

**SUMMARY REPORT OF  
NOISE MONITORING AT MEATH GREEN  
OCTOBER 2010 TO SEPTEMBER 2011**

Client: Gatwick Airport Limited



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## **NOISE CLIMATE AT MEATH GREEN, OCTOBER 2010 TO SEPTEMBER 2011: REPORT OF 12 MONTHS OF NOISE MONITORING**

### **1.0 Introduction**

A mobile Noise Monitoring Terminal (NMT) has been deployed at Meath Green in Surrey by Gatwick Airport Ltd. This report presents a summary of the results of the 12 months of noise monitoring, between October 2010 and September 2011, which covers a complete seasonal cycle of aircraft movements.

The site is approximately 4 km north of the airport, and the noise monitor is located in the large garden of a private house, with a farm nearby. In addition to aircraft noise there is some noise from farm vehicles and from traffic from a nearby minor road, in particular from heavy vehicles accelerating away from a sharp bend.

### **2.0 The noise data from the noise monitoring terminal**

The Noise Monitoring Terminal (NMT) gathers data about the number and level of aircraft noise events. Aircraft noise events are bursts of noise which activate the trigger condition of more than 60 dBA for at least 10 seconds and which also correlate with radar tracks from the airport's noise and track keeping system. In addition the NMT also gathers 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.

Figures 1 and 2 show typical aircraft tracks for both easterly and westerly take-offs from Gatwick, also showing the location of the NMT at Meath Green. It can be seen that when the take-off direction is to the west (as shown in Figure 1) the site will be overflown by some, but not all, aircraft arriving departing towards the east. Figure 2 also show that there may be a few aircraft departures which overfly the site during easterly take-off operations.

Further information about the NMT is given in Appendix 1, and a Glossary of acoustical terms is given in Appendix 2.

The monitor was set to operate with a threshold trigger level of 60 dBA, well above the general background noise level at the site.

### **3.0 Analysis of noise monitor survey results**

The results are discussed in the following sequence: the number of aircraft noise events recorded by the NMT; maximum noise levels of aircraft noise events; the noise climate at the site, including aircraft noise, residual noise, and total noise; putting the noise climate into context.

The results of the data gathered during the survey are displayed in Figures 3 to 7 below and are also summarised in the Table in section 5, on page 7.

#### **3.1 The number of aircraft noise events**

A total of approximately 7600 such events were recorded at the noise monitor during the 12 month period; with the number each month shown in Figure 3. Note that during August 2010 data was available for only 73% of the month and so the number of events displayed in

Figure 3 for August (595) is lower than it would be if all the data had been available. All of the recorded events were due to aircraft departures with the large majority (95%) arising from westerly departures following route 26LAM, and the remainder (5%) being due to easterly departures following route 08KEN; 95% of events occurred in the daytime period (07.00 to 23.00 hours) and 5% at night-time (23.00 to 07.00 hours).

The variation in the number of events recorded from month to month, as shown in Figure 3, is mainly determined by wind direction, which determines take off direction. The west / east split in runway usage during the 12 months was: October: 61%/39%; November: 59%/41%; December: 44%/56%; January: 43%/57%; February: 70% / 30%; March: 35% / 65%; April: 43% / 57%; May: 79%/21%; June: 75%/25%; July: 65%/35%; August: 81%/19%; September: 82%/18% .

The number of aircraft noise events varies, hour by hour, throughout each day. Figure 4 shows this variation. It can be seen that, on average over the twelve month period the highest numbers of aircraft noise events per hour recorded at the site occur in the morning between 07.00 and 11.00 hours, and in the evening between 19.00 and 21.00 hours (local time).

### 3.2 Maximum noise levels and durations of aircraft noise levels

The maximum noise level produced by each aircraft over-flight ranged between 60 dBA and 85 dBA, but over 90% of values were below 67 dBA, and 99% below 71 dBA. The arithmetic average of all of these values over the three month period was 64 dBA overall, with a standard deviation of 2.4 dBA.

The duration of these aircraft noise events ranged between 10 and 87 seconds. The average duration was 20 seconds, with a standard deviation of 7.5 seconds, and the average level of aircraft noise during the events was 62 dBA.

### 3.3 The total noise climate at the site

Figure 5 shows the month by month average daytime noise levels of aircraft noise. This is the notional level of aircraft noise which would occur if the all the intermittent bursts of aircraft noise were averaged to give a continuous steady level of noise. 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, and is the internationally accepted method for comparing environmental noise.

Also shown in Figure 5 are the average monthly levels of residual noise and total noise at the site, and the average values of maximum noise levels of aircraft noise events, and of background noise (LAS90 values). Figure 6 shows similar data for night-time

It can be seen that the average level of aircraft noise is about 40 dBA in the daytime and 30 dBA at night-time, with some month to month variation. The level of residual noise is much higher than that of the aircraft noise, being generally about 52 dBA in the daytime and 46 dBA at night-time. The total noise level, which is the combination of aircraft noise and residual noise levels, is marginally (by less than 1 dB) higher than that of the residual noise.

Although average maximum aircraft noise levels are similar in daytime and at night, the other noise levels are all significantly higher in the daytime than at night. There is some but not much month to month variation.

Therefore it can be seen that, as far as average noise levels are concerned the residual noise, from all other sources except aircraft, is the dominant source of noise at this site, and that the noise from aircraft noise events, when cumulatively averaged over an extended period of time (of hours, days or months) does not make a significant contribution to the average level of total noise at the site. However each individual aircraft noise event, whenever it occurs, is likely to be clearly audible and distinguishable from the residual noise because, in addition to being different in character, it results in a noticeable increase in the level of noise over the ambient noise level during each event.

Figure 7 shows the variation of average levels of aircraft noise, residual noise, background noise and total noise at the site with hour of day. It can be seen that the noise levels do not vary much during the daytime period (06.00 to 20.00 hours) but then fall during the late evening and night-time, rising again in the early morning. The average levels over the 12 month period for various parts of the 24 hour day are shown below:

	Total noise $L_{Aeq,T}$	Aircraft noise $L_{Aeq,T}$	Residual noise $L_{Aeq,T}$	Background noise level ( $L_{AS90}$ )
Day (16h) (07.00 - 23.00 h)	52.2 dBA	40 dBA	51.9 dBA	43 dBA
Night (8h) (23.00 - 07.00 h)	46.1 dBA	30.0 dBA	46.0 dBA	36 dBA
Day (12 h)* (07.00 - 19.00 h)	52.8 dBA	41 dBA	52.6 dBA	44 dBA
Evening (4 h)* (19.00 - 23.00 h)	49.3 dBA	39 dBA	48.9 dBA	41 dBA
24 hours	50.9 dBA	39 dBA	50.7 dBA	41 dBA

\* The 12 hour day and 4 hour evening periods have been defined as part of the day evening night noise index,  $L_{den}$ , used for noise mapping purposes (and described later in this report).

## 4.0 Putting the noise climate at the site into a wider UK context

### 4.1 Aircraft noise contours

The site at Meath Green lies well outside (approximately 3 km to the north of) the lowest contour (57 dBA  $L_{Aeq16h}$ ) of the latest (2010) set of aircraft noise contours for Gatwick airport published by the Civil Aviation Authority on behalf of the Department of Transport. This is consistent with the 12 month average  $L_{Aeq16hour}$  value of 40 dBA for this site, as shown in the Table above, although strictly speaking the values obtained from this 12 month survey are not directly comparable with the noise contours because the two sets of values are based on averages over different time periods, and, probably, different modal splits and different mixes of aircraft types. The 57 dBA contour is the lowest contour to be published because in the view of the UK government it denotes the approximate onset of significant daytime

community annoyance. The relationship between noise level and annoyance is of course not an exact one, and varies according to situation and locations.

In 2006 aircraft noise contours of day evening night level ( $L_{den}$ ) were published for Gatwick airport. As for the daytime  $L_{Aeq}$  contours the site at Meath Green lay well outside the lowest contour of 55 dB  $L_{den}$ . An  $L_{den}$  value for this site over the twelve month survey period may be estimated from the values in the above Table (section 3.3); the  $L_{den}$  value for the total noise is 54 dBA and for aircraft noise it is 41 dBA.

#### 4.2 The National Noise Incidence survey

National Noise Incidence studies of noise levels in England and Wales were carried out in 1990 and again in 2000 by the Building Research Establishment for Defra. A comparison of the data from the first two studies indicated that although there were some changes, much about the noise climate in England and Wales had not changed significantly over the 10 year period. Therefore the 2000 study remains a good basis for setting the noise levels from this study at Meath Green into a wider context. The results of the 2000 study, published in 2001, gave a breakdown of the proportion of UK residents exposed to noise, as follows:

Proportion of the population of England and Wales living in dwellings exposed to daytime noise levels ( $L_{Aeq, 16 \text{ hour}}$ ) 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 at Meath Green are also free field values.

Since the 16 hour  $L_{Aeq}$  value of total noise for this site is 52 dBA this puts the site in the 50 to 55 dBA noise exposure band, occupied by 37 % of dwellings in the UK.

#### 4.3 World Health Organisation and PPG 24 Guidance on Community Noise

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."

On 27th March 2012 the National Planning Policy Framework replaced all previous planning guidance including PPG24. However Local Authorities which have an adopted Core Strategy, which refers to PPG24, have 12 months to incorporate guidance on transport noise into their Core Strategy and during those 12 months it is generally considered that PPG24 can still be relied upon as the main guidance for transport related noise issues.



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  $L_{Aeq,8h}$ .

The daytime noise exposure level at this site (52 dB  $L_{Aeq,16hour}$ ) is below the WHO Guidelines of 55 dBA for the daytime, but the night-time noise exposure level (46 dB  $L_{Aeq,8hour}$ ) is above the night-time WHO Guideline value of 45 dBA.

## **5.0 Summary and Conclusions**

This report presents the results of 12 months of noise monitoring at a site in Meath Green, Surrey between October 2010 and September 2011.

The following aspects of the noise data have been presented and described: the number of aircraft noise events recorded by the noise monitor; the maximum noise levels of these aircraft noise events; the noise climate at the site, including average levels of aircraft noise, residual noise and total noise at the site.

The results show that the aircraft noise at the site arises mainly from aircraft departing to the west on route 26 LAM. There has been relatively little month to month variation in noise levels during this 12 month noise monitoring survey.

The noise climate at the site has been placed into context by comparisons with published aircraft noise contours, with the results of the 2000 National Noise Incidence Study, and with World Health Organisation Guidelines for Community Noise.

A summary of the main noise related parameters (12 month average for period from 1 October 2010 to 30 September 2011) for the site at MEATH GREEN are shown in the Table below:

Noise Climate at Meath Green, October 2010 to September 2011

Survey period	1 October 2010 to 30 September 2011
Aircraft noise event trigger level	60 dBA for 10 seconds
Length of noise monitoring period	12 months
W/E runway usage	October: 61/39%; November: 59/41%; December: 44/56%; January: 43/57%; February: 70/30%; March: 35/ 65%; April: 43/ 57%; May: 79/21%; June: 75/25%; July: 65/35%; August: 81/19%; September: 82/18%
Number of aircraft noise events	7600
% Arrivals and Departures	100 % Departures; 0 % Arrivals
Departure routes	26LAM 95%; 08KEN 5%
% DAY and NIGHT	95 % DAY; 5 % NIGHT
Average maximum noise level of events	64 dBA overall
Average total noise level	52 dBA (DAY); 46 dBA (NIGHT)
Average aircraft noise level	40 dBA (DAY); 30 dBA (NIGHT)
Average residual noise level	52 dBA (DAY); 46 dBA (NIGHT)
Daytime level (12 hours)	53 dBA (Total noise); 41 dBA (Aircraft)
Evening level (4 hours)	49dBA (Total noise); 39 dBA (Aircraft)
Day-evening night level	54 dBA (Total noise); 41 dBA (Aircraft)
Background noise (LAS90)	43 dBA (DAY); 36 dBA (NIGHT)



# Noise Climate at Meath Green, October 2010 to September 2011

Figure 1: Flight paths for a typical day of departures to the West (Arrivals are shown in Red and Departures in Green). The blue dot shows the location of the noise monitor at Meath Green.

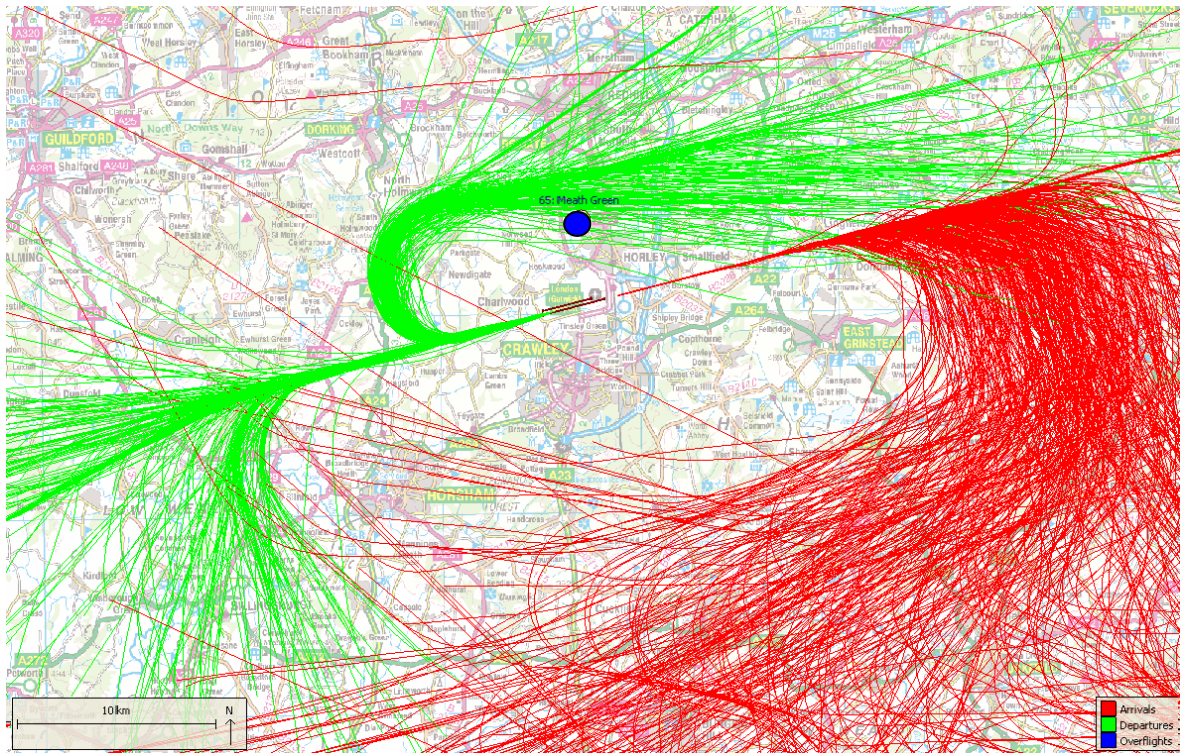
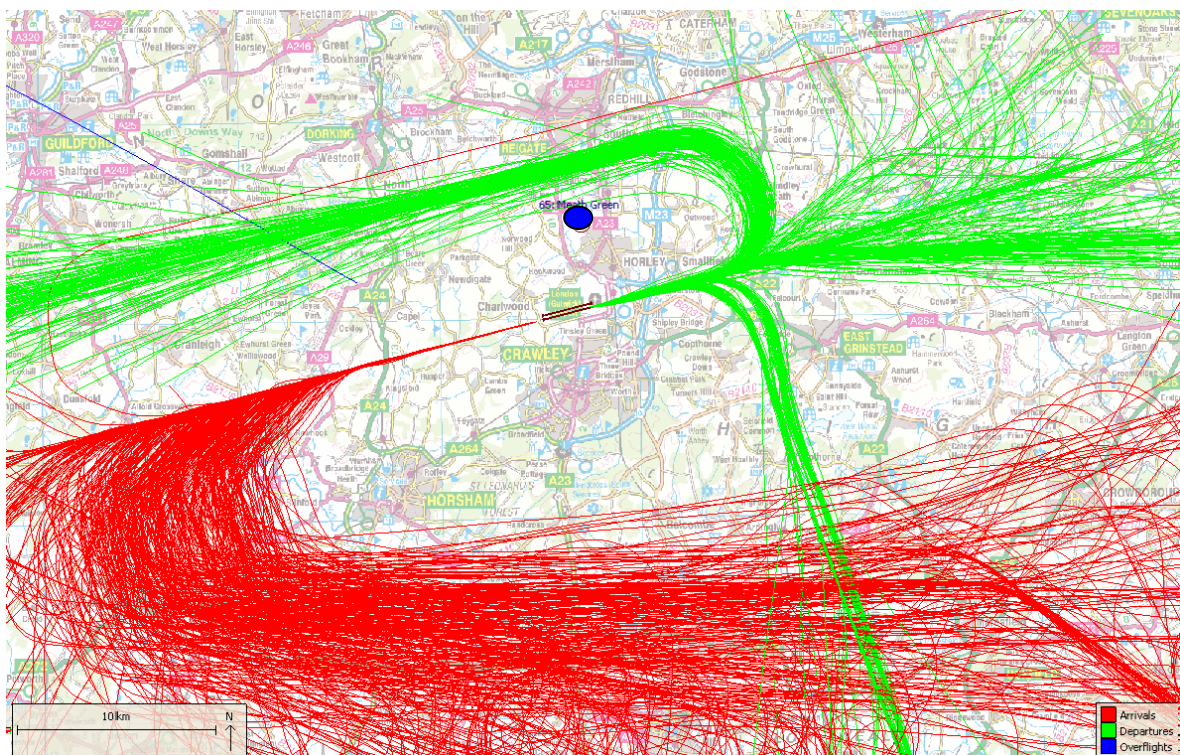
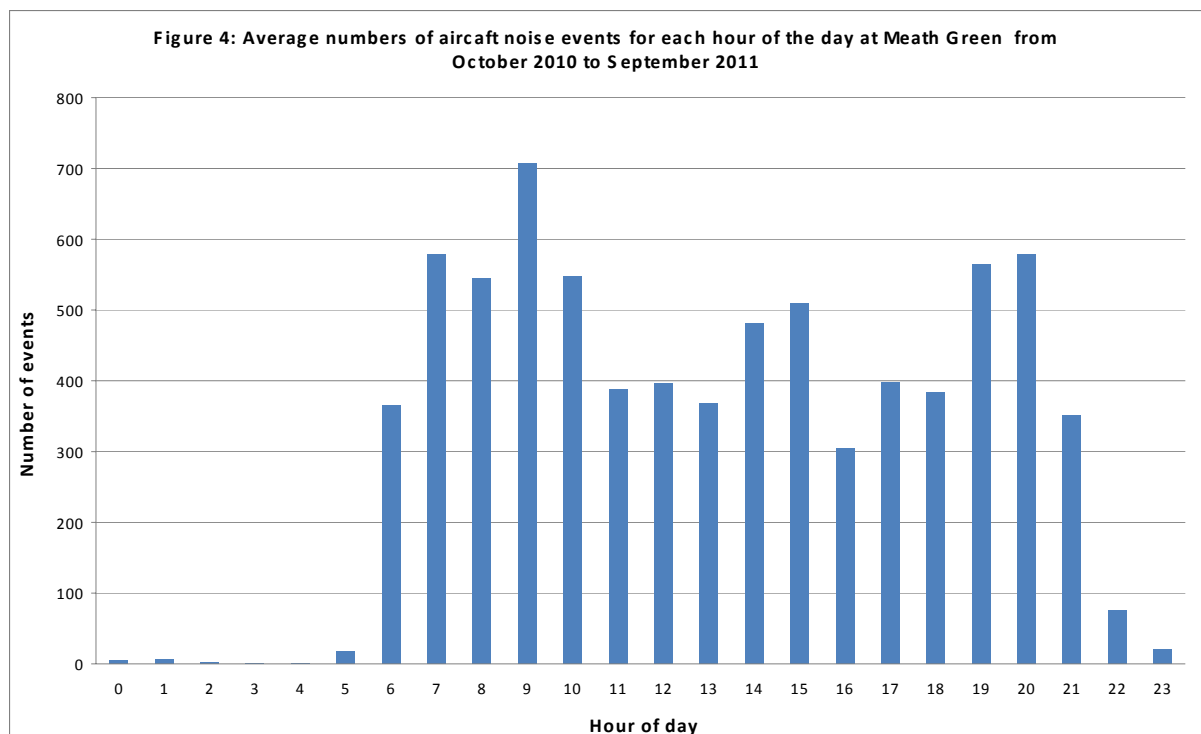
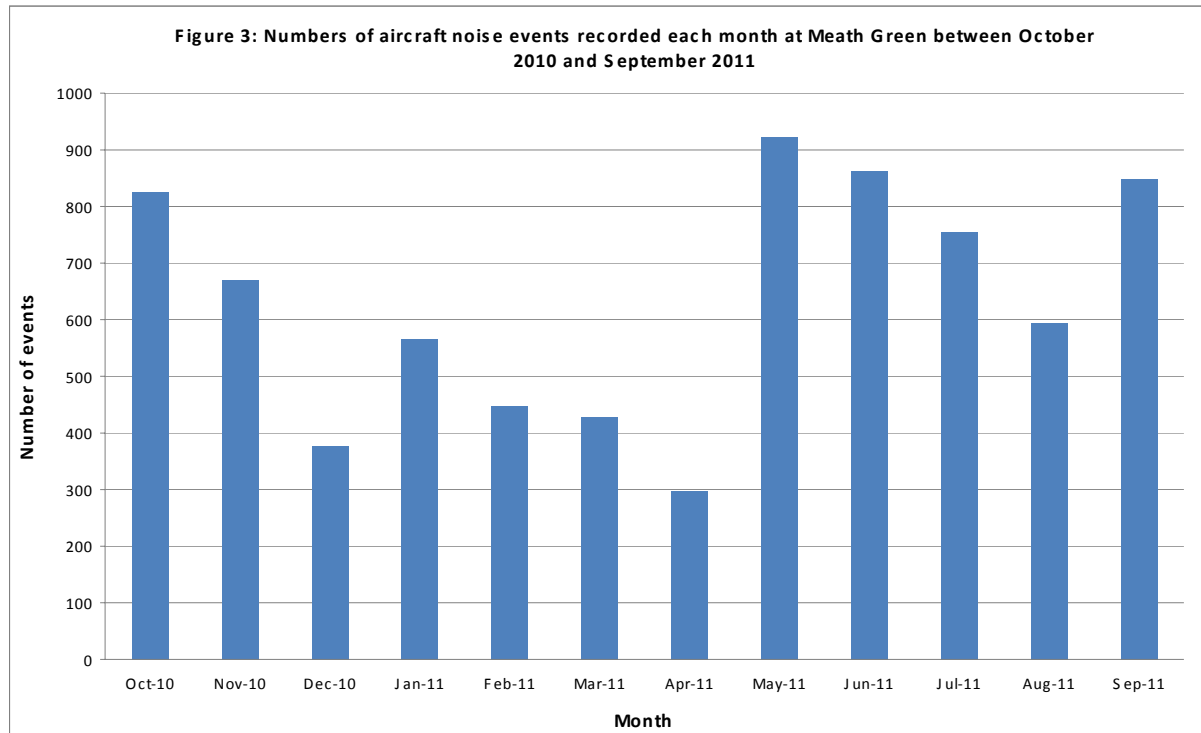


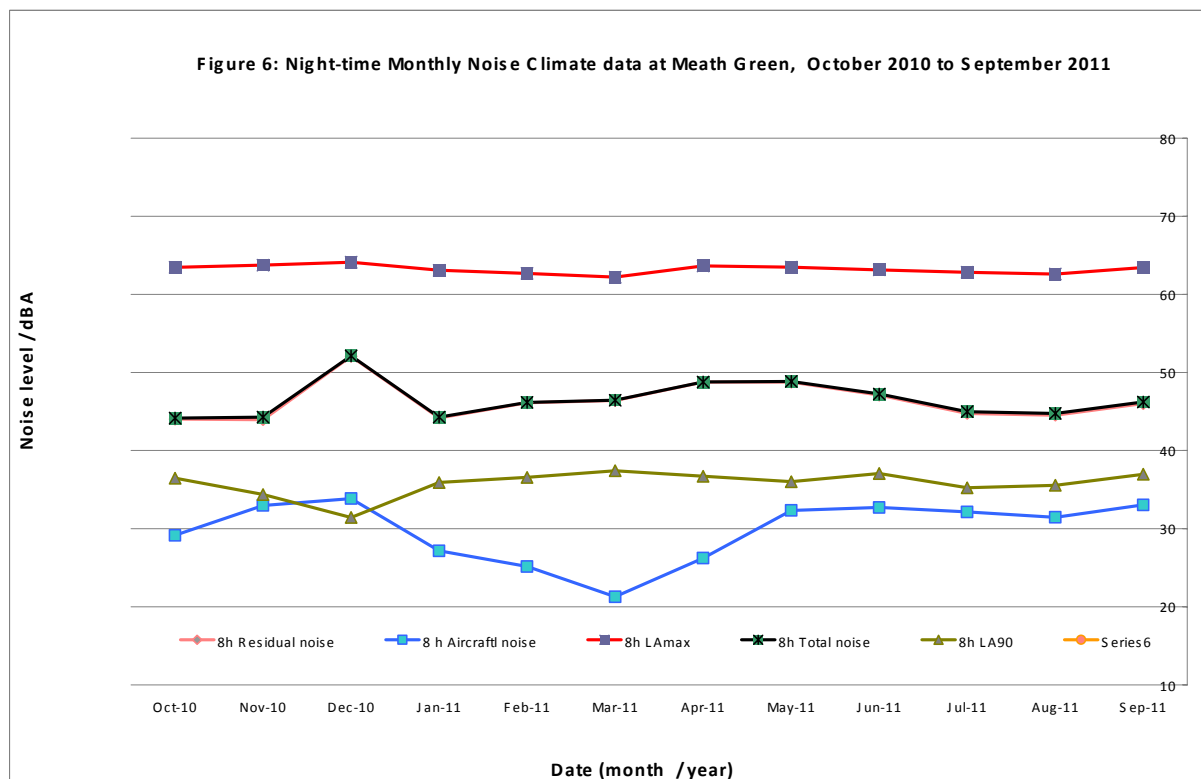
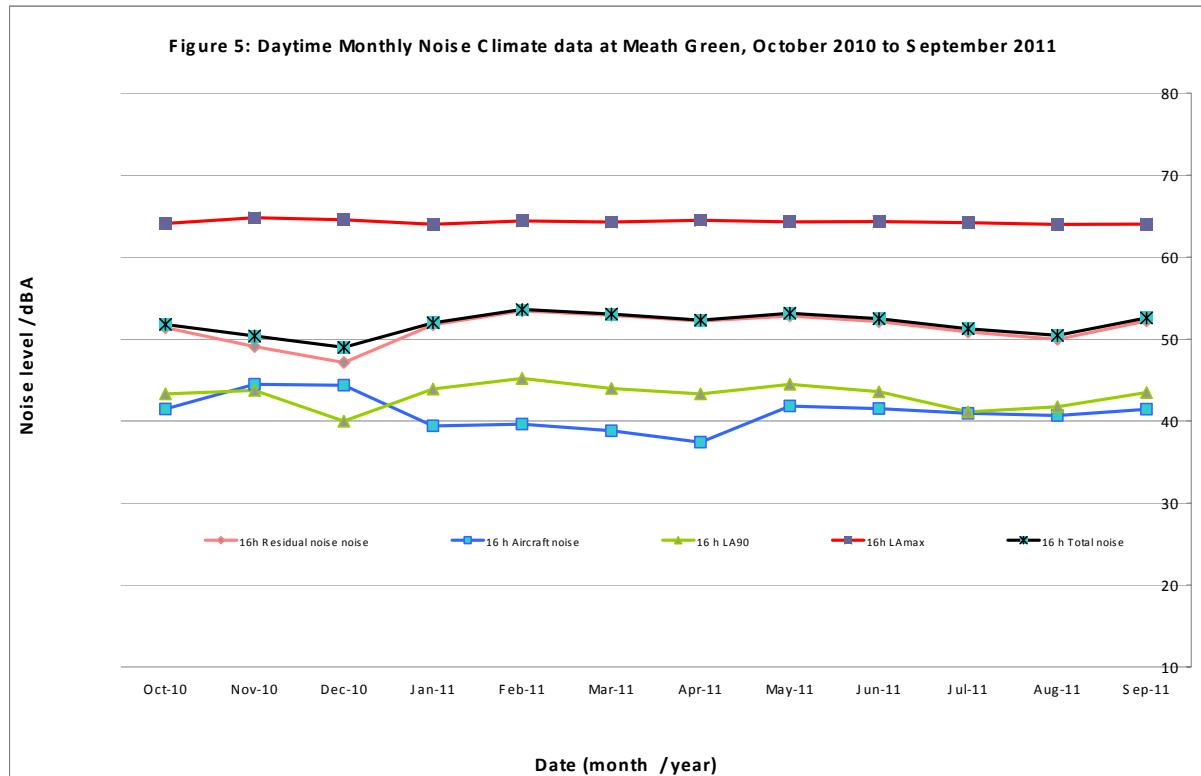
Figure 2: Flight paths for a typical day of departures to the East (Arrivals are shown in Red and Departures in Green). The blue dot shows the location of the noise monitor at Meath Green.



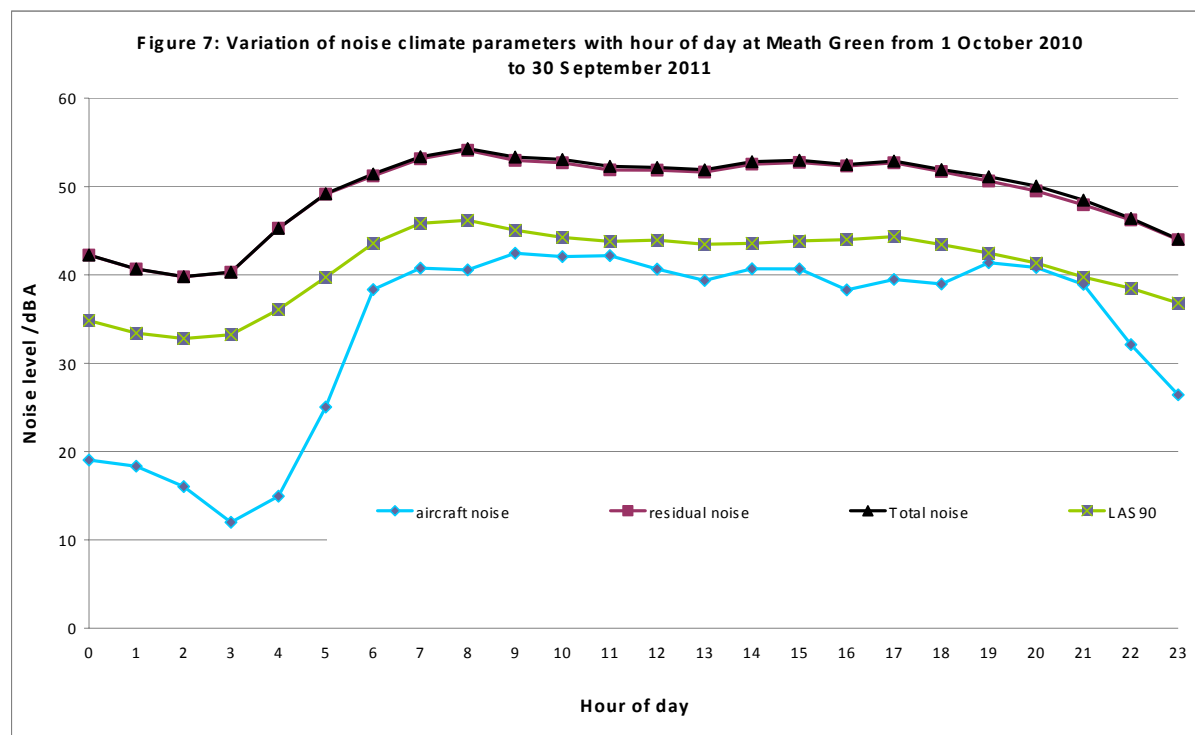
# Noise Climate at Meath Green, October 2010 to September 2011



# Noise Climate at Meath Green, October 2010 to September 2011



# Noise Climate at Meath Green, October 2010 to September 2011





## APPENDIX 1

### DATA FROM THE NOISE MONITORING TERMINAL



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## Appendix 1

### Data from the Noise Monitoring Terminal

The NMT records all noise regardless of its source. 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 60 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 Gatwick Airport will occasionally cause noise events to be captured.

To determine which of all those events are due to aircraft using Gatwick Airport their ANOMS (Aircraft Noise Management System) 'noise to track' matching software compares all captured noise events with Gatwick 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 60 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 Gatwick 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 60 dBA for a duration of at least 10 seconds was used.

The following information is recorded for each noise event: date, time, duration, maximum noise level ( $L_{A_{Smax}}$ ) 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,  $L_{Aeq}$ ) 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.

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.

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 level.

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.



## APPENDIX 2

### GLOSSARY OF ACOUSTIC 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 contours

Two types of aircraft noise contours have been produced; those based on the average daytime aircraft noise levels ( $L_{Aeq16hour}$ ), and those based on the  $L_{den}$  parameter, introduced for noise mapping purposes

$L_{Aeq16hour}$  aircraft noise contours have been produced annually and displayed on the Defra website for many years (approximately since 1990, when they replaced NNI contours) for various UK airports, including Heathrow, Gatwick and Edinburgh. The latest contours which are available are for the year 2010.

#### $L_{den}$ contours

The 24 hour day-evening-night noise index ( $L_{den}$ ) has been introduced by the EU for noise mapping purposes. This index is based on average levels of aircraft noise ( $L_{Aeq}$  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).

All UK airports have been required to produce Action Plans based on  $L_{den}$  aircraft noise contours as part of the Noise mapping exercise. Accordingly contours of  $L_{den}$  were 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.  $L_{night}$  ( $L_{Aeq,8hour}$ ),  $L_{day}$  and  $L_{evening}$  contours were also produced as part of this exercise.

The  $L_{Aeq16hour}$  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). They are produced in 3 dB steps from 57 dBA to 72 dBA. The 2006  $L_{den}$  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).

**Aircraft Noise events** Noise events which have been matched by the ANOMS noise and track keeping system to radar tracks in the vicinity of the NMT from aircraft arriving at or departing from Gatwick airport.

**Aircraft noise level** The average noise level derived from aircraft noise events, aggregated into hourly, daily or monthly average ( $L_{Aeq}$ ) 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 Gatwick Airport Ltd.

**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 Performance Team

The unit within Gatwick Airport 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.

#### Instrument Landing System (ILS)

An instrument landing system (ILS) is a ground-based instrument approach system that provides precision guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions, such as low ceilings or reduced visibility due to fog, rain, or blowing snow. The standard glide-slope path is 3° downhill to the approach-end of the runway.

#### 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, and extended to the whole of the UK in 2001, giving proportions of the population exposed to various levels of environmental noise.

A second National Noise Incidence study was carried out in 2000. A comparison of the data from the two studies indicated that although there were some changes, much about the noise climate in England and

Wales had not changed significantly over the 10 year period. Therefore the 2000 study remains a good basis for setting the noise levels from this study at Meath Green into a wider context.

**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.

On 27th March 2012 the National Planning Policy Framework replaced all previous planning guidance including PPG24. However Local Authorities which have an adopted Core Strategy, which refers to PPG24, have 12 months to incorporate guidance on transport noise into their Core Strategy and during those 12 months it is generally considered that PPG24 can still be relied upon as the main guidance for transport related noise issues.

**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 Gatwick 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 (WHO)

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<sup>th</sup> 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.

Although it is more usual to measure LA90 using the F weighting, the Slow weighting has been used for the data in this report, i.e. LAS90. It is not considered that the use of the S weighting will make any significant difference to the LA90 values in this case. (See under Time Weighting, Fast(F) and Slow(S)) below.

#### 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

In this report, in line with standard practice for aircraft noise measurement, the Slow (S) time weighting has been used for measurement of maximum levels of aircraft noise, hence reference is made to  $L_{ASmax}$ . (See under Time Weighting, Fast(F) and Slow(S)) below.

Noise                      Unwanted sound

Octave band spectra    In order to 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 and 100)

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, the Slow (S) time weighting has been used for measurement of maximum levels of aircraft noise, hence reference is made to  $L_{ASmax}$ . Because the sound level meter cannot measure using both Fast and Slow weightings simultaneously this necessarily means that the 90th percentile values have also been measured using the S weighting, hence reference is made to  $L_{AS90}$ . Although it is more usual to measure  $L_{A90}$  using the F weighting, it is not considered that the use of the S weighting will make any significant difference to the  $L_{A90}$  values in this case.