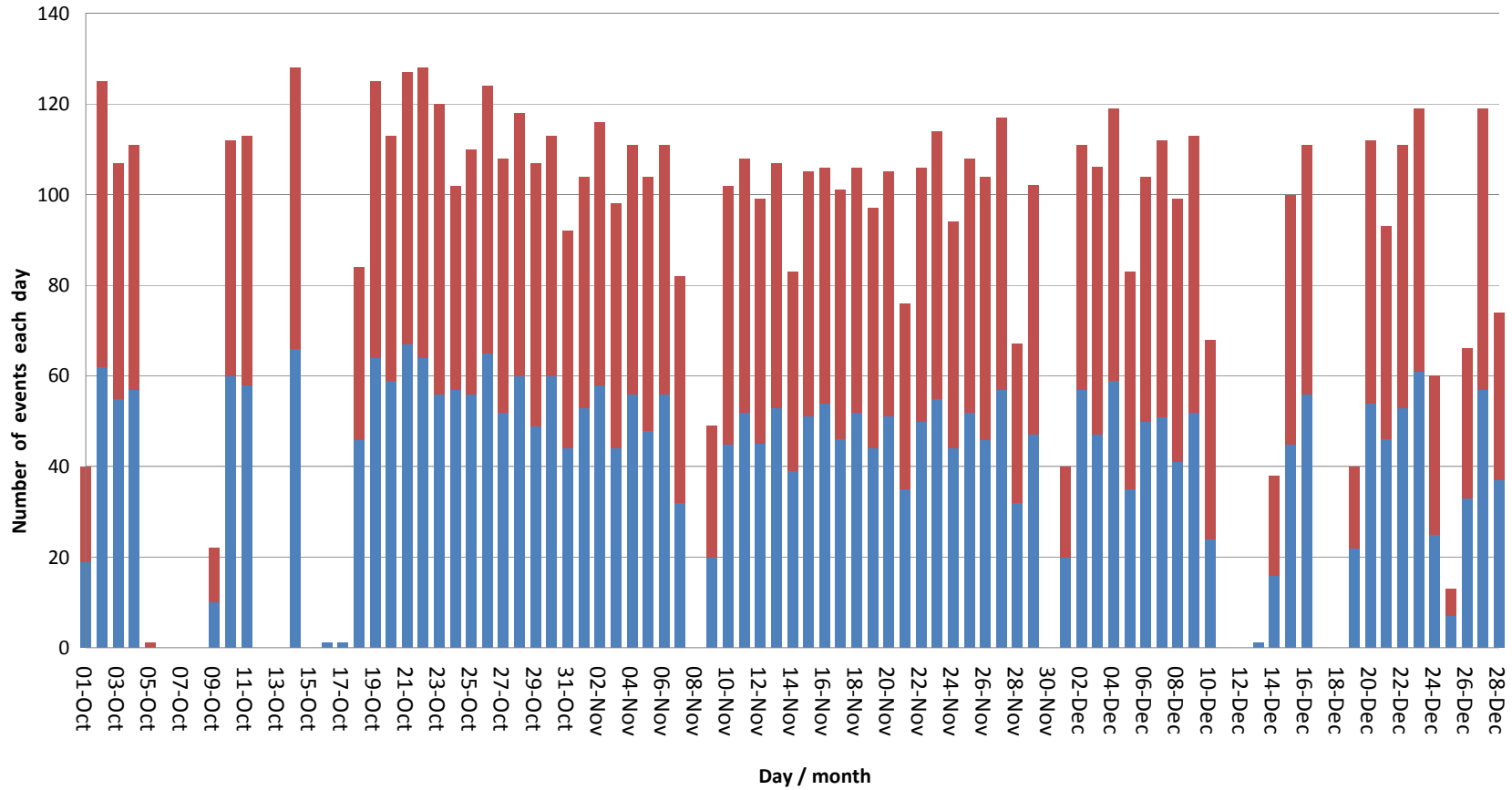


Figure 2: Average number of aircraft noise events per hour of the day at Hatfield Heath, Essex, during October, November and December 2009

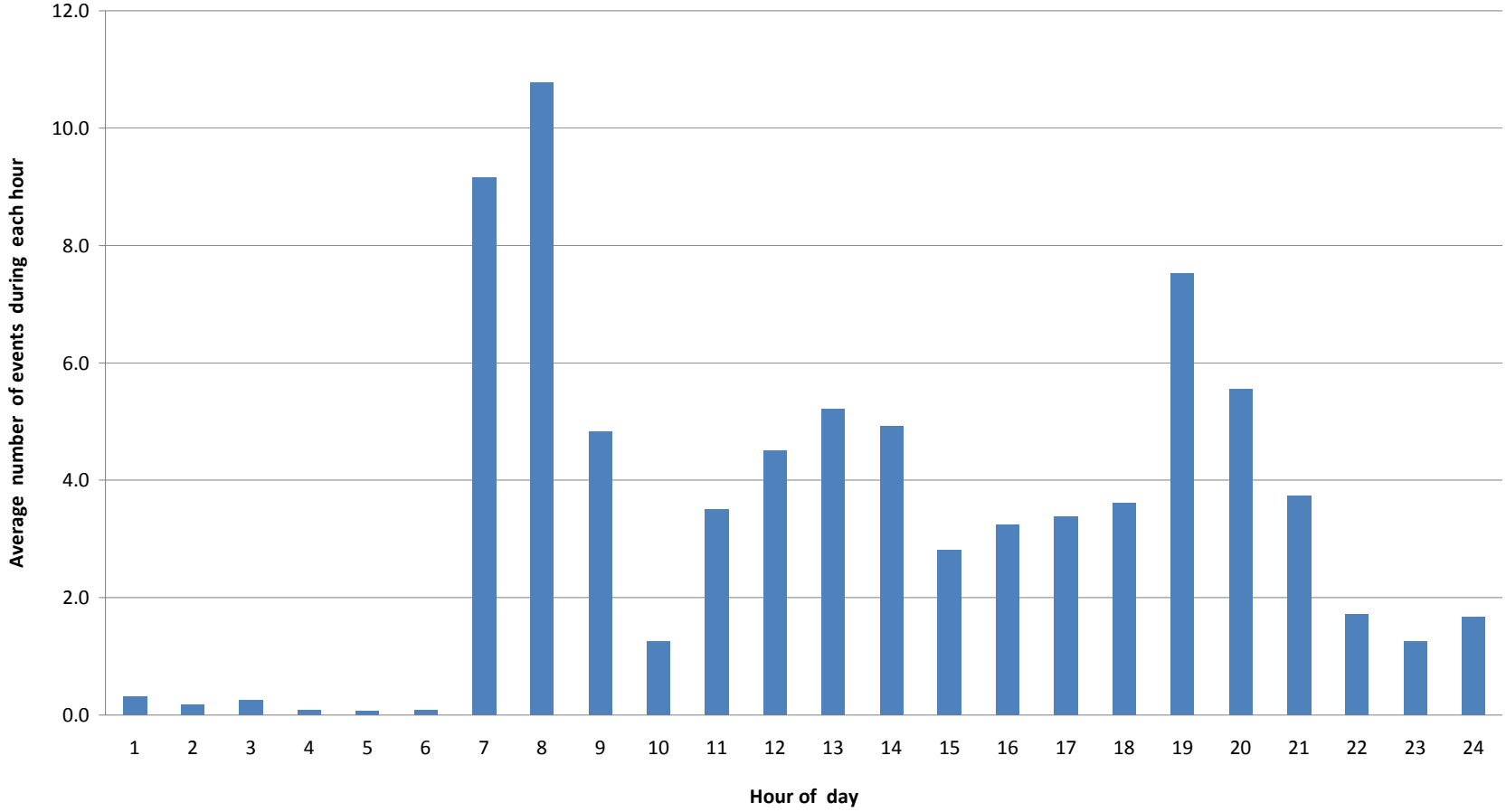


Figure 3: Average value of maximum noise levels of aircraft noise events at Hatfield Heath, Essex, each day during October November and December 2009

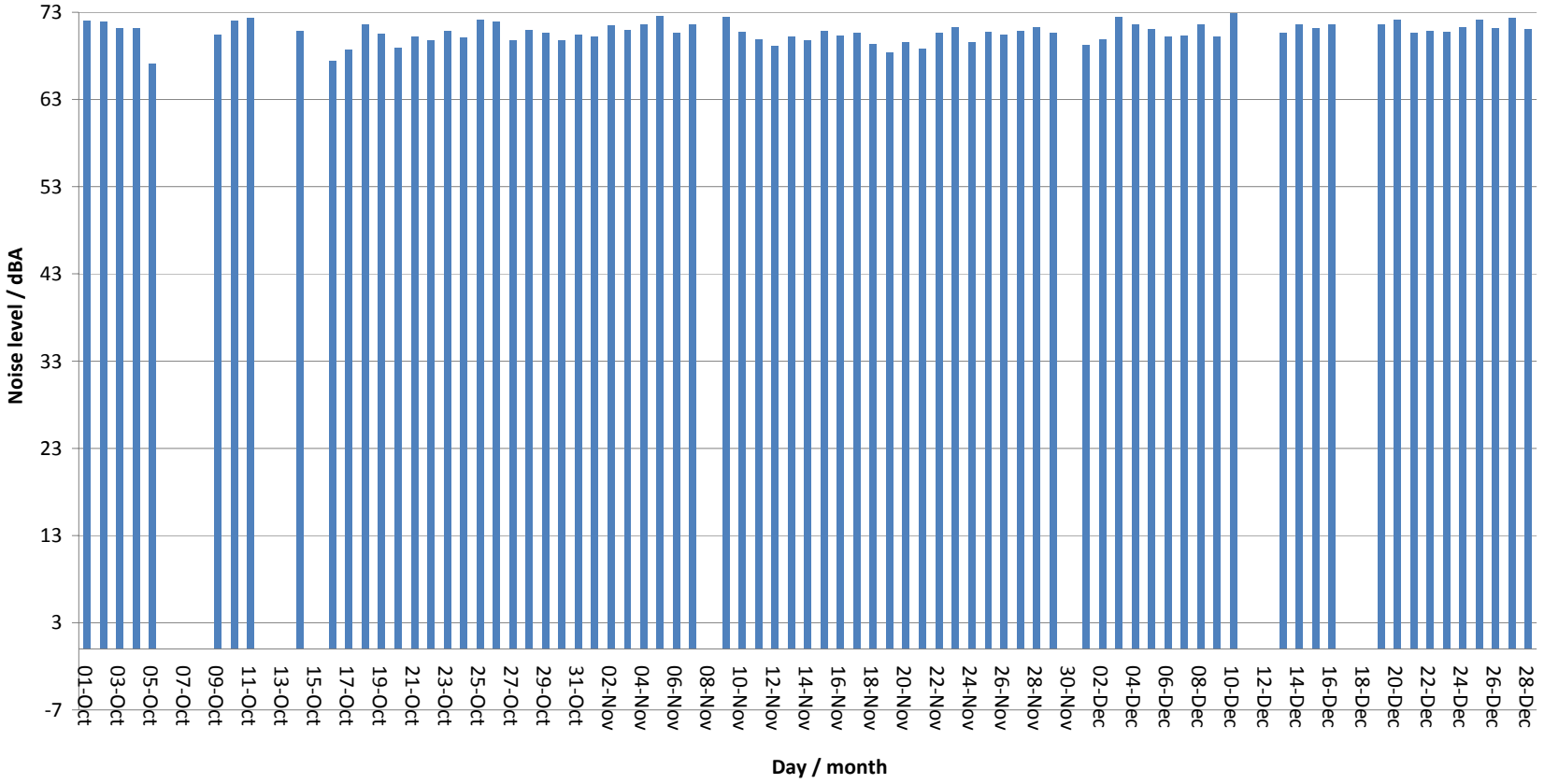


Figure 4: Average value of maximum levels of aircraft noise events per hour of day at Hatfield Heath, Essex, during October, November and December 2009

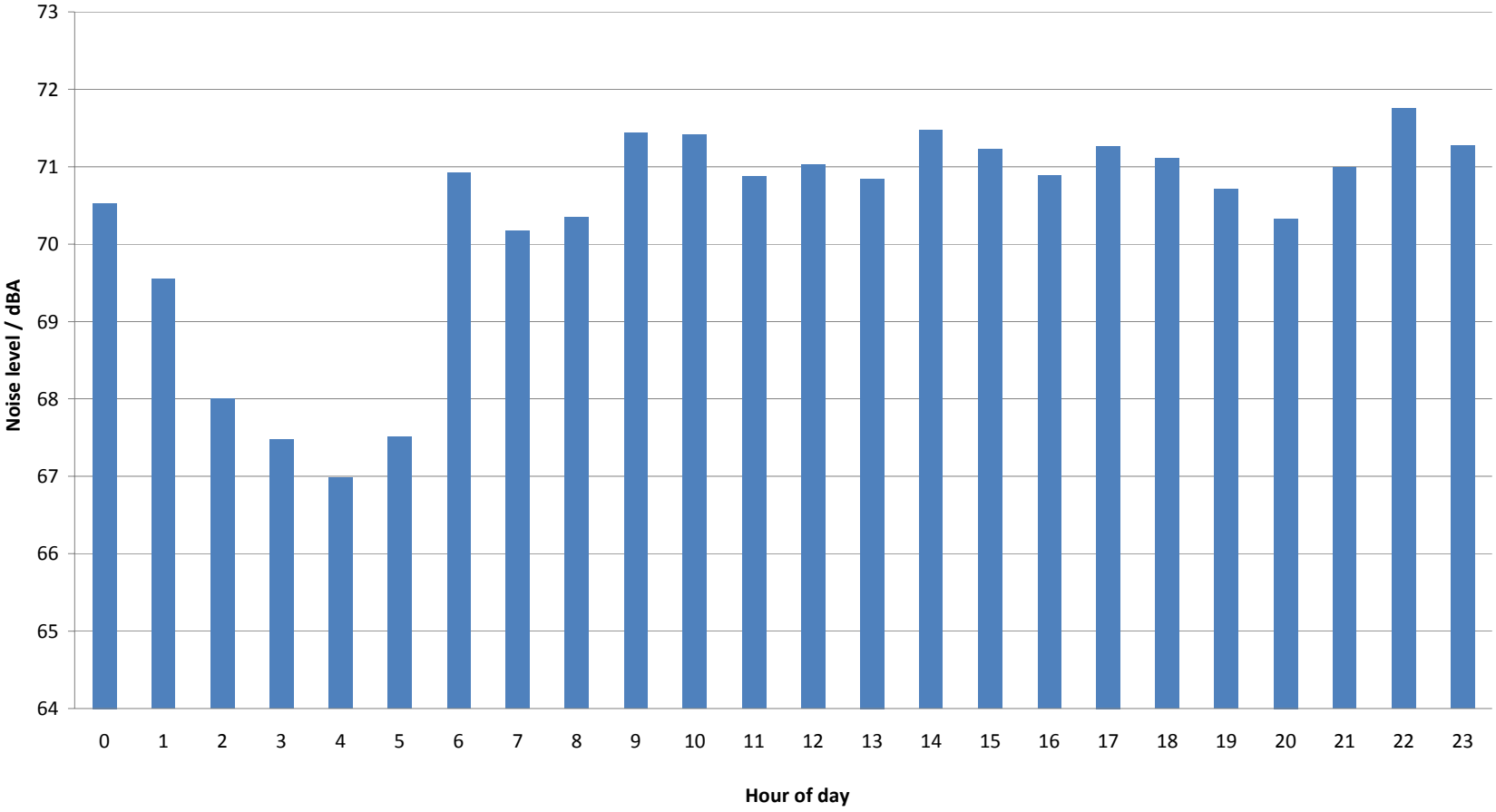


Figure 5: Statistical frequency distribution and % cumulative frequency distribution of maximum noise levels of aircraft noise events at Hatfield Heath, Essex during October, November and December 2009

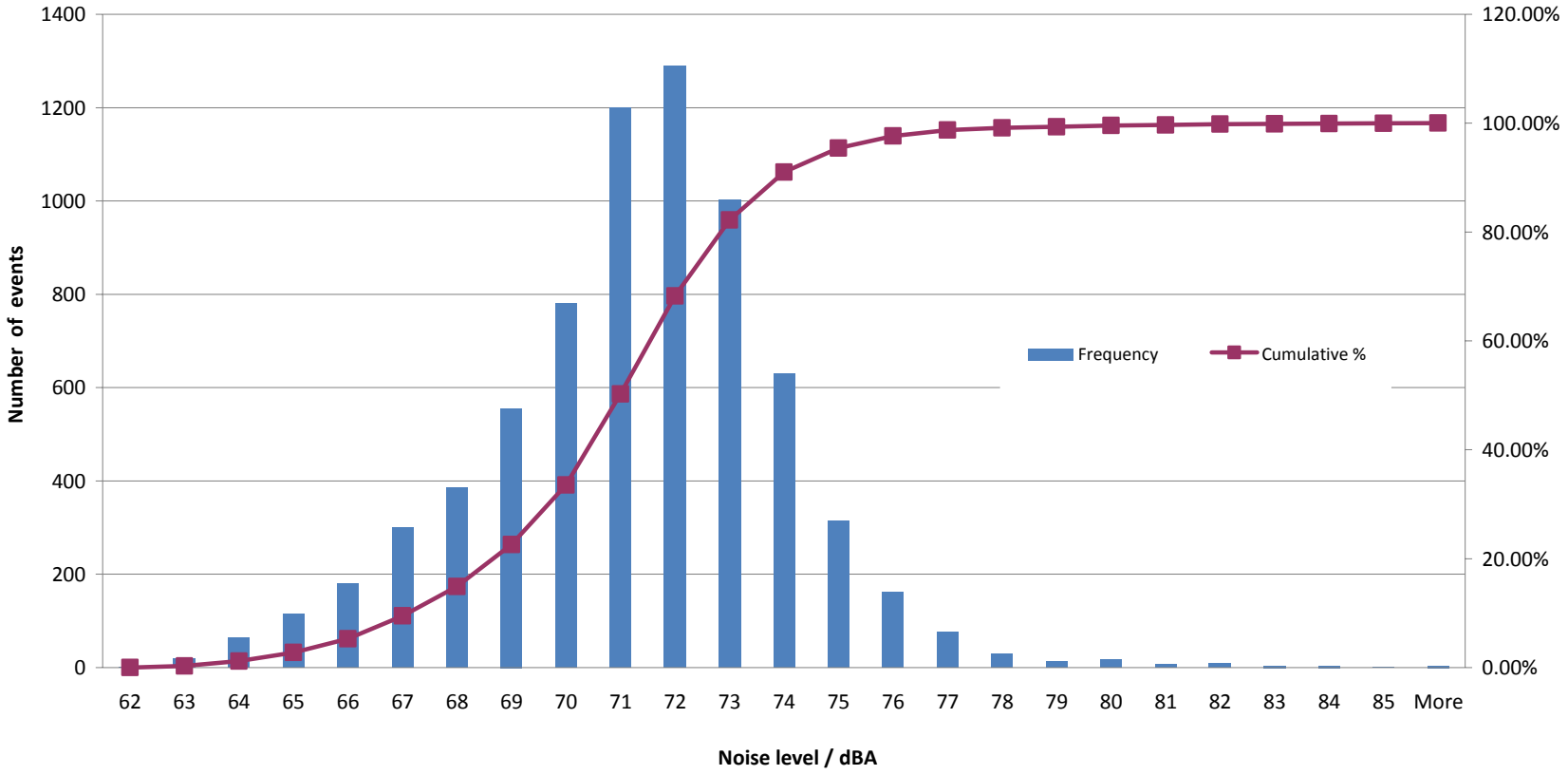


Figure 6: Noise Climate (average noise level and percentile values) hour by hour at Hatfield Heath, Essex, during October, November and December 2009

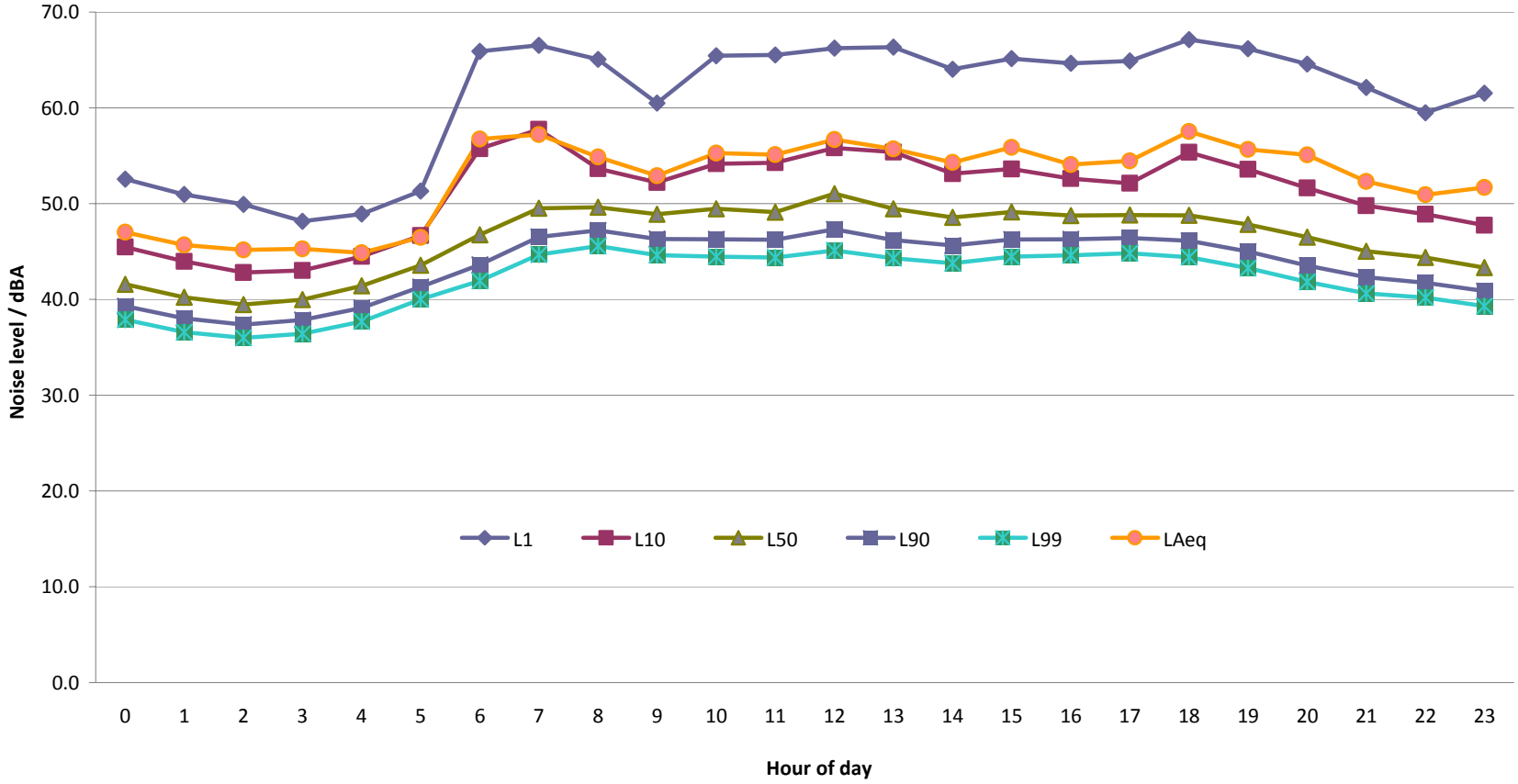


Figure 7: Noise Climate at Hatfield Heath Essex during October, November and December 2009 showing average values for each hour of day of total noise, aircraft noise and residual noise (LAeq values)

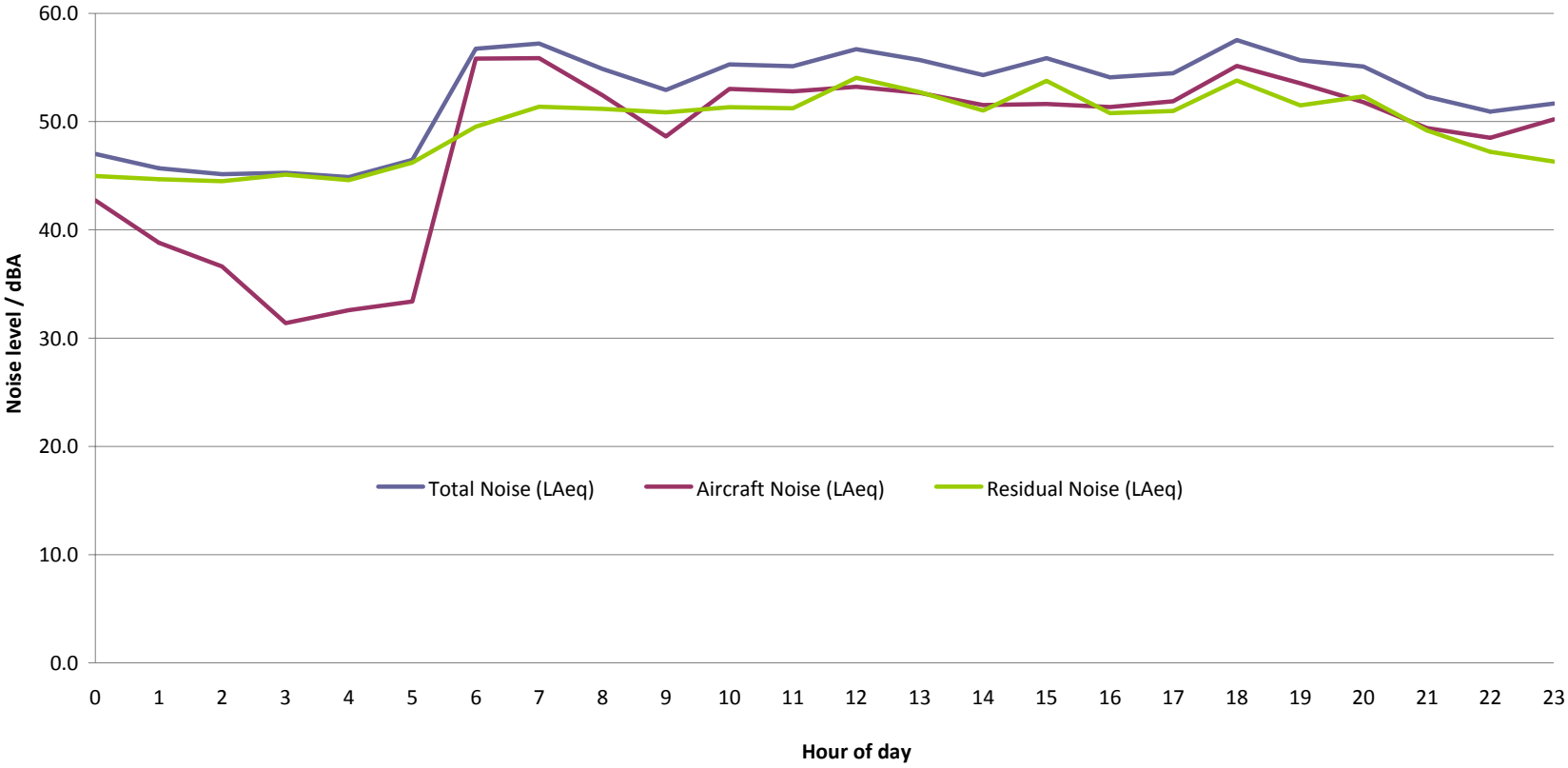


Figure 8: Numbers of aircraft noise events arising from different aircraft types at Hatfield Heath, Essex, during October, November and December 2009

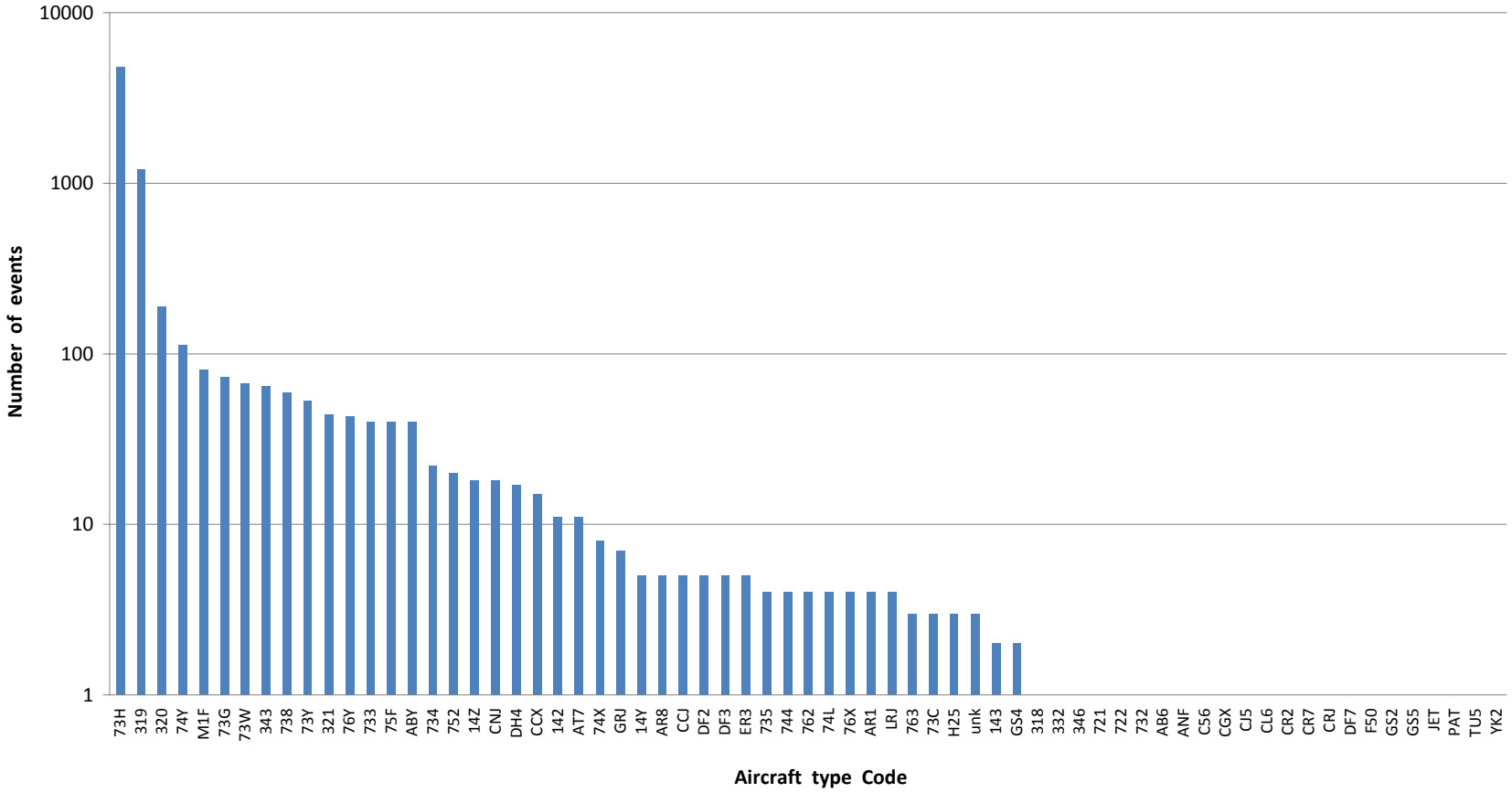
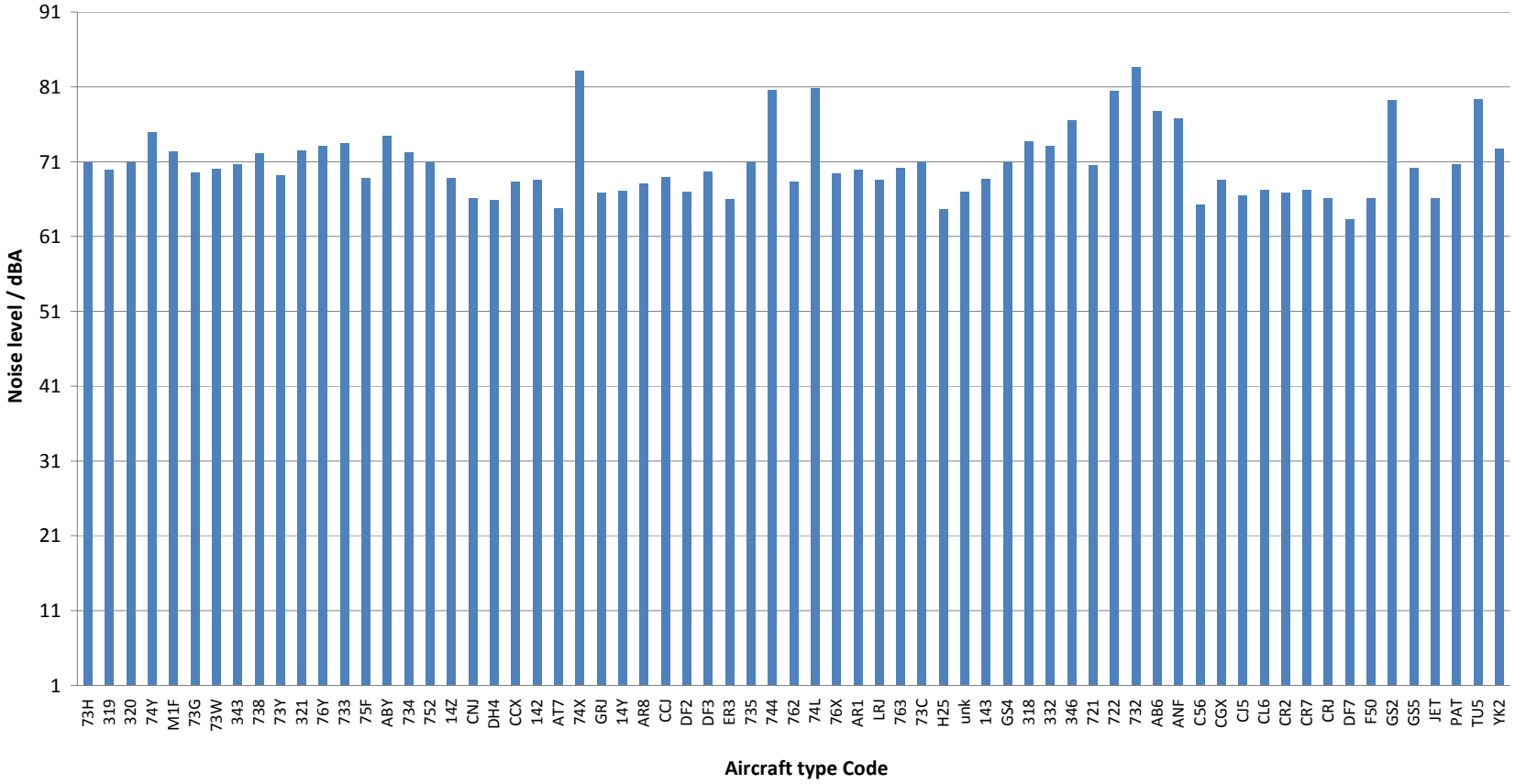


Figure 9: Average values of maximum noise levels of aircraft noise events arising from different aircraft types, at Hatfield Heath, Essex, during October, November and December 2009



APPENDIX 1

MAP OF SITE

Map showing location of noise monitor at Hatfield Heath

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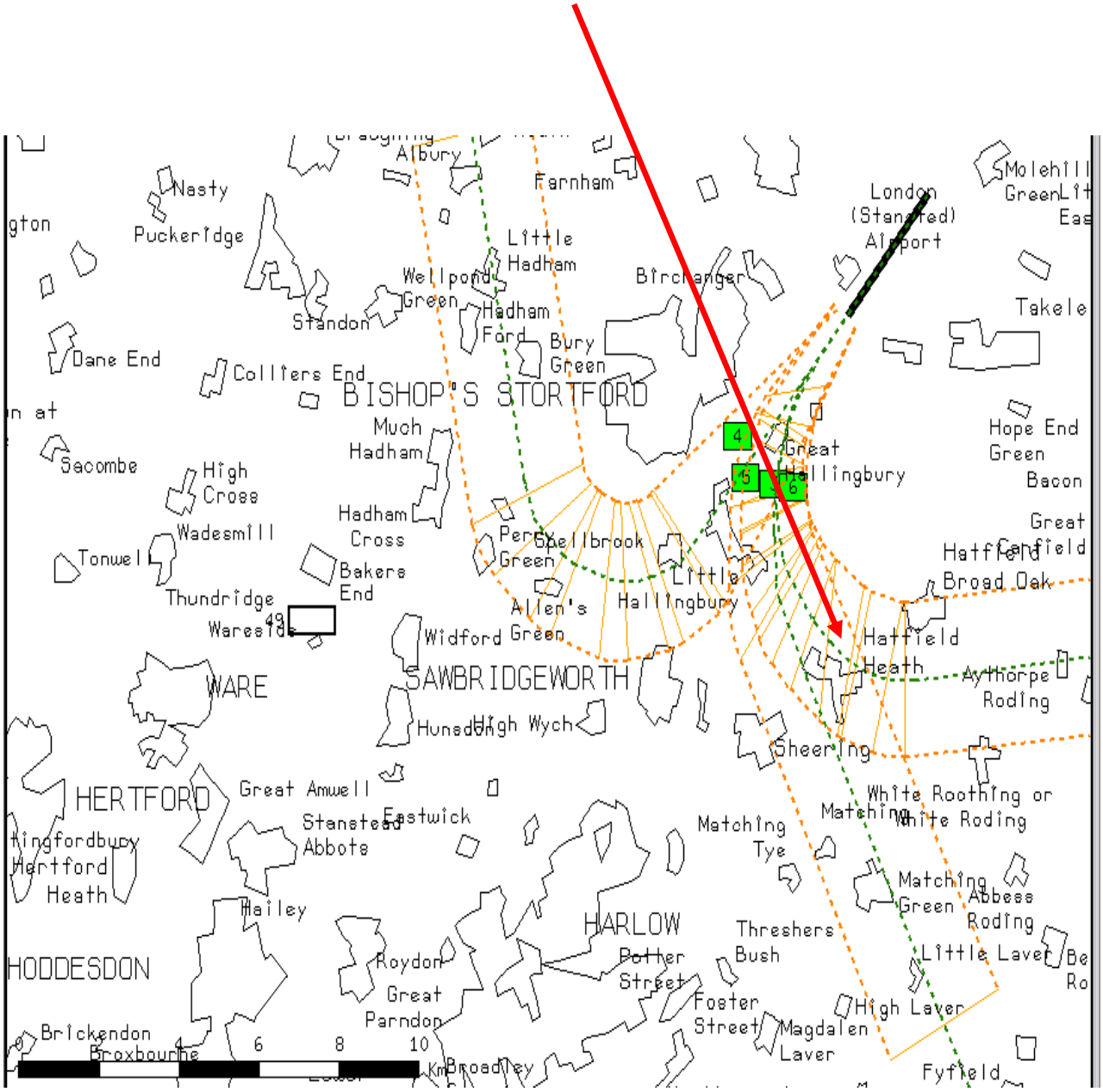
Map showing (approximate) location of noise monitor at Hatfield Heath



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APPENDIX 2

DATA FROM THE NOISE MONITORING TERMINAL

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Data from the Noise Monitoring Terminal

The NMT always records all noise from all sources. It has, however, the facility to capture and show separately all noise events that meet particular pre-set conditions. This facility is used to capture noise events likely to arise from aircraft flying near to the monitor. The pre-set condition used for this study is that the noise must exceed a level of 62 dBA for a minimum duration of 10 seconds. This is arrived at following preliminary noise measurements at the site, and is broadly similar to conditions set for other such studies. It is of course likely that noise arising from activities other than aircraft using Stansted Airport will occasionally cause noise events to be captured.

To determine which of all those events are due to aircraft using Stansted Airport their ANOMS (Aircraft Noise Management System) 'noise to track' matching software compares all captured noise events with all Stansted Airport's air traffic radar tracks. Noise events that are matched to aircraft are combined to provide a measure of 'aircraft noise' and noise events that are not matched to aircraft are included with 'all other noise' (i.e. that noise which is not captured as noise events, because it fails to meet the capture conditions of being above 56 dBA for 10 seconds), and is called residual noise.

Therefore wherever reference is made to aircraft noise events within this document it should be understood that these relate only to aircraft using Stansted airport. Any noise arising from aircraft travelling to or from any other airport will be included as residual noise.

The selection of the threshold conditions (noise level and time period) which trigger the capture of a noise event is a compromise judgement designed to include as much of the noise from passing aircraft as possible whilst at the same time excluding, as far as possible, noise from other sources. For this survey a threshold trigger level 62 dBA for a duration of at least 10 seconds was used.

The following information is recorded for each noise event: date, time, duration, L_{ASmax} and SEL values, and, in addition, for aircraft noise events, event type (arrival/ departure), departure route, runway used, and aircraft type.

In addition to gathering data about noise events the NMT also collects and stores information on an hourly basis about the total level of noise at the site from all sources (including that from aircraft movements), including individual noise events.

Because the noise level is usually not constant, but varies continuously throughout each hour it is necessary to describe the total noise level statistically in terms of a measure of the average noise level throughout the hour (and called the hourly continuous equivalent noise level, LAeq) and also in terms of a series of hourly percentile levels. The most important of these is the L_{AS90}, which is the noise level exceeded for 90% of each hour. This level of noise is conventionally taken to be a measure of the background noise level for each hour, and is the more or less constant level of noise which underlies the variations caused by various transient sources including aircraft.

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APPENDIX 3

GLOSSARY OF TERMS

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GLOSSARY OF TERMS

This glossary is presented in two parts. The first part contains definitions relating specifically to the context of this report, followed, in the second part, by a more general glossary of acoustic terms.

Definitions relating specifically to the context of this Report:

Aircraft Noise events	Noise events which have been matched by the GEMS noise and track keeping system to radar tracks in the vicinity of the NMT from aircraft arriving at or departing from Stansted airport.
Aircraft noise level	The average noise level derived from aircraft noise events, aggregated into hourly, daily or monthly average (LAeq) values.
ANOMS	Airport Noise and Operations Monitoring System. The software data analysis system currently in use at the airport (incorporating the NTK system).
Applied Acoustic Design (AAD)	Acoustic consultants retained by FEU
Average L_{ASmax} level	The arithmetic average of the L_{ASmax} values of all the events (of a particular type i.e. either aircraft noise or community noise) which occur over a particular period of time (eg hour, day or month).
Building Research Establishment	A former government organisation, now privately owned, which conducts research on noise. Carried out the National Noise Incidence Study for Defra in 2000.
Defra	UK government Department for Environment Food and Rural Affairs, which has responsibility for aspects of policy relating to environmental noise
Flight Evaluation Unit (FEU)	The unit within BAA which monitors all aircraft movements to ensure compliance with Department for Transport noise regulations relating to track keeping, noise abatement and night flights, and which also provides a means of investigating and responding to complaints and enquiries from the public.
National Noise Incidence Study 2000	A study carried out by the Building Research Establishment for Defra based on a survey of noise levels outside 1020 dwellings in England and Wales in 2000, giving proportions of the population exposed to various levels of environmental noise.

Noise event	A burst of noise at a high level which satisfies the noise event capture conditions for a particular NMT, i.e. which exceeds the pre-set trigger noise level (in this report 62 dBA) for a pre-set time interval (in this report 10 seconds). Noise events are detected, captured and stored by the NMT, and following subsequent processing by the NTK system are classified in this report as either aircraft noise events or community noise events
Noise Monitoring Terminal (NMT)	The noise measurement and analysis system installed at each site consisting of a precision grade sound level meter (Larson Davis type 870) inside a weather proof and tamper proof metal cabinet connected to an outdoor microphone located at a height of approximately 3.5 m above ground level.
NTK system	Noise and Track Keeping system. A software system able to match noise events recorded by the NMTs with aircraft tracks.
PPG24	Planning Policy Guidance Note 24:Planning and Noise, a document issued by the UK government Department for the Environment in 1994 which gives guidance to local authorities and others on noise and planning.
Residual noise	All noise arriving at the NMT microphone apart from aircraft noise events, i.e. comprising residual noise events and all other noise which does not satisfy the trigger conditions for capture as a noise event.
Residual Noise events	Those noise events which have not been matched by the NTK system to aircraft tracks using Stansted Airport in the vicinity of the NMT.
Statistical frequency Analysis (of L_{ASmax} noise levels)	An analysis of a group of L_{ASmax} values giving the numbers of events (or percentages of total numbers) at different dBA levels
Total noise	All noise arriving at the NMT microphone, i.e. not only including all noise events (both aircraft and residual) but also all other noise which does not satisfy the trigger conditions for capture as a noise event.
Total noise level	The average or continuous equivalent level (L_{Aeq}) of the total noise at the site, recorded each hour by the NMT, which may also be aggregated into daily or monthly values.
Total noise climate	The level of the total noise at the NMT microphone varies with time. over a particular period of time e.g. one hour, this variation may be

described in terms of a number of different noise indices including the average or equivalent noise level, maximum and minimum noise level values and various percentile levels. Such a description constitutes the noise climate at the site over that period of time.

The NMT records the following total noise indices every hour: L_{Aeq}, L_{ASmax}, L_{AS10}, L_{AS50}, L_{AS90} and L_{AS99}.

World Health Organisation

Issued 'Guidelines for Community Noise' in 2000

A general Glossary of acoustic Terms:

A-weighting — A method of producing a single figure measure of a broad band noise (as opposed to the 8 or 9 figures which make up an octave band spectrum) which takes into account, in an approximate way at least, the frequency response of the human hearing system. The idea is that sound levels measured in this way should give an indication of the loudness of the sound.

A-weighted sound pressure level (dBA).

The value of the sound pressure level, in decibels, measured using an A-weighting electronic circuit built into the sound level meter. The vast majority of noise measurements are carried out in this way.

Day, evening, night level, L_{den}

An index of environmental noise based on average noise levels (L_{Aeq}) throughout the 24 hour period, but with a weighting factor of 5 dBA added to evening noise levels (19.00 to 23.00 hours), and a weighting of 10 dB added to night-time noise levels (23.00 to 07.00 hours). It is the noise index used in the UK Noise mapping exercise commissioned by Defra in response to the European Union Directive on Environmental Noise in 2002.

Decibel scale — The decibel scale is the scale on which sound pressure levels are commonly measured. It is a logarithmic scale and is used for convenience to compress the audible range of sound pressures into a manageable range, from 0 dB to 140 dB. The zero of the scale, 0 dB, corresponds to the notional threshold of hearing, 0.00002 Pa, and the upper limit, 140 dB, corresponds to 20 Pa, which would cause immediate damage to the ear.

Equivalent continuous sound level ($L_{Aeq,T}$), also called the Average noise level.

The $L_{Aeq,T}$ represents a measure of the 'average' sound level over the measurement period. It corresponds to the steady continuous level of sound which, over the same period of time, T, would contain the same amount of (A-weighted) sound energy as the time varying noise.

This is the most common method of measuring time varying noise, and within certain limits gives the best correlation with human response to noise, for example with annoyance.

Frequency

The frequency of a musical note is what gives it its pitch. It is the number of cycles of the fluctuating sound pressure which occur each second, and is measured in cycles per second, Hertz (Hz). The human ear can detect frequencies in the range 20 to 20000 Hz.

Most noises are a mixture of all frequencies, called broad-band noise.

$L_{AS90,T}$

This is the most commonly used of many possible statistical measures of a time varying noise. It is the 90th percentile of the statistical noise level distribution, or, more simply, the noise level that is exceeded for 90% of the measurement time (T). Thus over one hour for example it represents the noise level which is exceeded for all but (the quietest) six minutes of that hour.

It is commonly used as a measure of the background noise in any given situation, against which the level of any new, potentially intrusive source of noise is often compared. Background noise itself often varies with time and so the $L_{A90,T}$ is almost universally used as the best measure of the 'more or less always present' noise level which underlies short term variations from other sources of noise.

Maximum sound pressure level ($L_{ASmax,T}$)

This is the highest value of the time weighted sound pressure level, (measured using the A frequency weighting and the Slow time weighting) which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the $L_{Aeq,T}$ value.

In the context of this report the L_{ASmax} value for each aircraft noise event is monitored

Noise

Unwanted sound

Octave band spectra

In order investigate the frequency content of broad band sounds, called its frequency spectrum, measurements of sound pressure are carried out over a range of frequency bands. The most common method is to split the audio frequency range into 8 or 9 octave bands. An octave is a frequency range from one particular frequency to double that frequency.

Octave band measurements are not referred to in this report.

Percentile noise level, (L_{ASN}, where N is a number between 0 and100)

The noise level which is exceeded for N% of the measurement period. For example, a value of $L_{A10,1hour}$ of 57 dBA means that in that hour the noise level was at or above 57 dBA for 6 minutes (i.e.10% of an hour), or alternatively, was at or below 57 dBA for 54 minutes.

Sound exposure level (SEL)

This is a measure of the A-weighted sound energy used to describe single noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event.

SEL values for events may be used to calculate the average noise level over a period of time (hour, day or month)

Sound pressure

sound is a disturbance or fluctuation in air pressure, and sound pressure, measured in Pascals (Pa), is used as a measure of the magnitude of the sound. The human ear can detect sound pressures in the range from 0.00002 Pa to 20 Pa. This is an enormously wide range and so for convenience sound pressures are commonly measured on a decibel (dB) scale.

Time varying noise

When the level of noise varies with time, as is often the case, for example with noise from road traffic, various measures or noise indices as they are called are used to give a single figure description of the noise over a given period of time. The three most commonly used noise indices are the $L_{Aeq,T}$ the $L_{A90,T}$ and the $L_{Amax,T}$ values.

In all three cases the 'L' stands for the level of the sound in decibels, the 'A' for the fact that it is the A- weighted value, and the 'T' for the time period over which the noise is measured, for example 5min, 1 hour, 24 hour etc.

Time weighting (Fast (F) and Slow (S))

An exponential function of time, of a specified time constant, that weights the square of the instantaneous sound pressure. (Defined in BS EN 61672 – 1:2003).

There are two time constants defined in BS EN 61672 – 1:2003, designated Fast (F) and Slow (S), and noise indices such as the maximum, or percentile noise levels which are based on instantaneous time-weighted sound pressure should indicate which time weighting has been used in the measurement.

In this report, in line with standard practice for aircraft noise measurement, it is the Slow (S) time weighting that has been used, hence reference is made to L_{ASmax} and to L_{AS90}.

APPENDIX 4

LIST OF AIRCRAFT IDENTIFICATION SOURCE CODES

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FACSIMILE: 01784 465447

List of Aircraft Identification Codes

100	Fokker 100
142	BAe 146-200
143	BAe 146-300
14Y	BAe 146-200 Freighter
14Z	BAe 146-300 Freighter
313	Airbus A310-300
318	Airbus A318
319	Airbus A319
320	Airbus A320
321	Airbus A321
332	Airbus A330-200
343	Airbus A340-300
346	Airbus A340-600
721	Boeing 727-100
722	Boeing 727-200
732	Boeing 737-200
733	Boeing 737-300
734	Boeing 737-400
735	Boeing 737-500
736	Boeing 737-600
738	Boeing 737-800
73G	Boeing 737-700
73H	Boeing 737-800 (winglets)
73W	Boeing 737-700 (winglets)
73Y	Boeing 737-300 Freighter
744	Boeing 747-400
74L	Boeing 747SP
74X	Boeing 747-200 Freighter
74Y	Boeing 747-400 Freighter
752	Boeing 757-200
75F	Boeing 757-200 Freighter
762	Boeing 767-200
763	Boeing 767-300
76Y	Boeing 767-300 Freighter
AB6	Airbus A300-600
ABX	Airbus A300 Freighter
ABY	Airbus A300-600 Freighter
ANF	Antonov AN-12 Freighter
AR1	Avro RJ-100
AR8	Avro RJ-85
AT4	ATR-42
AT7	ATR-72
ATP	BAe ATP
BE2	Beech B200
C56	Cessna Citation 560 CGX = CCX = Global Express
CCJ	Bombardier Challenger
CCX	Bombardier Global Express
CJ5	Cessna Citation Jet CL6 = Global Express Challenger 600 DF7 = Dassault Falcon 7x
CNJ	Cessna Citation
CR2	Bombardier CRJ-200
CR7	Canadair regional jet 700

CR9	Bombardier CRJ-900
D38	Dornier 328
DF2	Dassault Falcon (this covers various types) 76X= Boeing 767-200 Freighter 73C= Boeing 737-300 (winglets) G54= GS4 = Gulfstream IV = Gulfstream 4
DF3	Dassault Falcon 50/900
DH4	Dehavilland Dash 8-Q400
EM2	Embraer Brasillia
ER3	Embraer RJ-135
F50	Fokker 50
FRJ	Dornier 328 Jet
G52	GS2 = Gulfstream 2
G55	GS5 = Gulfstream 5
GRJ	Gulfstream II/III/IV/V
H25	Hawker HS-125
J31	BAe Jetstream 31
JET	Generic code used for small jet aircraft without a specific IATA code
LRJ	Bombardier Learjet 23/24/25/31/35/40/45/55/60
M1F	Boeing (McDonnell Douglas) MD11 Freighter
M82	Boeing (McDonnell Douglas) MD82
M83	Boeing (McDonnell Douglas) MD83
M87	Boeing (McDonnell Douglas) MD87
M90	Boeing (McDonnell Douglas) MD90
PA2	Piper
PAT	Piper, Twin Propeller
S20	Saab 2000
TU5	Tupolev TU-154
YK2	Yak 42