Date: 6 November 2009

Our ref: 09296/001/rp

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# A REPORT OF MONITORING OF AIRCRAFT NOISE FROM STANSTED AIRPORT AT HELIONS BUMPSTEAD, ESSEX BETWEEN SEPTEMBER AND DECEMBER 2008

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Director

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## Summary

A mobile Noise Monitoring Terminal (NMT) was deployed by Stansted Airport between 20th September and 18th December 2008. The site is approximately 20 km north east of the airport, at Helions Bumpstead, Essex.

The aim of this report is to present the results of this three month noise monitoring exercise 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.

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 56 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 56 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 3177aircraft noise events occurred during 90 of the days in the three month survey period. The number of aircraft noise events per day ranged from zero (on 4 days) to 81 (on one day), with an average of 35 events per day. All of these aircraft

noise events were due to arriving aircraft, all but 44 using runway 23. There were 39 arrivals using runway 05 and 5 overflights.

The numbers of aircraft noise events 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 evening between 17.00 and 19.00 hours, in the morning between 07.00 and 08.00 and in the late evening, between 22.00 and 23.00 hours (local time).

The daily average maximum noise level ($L_{ASmax}$) of aircraft noise events range between 57 dBA and 65 dBA with an overall average value of 62 dBA,

The average noise level ($L_{Aeq}$ value) during aircraft noise events, which have an average duration of about 28 seconds, is 59 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 49 dBA, $L_{AS90}$ of 36 dBA and $L_{Aeq}$ of 50 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 43 dBA, and for the evening period from 19.00 to 23.000 hours was 48 dBA.

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 of 52 dBA.

In order to place the noise climate at the site in a wider UK context it is compared with the results of the National Noise Index survey of noise levels in the UK in 2000, carried out by the Building Research Establishment for Defra. This gave a breakdown of the proportion of UK residents exposed to various noise levels, in 5 dBA bands. As an example the $L_{den}$ value for this site places it in the lowest noise exposure band, occupied by 33% of dwellings in the UK.

Levels of noise exposure ($L_{Aeq}$) at this site are below the World Health Organisation Guidelines of 55 dBA in the daytime, and 45 dBA at night-time.

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 residual noise provides the major component, generally about 1 dBA below that of the total noise level, with the average level due to aircraft noise events being typically about 7 or 8 dBA below the average ($L_{Aeq}$) level of total noise at the site

Therefore although each individual aircraft noise event is likely to be clearly audible and distinguishable, aircraft noise events in total make only a relatively minor contribution to the average ($L_{Aeq}$) level of total noise at the site.

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) was deployed by Stansted Airport for a three-month period from 20th September to 18th December 2008.

1.2 The noise monitor is located in the rear garden of a detached house at a quiet location at the edge of the village. A minor road runs past the property which is adjacent to farm land where there is occasionally noise from farm equipment, (ploughing, sowing etc.) and from grass cutting at the property. The site is approximately 20 km north east of the airport, at Helions Bumpstead, Essex. A map showing the location is presented in Appendix 1. On days when aircraft are taking off from Stansted to the west, the site lies on the path of arriving aircraft

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 2.

## 2.0 Data from the Noise Monitoring Terminal

2.1 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 56 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.

2.2 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.

2.3 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.

2.4 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 56 dBA for a duration of at least 10 seconds was used.

2.5 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.

2.6 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.

2.7 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, $L_{Aeq}$) 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.

## 3.0 Analysis of Noise Monitoring Survey Results

3.1 The numbers of aircraft noise events

3.1.1 There were 266 aircraft noise events in September, 1550 in October, 772 in November, and 589 in December, a total of 3177 over the 90 days of the three month survey period. The number of aircraft noise events per day ranged from zero (on 4 days) to 81 (on one day), with an average of 35 events per day.

3.1.2 The average number of aircraft noise events per day was 24 for September (11 days only), 50 for October, 26 for November and 33 for December (18 days only), or an average of 35 per day over the 90 days of the three month period.

3.1.3 All of these aircraft noise events were due to arriving aircraft, all but 44 using runway 23. There were 39 arrivals using runway 05 and 5 overflights.

3.1.4 Figure 1 shows the total number of aircraft noise events occurring each day during the 3 months survey period from September to December 2008. The number of aircraft noise events varied from 0 to 81 per day. There was no obvious correlation between the number of aircraft noise events and the day of the week or weekend.

3.1.6 Figure 2 indicates the average distribution of numbers of aircraft noise events throughout the day, showing that the highest number of events per hour occurred in the early evening between 17.00 and 19.00 hours, in the morning between 07.00 and 08.00 and in the late evening, between 22.00 and 23.00 hours (local time).

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 56 dBA to 74 dBA, but 90% of the events lay within a smaller range of 60 to 70 dBA, and more than 50% between 60 and 65 dBA. Figure 3 indicates the average $L_{ASmax}$ value of aircraft noise events recorded each day during the three month monitoring period and 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 that average maximum level per day range between 57 dBA and 65dBA with an overall average value of 62 dBA. There appears to be no noticeable pattern to the variation from day to day. The variation by hour of day shows the highest average levels occurred between 04.00 and 05.00 hours, although, as shown by by Figure 2, this corresponds to only a very small number of events.

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 42 seconds, with an average value of 28 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 54 to 68 dBA with an average value of 59 dBA.

3.3.3 Thus a typical aircraft noise event represents an average noise level of about 59 dBA for about 30 seconds but varying within the 30 seconds, with a maximum value of between 62 and 65 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 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 Since 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 assessmen of noise climates near to schools in the vicinity.

3.4.4 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 average total noise level at this site would be 50 dBA, and would exceed 49 dBA for 6 minutes, and would be below 36 dBA for 6 minutes, and would therefore be between 36 and 49 dBA for 48 minutes of the hour.

3.4.4 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 an $L_{den}$ value of 52 dBA.

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

3.5.1 The National Noise Incidence survey of noise levels in the UK in 2000 carried out by the Building Research Establishment for Defra gave a breakdown of the proportion of UK residents exposed to noise, as follows:

| Proportion of UK population living in dwellings exposed to daytime noise levels ($L_{Aeq,\ 16\ hour}$) in 5 dB bands, in 2000 National Noise Incidence survey | |
|---|---|
| 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% |

3.5.2 From the data used to compile Figure 6 the 16 hour $L_{Aeq}$ value for this site is 49.8 dBA, and this puts the site in the lowest noise exposure band, occupied by 30 % of dwellings in the UK.

3.5.3 A similar breakdown is given for the $L_{den}$ index:

| Proportion of UK population living in dwellings exposed to noise levels in 5 dB bands, according to the $L_{den}$ noise index, in 2000 National Noise Incidence survey | |
|---|---|
| 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% |

3.5.4 Since the 16 hour $L_{den}$ value for this site is 52 dBA (from paragraph 3.4.4) this puts the site in the lowest noise exposure band, occupied by 33% of dwellings in the UK.

World Health Organisation and PPG 24 Guidance on Community Noise

3.5.5 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."

3.5.6 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 $L_{Aeq, 8h}$.

3.5.7 The noise exposure levels at this site based on the data collected during the 3 month noise survey period (an $L_{Aeq}$ of just below 50 dBA in the daytime and 43 dBA at night-time) are below the WHO Guidelines of 55 dBA in the daytime, and also below the night-time Guideline value of 45 dBA.

3.6 The contribution of aircraft noise events to the total noise climate at the site

3.6.1 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.

3.6.2 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.

3.6.3 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.

3.6.4 Figure 7 shows a comparison between the average hourly $L_{Aeq}$ values throughout the three month period of the total noise, aircraft noise and residual noise.

3.6.5 It can be seen that for the period from 06.00 hours to midnight, when most of the aircraft noise events occur, the total noise level varies between 46 dBA and 52 dBA, with an average of about 50 dBA, and that the level due to aircraft noise events is, on average about 7 or 8 dBA lower than this. Residual noise levels throughout the 24 hour period are approximately 1 dBA below the total noise level.

3.6.6 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 only a relatively minor contribution to the average level of total noise at the site. However each individual aircraft noise event is likely to be clearly audible and distinguishable because, in audition to a change 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

3.7 <u>The contribution of different aircraft types to aircraft noise at the site</u>

3.7.1 Sixty five different aircraft types contributed to the total number of 3177 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 3.

3.7.2 Although 65 different aircraft types were involved in total, one aircraft type accounted for more than 50% of the events, and more than 75% arose from only two types of aircraft: Boeing 737-800: 1718 events, Airbus A319: 718 events.

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.

## 4.0 Summary and Conclusions

4.1 A total of 3177aircraft noise events occurred during the 90 of the days in the three month survey period. The number of aircraft noise events per day ranged from zero (on 4 days) to 81 (on one day), with an average of 35 events per day. All of these aircraft noise events were due to arriving aircraft, all but 44 using runway 23. There were 39 arrivals using runway 05 and 5 overflights.

4.2 The numbers of aircraft noise events 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 evening between 17.00 and 19.00 hours, in the morning between 07.00 and 08.00 and in the late evening, between 22.00 and 23.00 hours (local time).

4.3 The daily average maximum noise level ($L_{ASmax}$) of aircraft noise events range between 57 dBA and 65 dBA with an overall average value of 62 dBA.

4.4 The average noise level ($L_{Aeq}$ value) during aircraft noise events, which have an average duration of about 28 seconds, is 59 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 49 dBA, $L_{AS90}$ of 36 dBA and $L_{Aeq}$ of 50 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 43 dBA, and for the evening period from 19.00 to 23.000 hours was 48 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 residual noise provides the major component, generally about 1 dBA below that of the total noise level, with the average level due to aircraft noise events being typically about 7 or 8 dBA below the average ($L_{Aeq}$) level of total noise at the site

4.7 Therefore although each individual aircraft noise event is likely to be clearly audible and distinguishable, aircraft noise events make only a relatively minor contribution to the average level of total noise at the site.

4. 8 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.

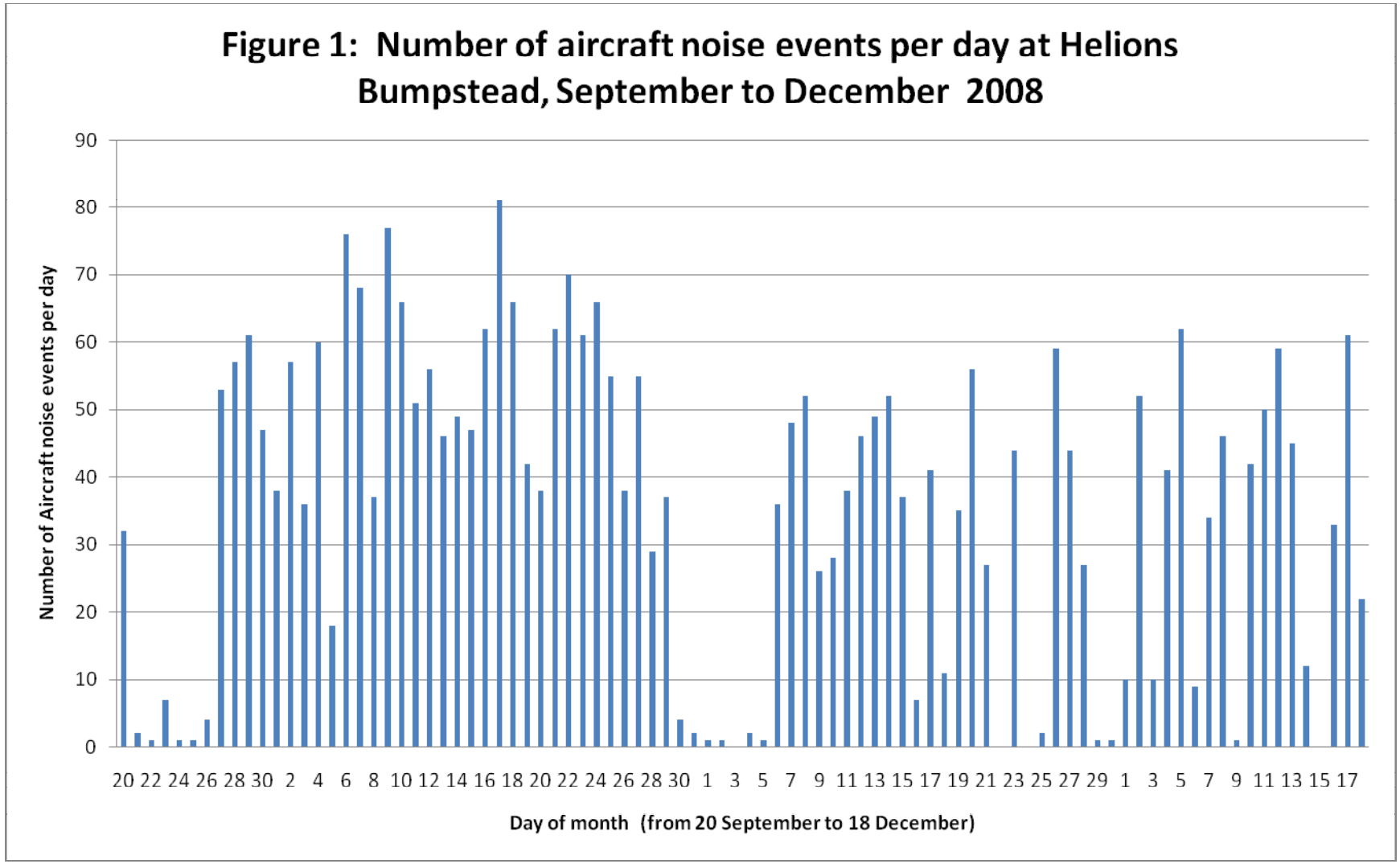


Figure 1: Number of aircraft noise events per day at Helions Bumpstead, September to December 2008
Number of Aircraft noise events per day
0
10
20
30
40
50
60
70
80
90
20 22 24 26 28 30 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 1 3 5 7 9 11 13 15 17
Day of month (from 20 September to 18 December)

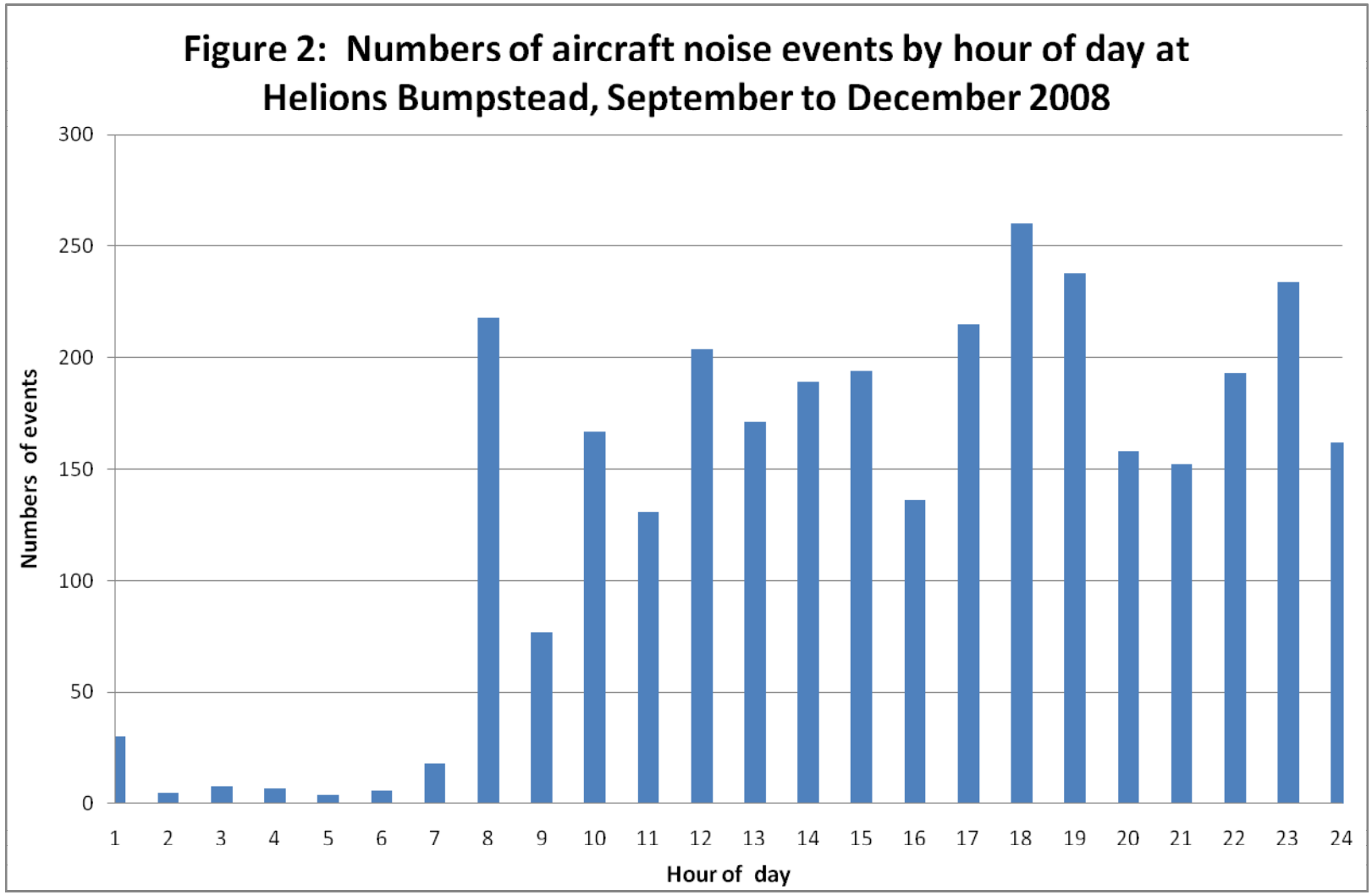
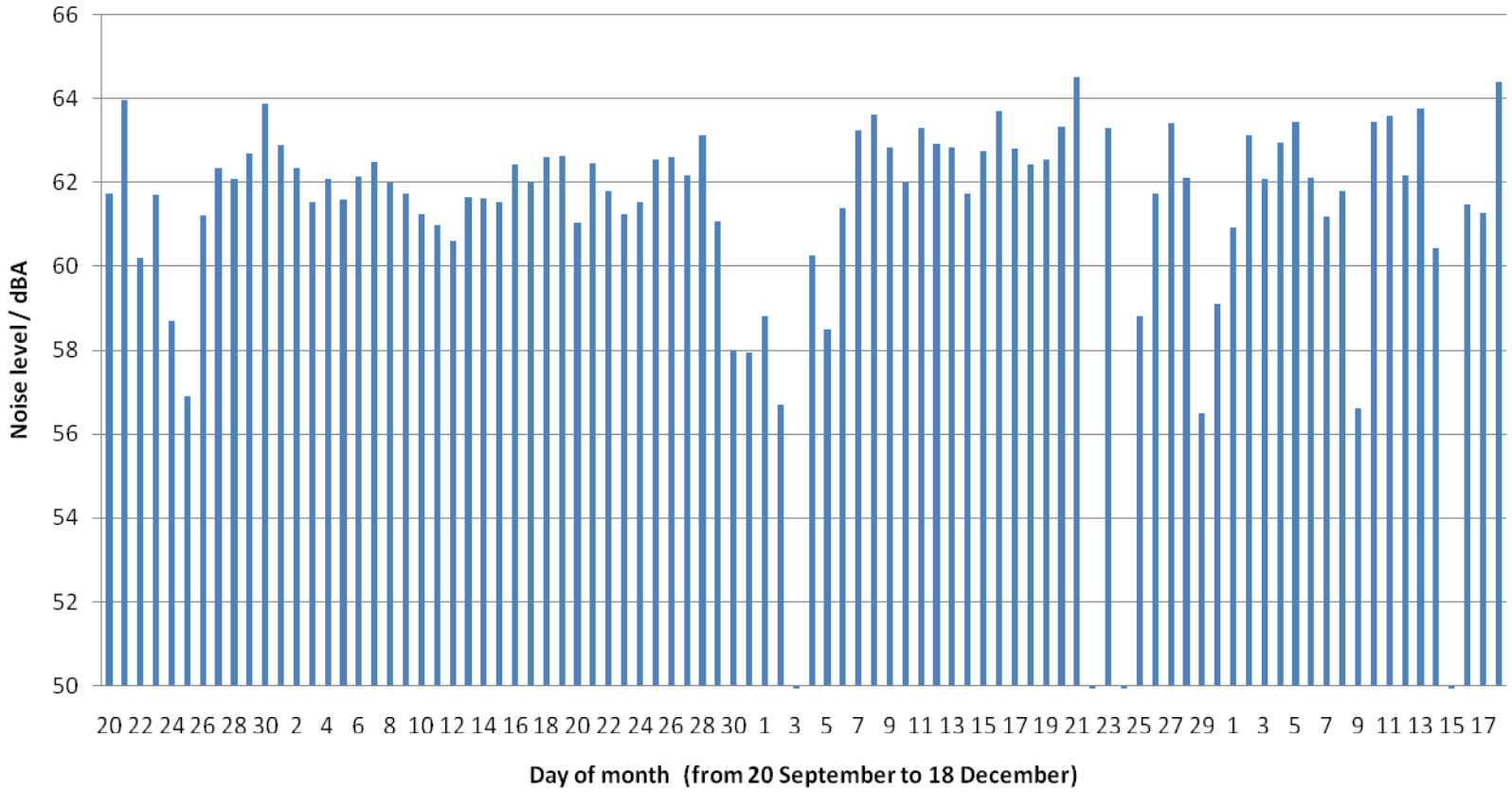


Figure 2: Numbers of aircraft noise events by hour of day at Helions Bumpstead, September to December 2008
Numbers of events
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour of day

**Figure 3: Average maximum noise level of aircraft noise events per day at Helions Bumpstead, September to December 2008**



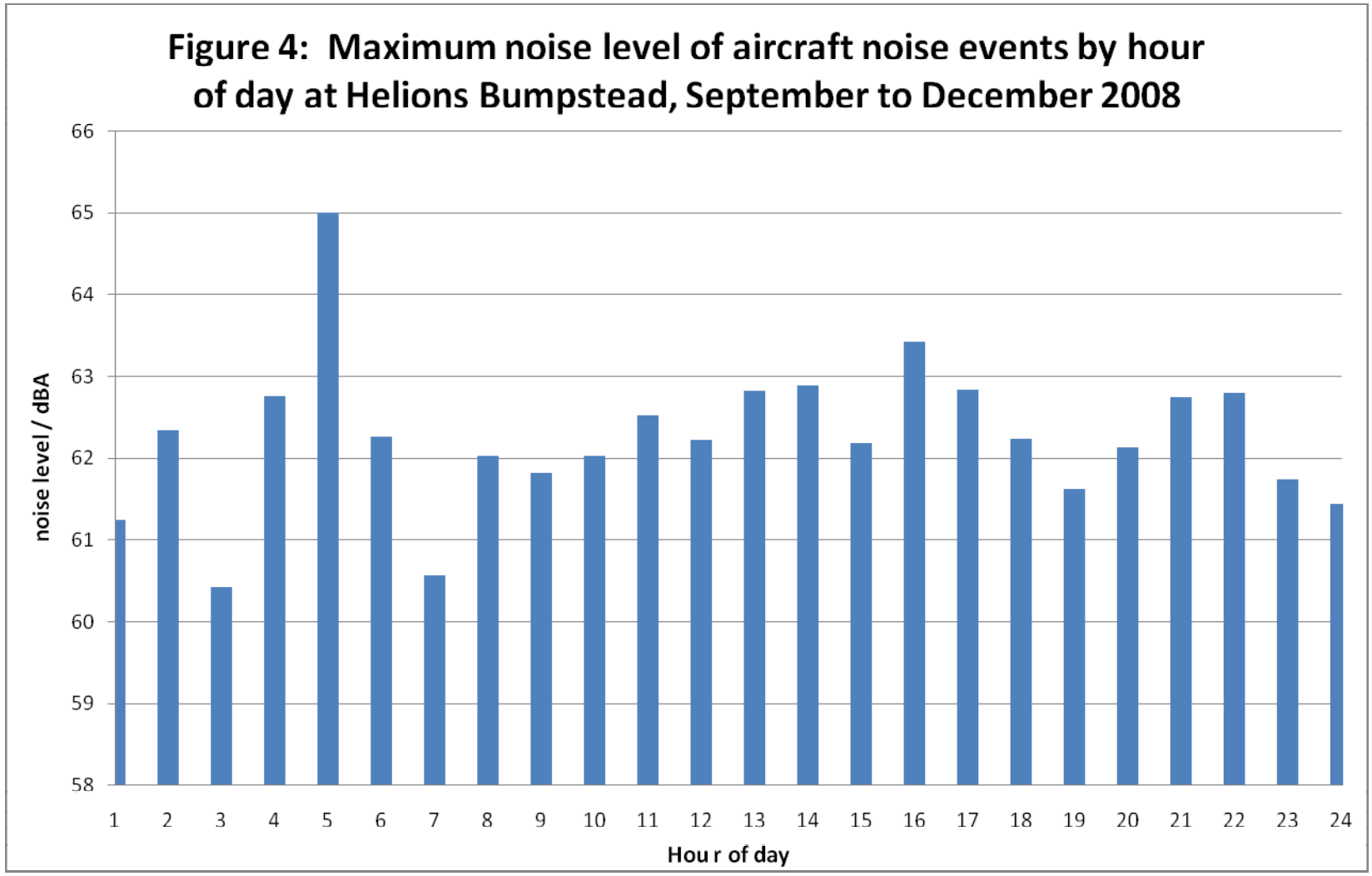


Figure 4: Maximum noise level of aircraft noise events by hour of day at Helions Bumpstead, September to December 2008
noise level / dBA
66
65
64
63
62
61
60
59
58
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hou r of day

**Figure 5: Statistical frequency distribution of maximum noise levels of aircraft noise events at Hellions Bumstead, September to December 2008**

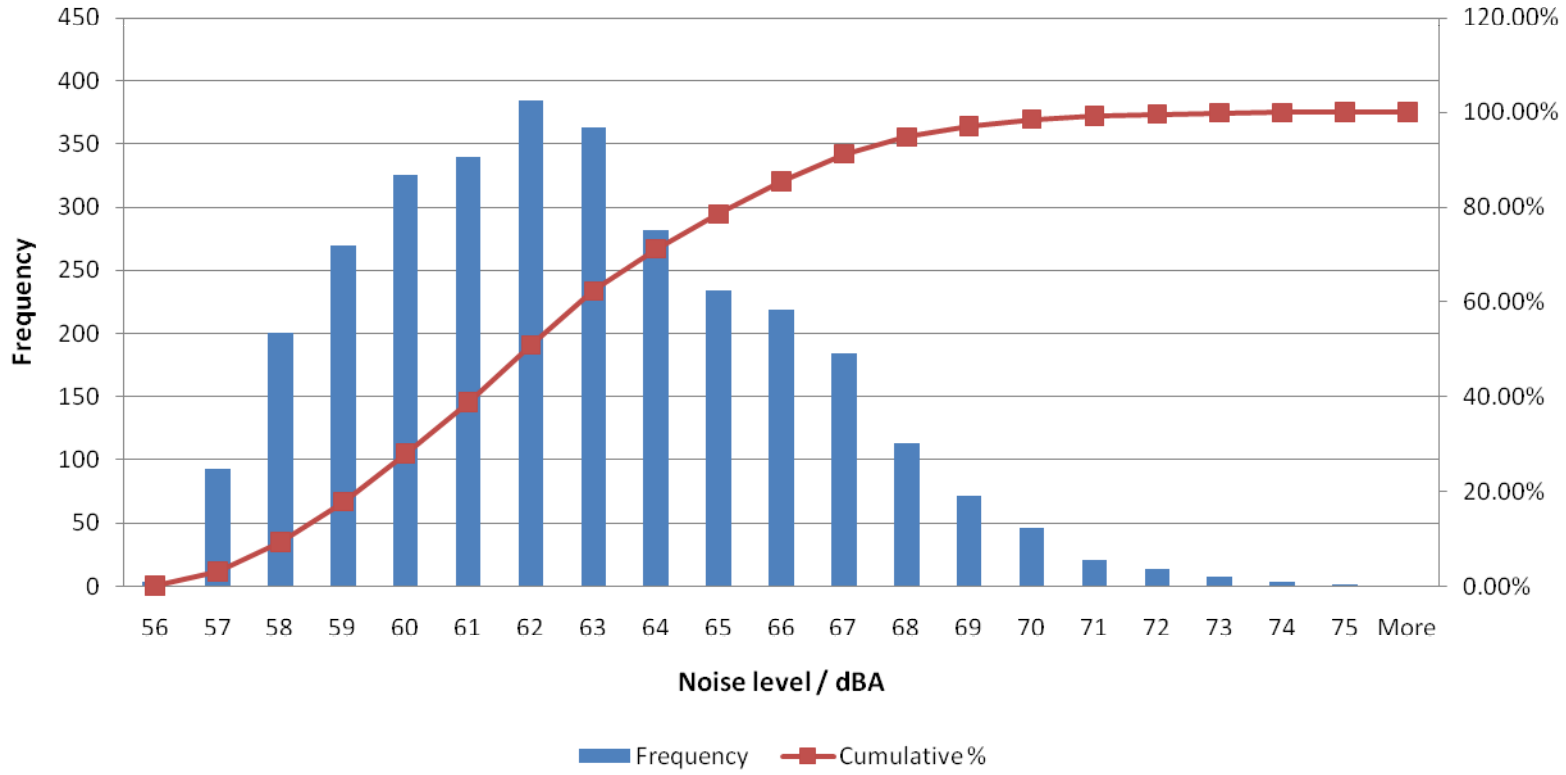


**Figure 6: Noise Climate (Average and Statistical percentile noise levels ) by hour of day at Helions Bumpstead, September to December 2008**

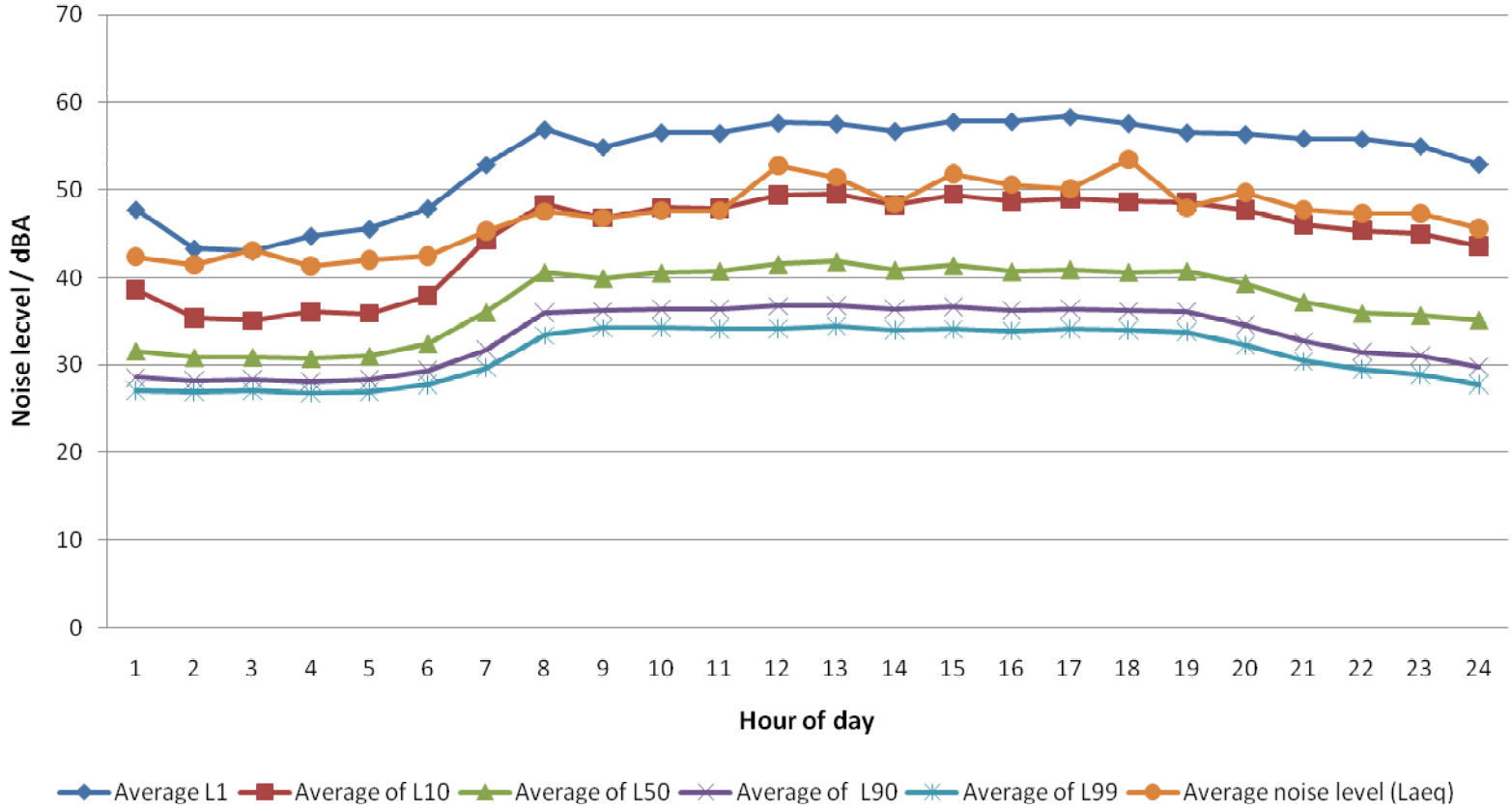


**Figure 7: Contribution of aircraft noise ($L_{Aeq}$ values) to total noise at Helions Bumpstead, by hour of day, September to December 2008**

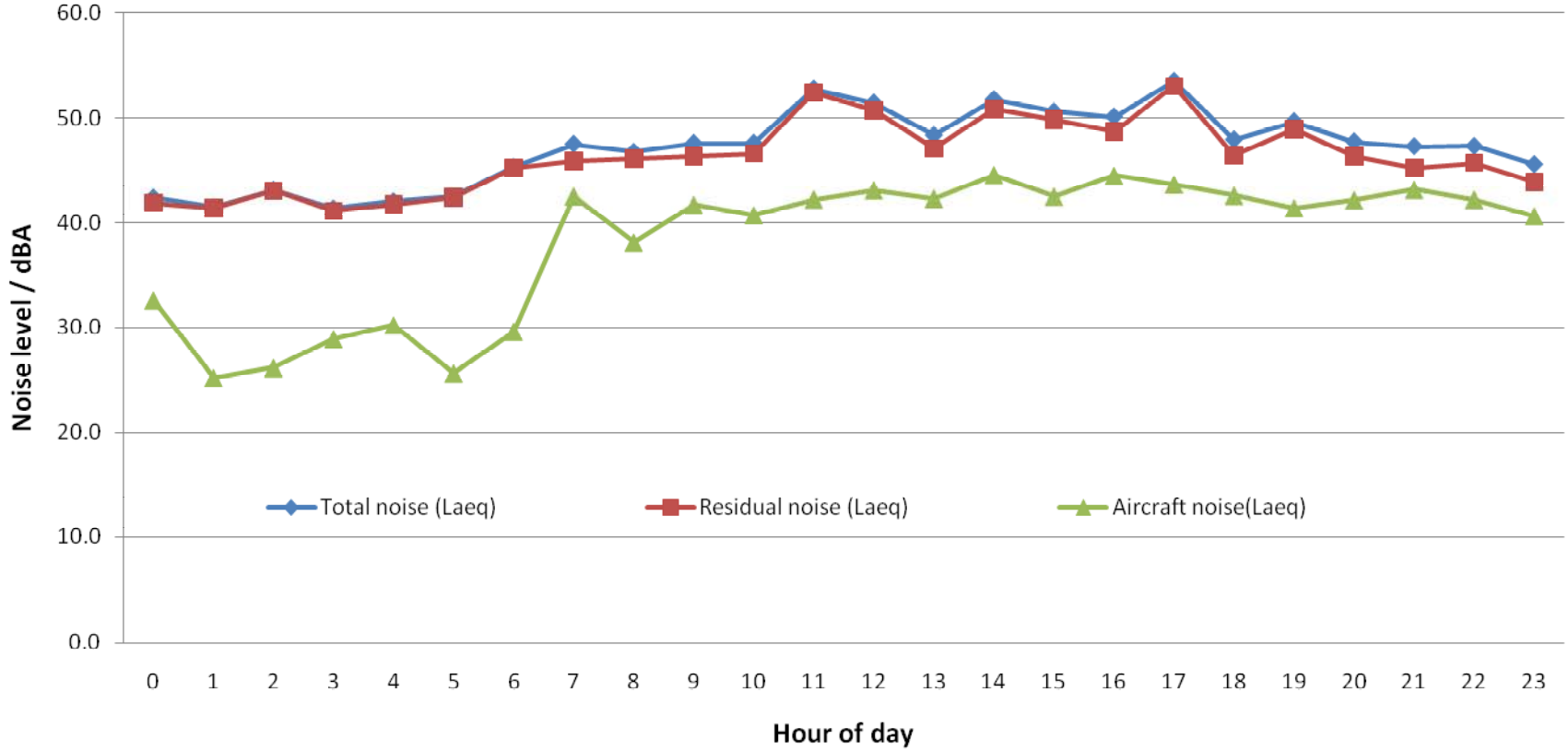


**Figure 8: Numbers of aircraft noise events from different aircraft types, at Helions Bumpstead, September to December 2008**

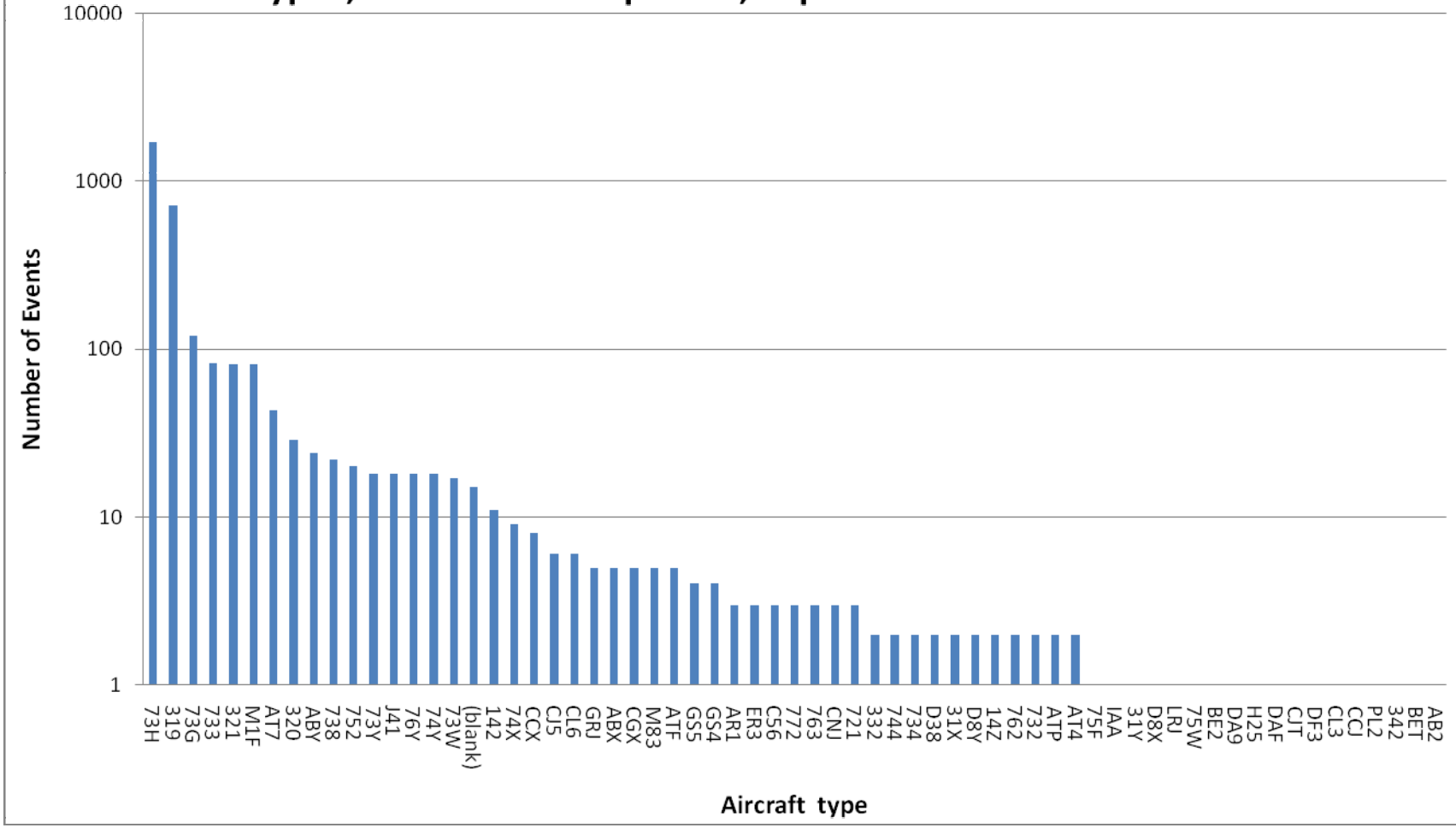
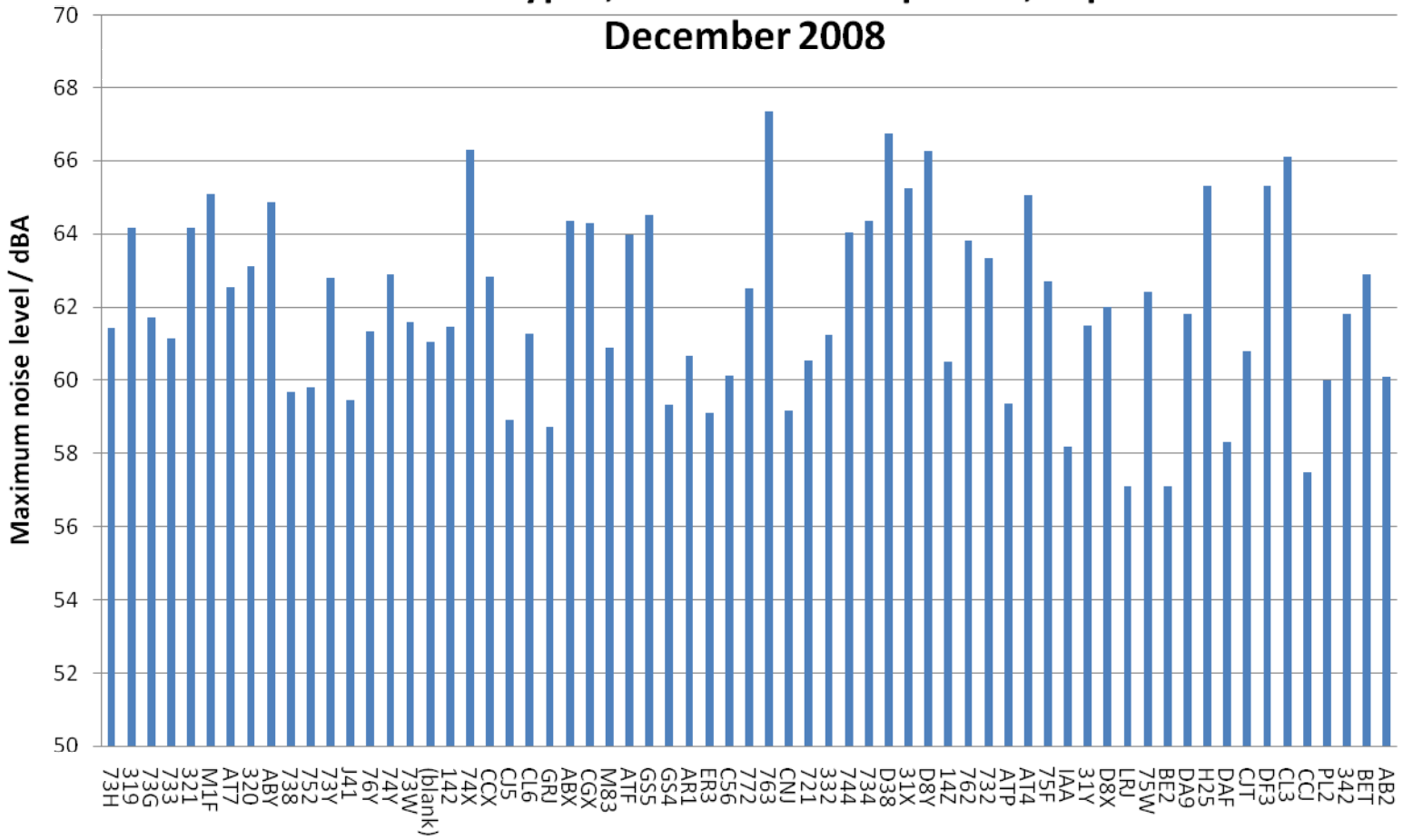


**Figure 9: Maximum noise level of aircraft noise events from different aircraft types, at Helions Bumpstead, September to December 2008**



**APPENDIX 1**

**MAP OF SITE**

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THE GREEN BUSINESS CENTRE
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STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
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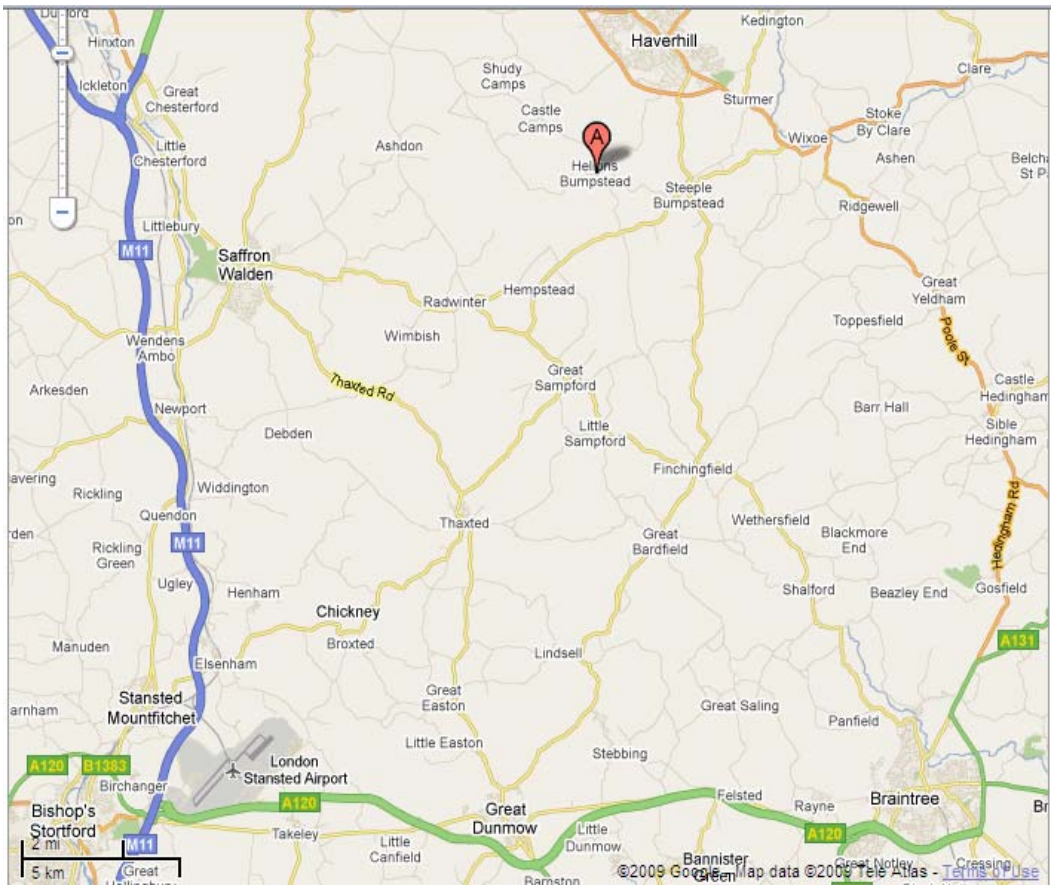
**Map showing location of noise monitoring site at Helions Bumpstead, Essex , relative to Stansted Airport**



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**APPENDIX 2**

**GLOSSARY OF ACOUSTIC TERMS**

THE GREEN BUSINESS CENTRE
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STAINES
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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.<br><br>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 60 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 90$^{th}$ 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 and community 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 3**

**LIST OF AIRCRAFT IDENTIFICATION SOURCE CODES**

AAD
applied
acoustic
design

THE GREEN BUSINESS CENTRE
THE CAUSEWAY
STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
FACSIMILE: 01784 465447

List of Aircraft Identification Codes

| | |
|---|---|
| 100 | Fokker 100 |
| 142 | BAe 146-200 |
| 143 | BAe 146-300 |
| 313 | Airbus A310-300 |
| 319 | Airbus A319 |
| 320 | Airbus A320 |
| 321 | Airbus A321 |
| 332 | Airbus A330-200 |
| 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 |
| 762 | Boeing 767-200 |
| 763 | Boeing 767-300 |
| 76Y | Boeing 767-300 Freighter |
| ABX | Airbus A300 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 |
| CCJ | Bombardier Challenger |
| CCX | Bombardier Global Express |
| CNJ | Cessna Citation |
| CR2 | Bombardier CRJ-200 |
| CR9 | Bombardier CRJ-900 |
| D38 | Dornier 328 |
| DF3 | Dassault Falcon 50/900 |
| EM2 | Embraer Brasillia |
| ER3 | Embraer RJ-135 |
| F50 | Fokker 50 |
| FRJ | Dornier 328 Jet |
| GRJ | Gulfstream II/III/IV/V |
| H25 | Hawker HS-125 |
| J31 | BAe Jetstream 31 |
| 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 |
| S20 | Saab 2000 |
| TU5 | Tupolev TU-154 |