MANSTON AIRPORT
AIRCRAFT NIGHT NOISE ASSESSMENT REPORT

Report to

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1.0 INTRODUCTION

Manston Airport (MSE) is seeking to agree a policy with Thanet District Council to establish a regular schedule of flights into and out of the airport that will occur between the recognised night-time hours of 23:00 and 07:00. It is already acknowledged and accepted that in order for an airport like MSE to function successfully, a degree of flexibility is required to enable aircraft to fly in and out during these night-time hours. At present, these events already take place on an ad-hoc basis.

It is a requirement of the current Section 106 Agreement between Thanet District Council and MSE that prior to the introduction of any regular night flying operations, a Night-time Flying Noise Policy is to have been prepared by the airport and lodged with the Council.

The Second Schedule to the Section 106 Agreement dated 26/09/2000 sets out requirements for the Night-time Flying Noise Policy and, in August 2009, a draft Night-time flying policy was submitted to the Council for their consideration. A further submission was made to the Council in September 2010. In both cases the proposed policy was to be based on the Night-time Quota Count System that is successfully deployed at many major UK airports including Gatwick, Heathrow, Stansted, Manchester, Bristol and others.

In recognition of the flexibility required in the scheduling of aircraft, and in the sensitivity of people to noise disturbance at night, the Quota Count System is based around the hours of 23:30 to 06:00 and sets a quota against which each aircraft movement, a departure or a landing, is counted. The count varies according to the noisiness of the aircraft. A count of 4 for example is noisier than a count of 2. The details of this proposal are beyond the scope of this report but MSE have developed forecasts for their expected annual number of required night operations, both during the night-time quota count period (23:30 to 06:00 hours) and also the night-time period of 23:00 to 07:00 hours.

This report considers the likely noise impacts from these forecast operations which are expected to be reached by 2018. This is done by taking the forecast night-time operations and generating noise contours (in terms of the $L_{Aeq,8h}$ index) which depict the average noise levels expected over a typical night period. In addition, noise footprints are presented for the most commonly used aircraft at night and the most significant with respect to noise that are expected to operate in the future. These footprints provide an illustration of the noise produced on the ground during a single aircraft event, rather than an average. Contour areas, dwelling and population counts within contour bands are also presented.

A description is provided of the criteria available for rating the effects of night-time noise in light of research undertaken by various parties and of those set out in recognised guidance documents and standards. Based on this information, criteria are suggested and adopted for rating the impact of regular night operations at MSE. Where considered appropriate, mitigation measures are suggested for controlling the level of impact predicted as a result of these proposals.

2.0 SITE DESCRIPTION

Manston Airport is situated in the Isle of Thanet, a few kilometres to the west of Ramsgate town and about six kilometres to the south of Margate. In close proximity to the airport, to the north and south, a number of small villages are located such as Monkton, Minster and Cliffs End to the south, and Manston and Acol to the north. The village of St Nicholas Wade is located about 6 kilometres to the west of the airport.

The density of people located around the airport is therefore by far the most significant to the east of the airport as compared to the west. For this reason, the airport operates a preferred Runway usage seeking to ensure aircraft depart on Runway 28 to the west and arrive on Runway 10 when weather conditions permit such operations in a safe manner.

For aircraft departing on Runway 28, a noise abatement route exists which requires operators of jet and large aircraft to make a right turn to the north west at a distance of around 1.5 miles from the centre of the airport Runway to avoid overflying Herne Bay, as long as operationally safe to do so.

3.0 AIRCRAFT MOVEMENTS AT NIGHT

3.1 Current Night-time Aircraft Movements

Night-time aircraft movements at Manston currently occur on an ad-hoc basis and involve aircraft of the type that are expected to fly in the future, for example the Boeing 747-400. The number of movements that take place currently vary from week to week and month to month but are typically around 1 or 2 per week at present.

3.2 Future Night-time Aircraft Movements

MSE have developed forecasts for future night-time aircraft movements up to the year 2018. The forecast movements over a calendar year and during a typical night are given in Table 1.

Period	**Annual**		**Typical Night**	
	Passenger	**Freight**	**Passenger**	**Freight**
23:00 to 23:30	1016	157	2.8	0.4
23:30 to 06:00 (Night-time Quota Period)	203	456	0.6	1.2
06:00 – 07:00	1016	157	2.8	0.4
Total	**2236**	**770**	**6.1**	**2.1**

Table 1 – Forecast Night-time aircraft movements in 2018

A detailed breakdown of the aircraft movement numbers by aircraft type are presented in Appendix A.

For the Night-time Quota Period, the quota count sought for the calendar year amounts to 1593. The total number of aircraft movements per annum during the Night-time Quota Period of 23.30 to 06.00 hours will be limited to 659.

The above information forecasts that in 2018, an average of 3.2 flights per night will take place during each of what are known as the shoulder periods of 23:00 to 23:30 and 06:00 to 07:00 hours (78% of all night-time activity), and 1.8 flights during the Night-time Quota Period (23:30 to 06:00). It is generally accepted that the most sensitive time for people at night is the intervening period and, from recent research, particularly during the hours of 01:00 to 06:00.

The conventional manner of assessing night-time noise however relies on the consideration primarily of the overall night period from 23:00 to 07:00 and it is this 8 hour period that has been adopted, together with the associated aircraft movement numbers, in the noise contours presented in this report.

4.0 NIGHT NOISE ASSESSMENT CRITERIA

The assessment of airborne aircraft noise during the daytime is based entirely on $L_{Aeq,T}$ dB contours. Night-time aircraft noise is evaluated in different ways however, using different units, such as the Single Event Level (SEL) as well as the $L_{Aeq,8h}$ index (for the period 23:00 to 07:00 hours).

It is common practice for airports to consider aircraft activity separately over various periods of the 8 hour night, such as during the late evening period of 23.00 to 23.30 or 00.00 and during the early morning period from 06.00 to 07.00 hours. In noise terms however, the night period is normally assessed as a whole, taking account of all night traffic over the period from 23.00 to 07.00 hours.

It has been recognised in a recent report[1] prepared for the Department of Health that the structure of legislation in the UK with respect to environmental noise is highly complicated involving a wide range of separate departments and agencies and calling upon a large number of legal and guidance documents. This section of the report refers to some of the key documents relevant to the assessment of night-noise in the UK.

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[1] Environmental Noise and Health in the UK, Health Protection Agency 2010

4.1 Aircraft Noise and Sleep Disturbance

The current UK planning guidance is underpinned by the considerable research study undertaken by the Department of Transport and published in 1992[2] on the topic of aircraft noise and sleep disturbance.

The extensive Department of Transport research study on the effect of night noise indicated that outdoor noise levels below 90 dB(A) SEL due to aircraft noise events are most unlikely to cause any measurable increase in the overall rates of sleep disturbance experienced during normal sleep. At higher levels the study indicated that there was a 1 in 75 chance of the average person being "wakened". One of the conclusions of the study was that, once asleep, very few people living near airports are at risk of any sleep disturbance due to aircraft noise.

An interpretation of the research study results is that there is no significant risk of sleep disturbance for locations outside 90 dB(A) SEL footprint area. For locations within 90 dB(A) SEL footprint, a very slight risk of sleep disturbance will be present. The chance of "awakening" (1 in 75) relates not to aircraft noise levels at 90 dB(A) SEL, but to aircraft noise levels in the range 90 to 100 dB(A) SEL.

Night-time noise from aircraft has also been considered taking into account the combined effect of several aircraft at night, by determining the night-time $L_{Aeq,8h}$ dB values. The use of A-weighted L_{eq} contours at night has been adopted in light of the findings of CAA research studies[3] into night noise, WHO guidelines and Planning Policy Guidance PPG 24 Planning and Noise which requires the night-time $L_{Aeq,T}$ dB value to be determined when assessing the suitability of a site for new housing.

The DoT study regarding sleep disturbance presented most of its conclusions in terms of the 90 dB SEL value, as mentioned earlier in this section. The study did however also include information on the measured sleep disturbance at the eight study sites in terms of the percentage arousals, and separately the night-time combined aircraft noise level in terms of $L_{Aeq,8h}$. The sleep disturbance information gives the percentage of sleep arousals at each site during periods which had an aircraft noise event (noise epochs) and also during periods where no aircraft noise was present (quiet epochs). The findings of the study are given in Table 2.

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[2] Ollerhead J. B. et al (1992). *Report of a Field Study of Aircraft Noise and Sleep Disturbance*. Department of Transport.

[3] DORA report 8008 (1980). *Aircraft noise and sleep disturbance: final report*. Prepared by the Civil Aviation Authority, on behalf of the Department for Trade.

Site Studied	Noise Exposure $L_{Aeq,8h}$ dB	% Arousals (Noise Epochs)	% Arousals (Quiet Epochs)
Stansted (WSB)	44	4.99	4.93
Stansted (HAT)	46	5.27	5.34
Gatwick (LFD)	52	5.62	5.24
Gatwick (LGN)	54	5.89	5.51
Heathrow (SWM)	54	4.79	4.80
Manchester (EDG)	56	6.13	5.58
Heathrow (HLW)	62	6.26	5.41
Manchester (HGN)	66	6.97	5.41

Table 2 – Summary of DoT sleep disturbance study

The information above indicates that the average noise exposure at the study sites varied from 44 dB $L_{Aeq,8h}$ to 66 dB $L_{aeq,8h}$.

To assess when the level of aircraft noise becomes significant with regard to sleep disturbance, the two columns of percentage arousals have to be inspected. An increase less than 1% in percentage arousals occurs when the noise exposure levels are 62 dB $L_{Aeq,8h}$. The increase becomes 1.5% when the exposure reaches 66 dB $L_{Aeq,8h}$. This suggests a significant effect on sleep disturbance when such levels occur. The early 1980's CAA studies into night noise advised on the L_{Aeq} unit being a good aircraft noise disturbance measure for evening and night, and that there was a discernible increase in disturbance when night-time noise exposure is about 65 L_{eq}.

At lower levels, the increase in percentage arousals between quiet and noisy conditions is less clear. The results are inconsistent at 54 dB $L_{Aeq,8h}$. At 56 dB $L_{Aeq,8h}$ there is a very small increase (0.5%), equivalent to two arousals per year.

This UK Study received some criticism at the Heathrow Terminal 5 Public Inquiry with the Inspector agreeing with the view that some data bias may have occurred. It was alleged during the Inquiry that data for Heathrow airport may have been contaminated as a result of workers employed at the airport having some influence on their families who were interviewed in the Study. Nevertheless, this Study provides another tool that is regularly used to rate the impacts of single events of night-time noise and the SEL unit at night is commonly used at many UK airports as a means of night-time noise control, for example, as a threshold for sound insulation schemes.

4.2 WHO – Night Noise Guidelines

Research studies in the field of the effects of aircraft noise at night are on-going and a working party for the World Health Organisation recently produced guidelines[4] reporting the latest findings concerning night noise from transportation sources and its effects on health and sleep. These guidelines acknowledge that the effect of noise on people at night depends not just on the magnitude of noise of a single event but also the number of events. It considers that in the long term, over a year, these effects can be described using the $L_{night,outside}$ index. This is essentially equivalent to the $L_{Aeq,8h}$ index commonly used in the UK, but instead of being based on aircraft activities during the average summer night, is based on the average annual night.

These guidelines were prepared by a working group set up to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. Although this provides guidance to the European Community in general and has no policy status, it provides a description of recent research into the health effects of noise and provides guidance on noise targets.

The following night noise guideline values are recommended by the working group for the protection of public health from night noise:

- Night noise guideline (NNG) $L_{night,outside}$ equal to 40 dB
- Interim target (IT) $L_{night,outside}$ equal to 55 dB

The NNG is a health based limit to aspire towards whereas the IT represents a feasibility based intermediate target. This is borne out to some extent by the recent Strategic Noise Mapping work undertaken across European Member States in compliance with the Environmental Noise Directive[5]. For night noise, Member States have been required to produce noise maps in terms of the $L_{night,outside}$ index no lower than 50 dB for strategic planning purposes.

The relationship between night noise exposure and health effects can be summarised as shown in Table 3.

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[4] WHO (2009), Night Noise Guidelines for Europe, World Health Organisation.

[5] Environmental Noise Directive 2002/49/EC

$L_{night,outside}$ dB	Relationship between night noise exposure and health effects
< 30	No effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise
30 – 40	There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night,outside}$ are harmful to health
40 – 55	Adverse health effects are observed at the level above 40 dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives
> 55	Cardiovascular effects become the major public health concern, which are likely to be less dependent on the nature of the noise

Table 3 – WHO guidance on the relationship between night noise exposure and health effects

Note 1: Equivalent to $L_{Aeq,8h}$

4.3 Environmental Noise and Health in the UK

A recent report entitled Environmental Noise and Health in the UK prepared for the Department of Health[1] states that WHO guidelines are offered to policy makers as a contribution to policy development. They are not intended as standards in a formal sense but as a possible basis for the development of standards. The report goes on to conclude:

Annoyance is the main health effect of environmental noise to be covered by legislation in the UK. It can be argued that health effects are taken into account more broadly in the statutory nuisance regime but this, however, does not apply to transportation noise sources. There are as yet no strict limits on noise derived from considerations of effects such as cardiovascular disease in the UK.

It is recognised in the above report that further research is required into the effects of noise and health to assist in this policy making process:-

There is still a need for further field research on noise and sleep disturbance. In addition, the links between long-term sleep disturbance by noise and health outcomes, particularly increased risk of coronary heart disease, need to be explored.

4.4 PPG 24 – Planning and Noise

In the UK, PPG 24 makes clear that use of the noise exposure category standards (for new residential planning applications) cannot be made in the context of proposals which would introduce new noise sources into areas of existing residential development and gives no guidance with regard to noise at night from developments such as aerodromes. It does, however, report that Central Government proposed in 1990 to adopt as a trigger level 57 dB $L_{Aeq,8h}$ at Stansted Airport for sound proofing eligibility at night.

The Government's policies with regard to planning and noise of new residential developments are set out in Annex 1 of the PPG 24 document. 48 dB $L_{Aeq,8h}$ has been taken to represent the level of night-time noise where, although new dwellings may be constructed, noise should be taken into account. Up to a level of 57 dB $L_{Aeq,8h}$, it states that noise should be taken into account and, where appropriate, conditions imposed to ensure an adequate level of protection against noise. When the noise level at night exceeds 57 dB $L_{Aeq,8h}$ Government's advice is that planning permission should not normally be granted. Where it is considered that permission should be given, conditions should be imposed to ensure a commensurate level of protection against noise.

A summary of the PPG 24 guidance and other research findings is given in Table 4.

$L_{Aeq,8h}$ dB	Guidance/Experience with regard to airborne aircraft noise (night-time)
<48	PPG 24 Category A
48	Exposure compatible with achieving WHO internal level of 35 dB(A) in order to "preserve the restorative powers of sleep" with partially open windows
48 – 57	PPG 24 Category B
57	Trigger level for proposed sound insulation grants at Stansted airport (SIGS)
57 – 66	PPG 24 Category C
>66	PPG 24 Category D
70	Level compatible with achieving WHO internal level of 35 dB(A) in order to "preserve the restorative powers of sleep" with the property provided with the standard noise insulation package which provides an insulation of about 35 dB(A).

Table 4 – Guidance/experience with regard to night-time airborne aircraft noise

For some UK airports, dwellings are exposed to noise levels in excess of 60 dB $L_{Aeq,8h}$ at night, e.g. Nottingham East Midlands Airport (over 200 dwellings ≥ 60 dB $L_{Aeq,8h}$ in 2004).

The number of dwellings exposed to lower levels (i.e. 55 dB $L_{Aeq,8h}$) around some UK airports are given in Table 5.

Airport	No. Dwellings
Nottingham East Midlands Airport (2004)	800
Stansted Airport (2003)	700
Gatwick Airport (2003)	600
Heathrow Airport (2003)	27100

Table 5 – Dwellings exposed to lower levels of night-time airborne aircraft noise

Annex 1 of PPG 24 also mentions an L_{Amax} dB criterion for night-time noise levels with regard to residential development sites, expressed as individual noise events regularly exceeding 82 dB L_{Amax} (S weighting) several times in any hour. Any site which is exposed to maximum noise levels of this magnitude should be considered as Category C (unless the site is already in Category D). Detailed research into aircraft noise at night has found that 82 dB L_{Amax} is approximately equal to 90 dB(A) SEL.

In the case of SEL values, PPG 24 above records that an individual event is required to occur regularly above approximately 90 dB(A) several times in any hour to rate the site as Category C. This demonstrates that the number of times a noisy event occurs is of relevance.

4.5 BS 8233 Sound insulation and noise reduction for buildings

BS 8233[6] recommends that for new dwellings, for a reasonable standard in bedrooms at night, individual noise events (measured with FAST time weighting), should not normally exceed 45 dB L_{Amax}. For newly built dwellings, with thermal double glazing, PPG 24 indicates a reduction of 32 dB(A) across the facade. When accounting for the difference between a SLOW and FAST time weighting, which for aircraft events can be around 3 dB higher when measured with a FAST time weighting, this would equate to an outdoor individual noise level of around 80 dB LAmax. This is consistent with the guidance given in PPG 24.

4.6 Evaluation Criteria for Aircraft Noise

From studies undertaken by Scheuck (2003)[7], evaluation criteria have been devised for aircraft noise exposure to protect those living in the vicinity of civil airports. The criteria involve a three tier hierarchy:

Critical limits - Above these levels there is a risk of health effects and such levels should only be tolerated as an exception for a limited time. Above these levels of noise it is imperative that noise control measures should be introduced.

Protection guides - Exposure below these levels should not induce adverse health effects in the average person, although sensitive groups may still be affected. These are the ‘central assessment values’ above which action should

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[6] BS 8233:1999 Sound insulation and noise reduction for buildings – Code of Practice.

[7] Scheuch K., Griefahn B., Jansen G., Spreng M. (2003). *Evaluation criteria for aircraft noise*. Rev. Environ Health, Jul-Sep 2003, 18(3), 185-201.

be taken to reduce noise exposure.

Threshold values - Inform about measurable physiological and psychological reactions to noise exposure where long term adverse health effects are not expected. To increase quality of life these values constitute a long term goal.

The limits applicable for individual aircraft noise events over an 8 hour night period are given in Table 6.

Tier	Limit over an 8-hour Night-time period
Critical limits	6 events at 60 dB L_{Amax}
Protection guides	13 events at 53 dB L_{Amax}
Threshold values	23 events at 40 dB L_{Amax}

Table 6 – Limits applicable for individual aircraft noise events - indoors

Taking account of the sound reduction that may be expected from outside to inside though a closed single glazed window, which amounts to 27 dB(A) from PPG 24, results in the limits applicable for individual aircraft noise events given in Table 7.

Tier	Limit over an 8-hour Night-time period
Critical limits	6 events at 87 dB L_{Amax} outdoors (approximately 95 dB(A) SEL)
Protection guides	13 events at 80 dB L_{Amax} outdoors (approximately 88 - 90 dB(A) SEL)
Threshold values	23 events at 67 dB L_{Amax} outdoors (approximately 75 dB(A) SEL)

Table 7 – Limits applicable for individual aircraft noise events – outdoors (windows closed)

4.7 Person Event Index and Average Individual Exposure

The number of times a person is exposed to a given SEL value, say 90 dB(A), can be assessed using an index known as the Person Event Index.

The Person Event Index (PEI) allows the total noise load generated by an airport to be computed by summing, over the exposed population, the total number of instances where an individual is exposed to an aircraft noise event above a specified noise level over a given period. This provides a useful index for assessing on how many occasions a person might be exposed to a noise level at night greater than 90 dB(A) SEL. For example, if a departure off a specific runway at an airport by a particular aircraft type leads to 300 people being exposed to a single event noise level (SEL) greater than 90 dB(A), then the PEI(90) in terms of SEL for that event would be 300. If there were a further similar event, the PEI(90) for the period would double to 600.

The PEI does not however indicate the extent to which the noise has been distributed over the exposed population. For example, an annual PEI(90) of 100,000 for an airport might mean that one person has been exposed to 100,000 events in excess of 90 dB(A) SEL (assuming that were possible), or that 100,000 people have each received one event or it could have been arrived at by any other combination of the two factors. The Average Individual Exposure (AIE) divides the PEI by the total population so exposed, thereby giving a useful average that can be used to compare runway options, and noise load at night in particular.

4.8 Summary of Night Noise Criteria for Manston Airport

In summary, based on the above night noise assessment review, the night-time aircraft noise at Manston Airport may be assessed using the two noise indices, SEL and $L_{Aeq,8h}$, with their appropriate criteria given in Table 8.

Acoustic Parameter	Criteria	Max. events per 8 hour night	Risk of Sleep Disturbance
SEL Individual Aircraft Movement	75 dB(A) 90 dB(A) 95 dB(A)	≤ 23 ≤ 13 ≤ 6	Minimal – long term goal No significant risk Slight risk
$L_{Aeq,8h}$ Airborne Aircraft Noise	48 dB 55 dB$^{(1)}$ >55 dB 57 dB	- - - -	Onset of any risk of sleep effects WHO NNG Interim target Risk of some sleep disturbance PPG 24 NEC B/C Boundary (Recommended SIGS eligibility at Stansted Airport)

Table 8 – Methods for assessing night-time noise

Note 1: $L_{night,outside}$.

5.0 NOISE CONTOUR AND ASSESSMENT METHODOLOGY

5.1 General

The night noise contours and SEL footprints for Manston Airport have been generated using the Integrated Noise Model (INM) developed by the Federal Aviation Authority. This software evaluates aircraft noise in the vicinity of airports using flight track information, aircraft fleet mix, standard defined aircraft profiles, user-defined aircraft profiles and terrain. It is commonly used to evaluate noise around airports in the UK and worldwide.

Noise contours have been generated using the INM for the year 2018 which represents the date by which the full usage of the night operations sought at Manston are expected to be achieved.

The assumptions upon which the noise contours presented in this report have been based are set out in Appendix A. This includes description of a representative mix of the number of aircraft movements expected in the future. Current activity levels at the airport at night lie below these levels so any increase will occur gradually over a period of time.

The shape of the contours will be affected by the flight routes flown by the aircraft. Figure 1 illustrates the departure and arrival routes in place at the airport and assumed in this analysis. For noise abatement purposes, there is a preference for departing on Runway 10 although the wind direction dictates to a large extent the Runway usage. This analysis has assumed a Runway usage of 67% movements on Runway 28 and 33% movements on Runway 10 which is consistent with night-time runway usage throughout the 2010 calendar year.

SEL footprints have been generated for the most common aircraft types and the most significant with respect to noise expected to operate at night as follows:

- Boeing 737-800 - most common passenger aircraft operating at night
- MD 11 - most common freight aircraft operating at night
- Boeing 747-400 - most significant aircraft operating at night with respect to noise.

6.0 IMPACT OF NIGHT-TIME AIRBORNE AIRCRAFT NOISE

6.1 Current (2010) night operations

Night-time aircraft movements at Manston currently occur on an ad-hoc basis and involve aircraft of the type that are expected to fly in the future, for example the B747-400. The number of movements that take place currently vary from week to week and month to month but are typically around 1 - 2 per week at present. The night-time $L_{Aeq,8h}$ contours for 2010 are presented in Figure 2.1.

There are currently no dwellings located inside the 48 dB $L_{Aeq,8h}$ night-time noise contour, the area of which is 1.1 km^2.

The SEL footprints for freight aircraft in use today at MSE are discussed in Section 6.2.

6.2 Future night operations – 2018

The night-time $L_{Aeq,8h}$ dB contours for 2018 are presented in Figure 2.2. The 85, 90 and 95 dB(A) SEL footprints for the most common aircraft operating and the most significant aircraft operating at night with respect to noise are presented in Figures 3.1 to 5.2. The SEL footprints relate primarily to operations on Runway 28 as these impact people the most. Footprints on Runway 10 are however also presented for the B747-400, the most significant aircraft concerning noise in 2018 operating at the airport.

The impact of night-time aircraft noise relates to the consideration of the noise contours, and noise from individual aircraft movements. Table 9 gives details of the contour areas and estimates of the number of dwellings situated within the $L_{Aeq,8h}$ noise contour bands for the year 2018.

Dwelling counts and population numbers have been determined from a consideration of 2010 Census data by postcode location provided by CACI Ltd.

Level	Area, km^2	Population	No. Dwellings
48	12.4	11622	5338
51	7.1	6388	2873
54	4.0	1250	638
55	3.3	984	516
57	2.3	155	72
60	1.4	0	0
63	0.9	0	0
66	0.6	0	0
69	0.4	0	0
72	0.2	0	0

Table 9 – Areas and population, dwellings counts for night-time contours (dB $L_{Aeq,8h}$)

Table 9 indicates that 72 dwellings will be exposed to 57 dB $L_{Aeq,8h}$ and above with no properties exposed to 60 dB $L_{Aeq,8h}$. Around 500 dwellings will lie inside the 55 dB $L_{Aeq,8h}$ criterion mentioned in Table 4, giving rise to a risk of sleep disturbance for some.

Freight aircraft, such as the B747-400, that are currently in operation are expected to remain so in the future. Issues concerning noise from individual departures and arrivals are therefore equally valid now as in the future.

As discussed previously, the area under the 95 dB(A) SEL contour indicates the zone where, provided that the number of events at this level do not exceed six per night, the risk of any sleep disturbance is slight. The numbers of dwellings beneath the aircraft footprints are given in Table 10.

Appendix A provides further details of areas, dwelling and population counts for all SEL footprints.

Aircraft	Number of Dwellings under 95 dB(A) SEL footprint			
	Westerly Operations Runway 28		Easterly Operations Runway 10	
	Departure	Arrival	Departure	Arrival
B737-800	52	29	48	0
B747-400	117	2599	64	31
MD 11	77	29	61	0

Table 10 – Number of Dwellings under 95 dB SEL footprint

With respect to the noise effects of individual aircraft, Table 10 identifies that for all but the B747-400 aircraft, less than 100 properties lie within the 95 dB(A) SEL footprints for operations on either runway. For the B747-400, an arrival over Ramsgate on Runway 28 will expose over 2500 dwellings to a noise level of 95 dB(A) SEL or greater. This one event however would only occur on average around twice a week throughout a year.

On average, there will be around 8 individual aircraft movements per night operating at MSE by 2018, most of which will produce the smaller of the noise footprints described above. During each of these aircraft events (excluding the B747-400), less than 100 dwellings will be exposed to a level of 95 dB(A) or higher although this would generally not occur more than around twice per night at any given property. For those properties closest to the airport and receiving regularly the highest noise levels however, some risk of sleep disturbance will arise without mitigation.

The computations of dwelling counts and contour areas assume flat terrain around the airport whereas the western edge of Ramsgate Town lies at a lower ground level than the Runway and ground levels continue to fall towards the sea. It is estimated that this would reduce the noise levels incident on properties beneath the flight path in this zone by around 0.5 to 1 dB as compared to noise levels presented in this report.

The night traffic proposed in 2018 will however give rise to some risk of sleep disturbance to a portion of residents in Ramsgate and also to some residents of isolated properties to the west of the airport. The current situation is that these residents are exposed about once a week to high levels of noise from ad-hoc freight movements into or out of the airport. This situation is likely to be of concern to a few people but is generally considered acceptable and has been taking place for a number of years. The numbers of these movements will gradually increase in the future towards the levels forecast in 2018.

The number of times a person would be exposed to an aircraft noise event of a given SEL value during an average night over the year both now (2010) and in the future (2018) is set out in Table 11, along with the average individual exposure.

Year	PEI(90)	AEI(90)	PEI(95)	AEI(95)
Current (2010)	0	0	0	0
Future (2018)	10371	2.01	312	1.74

Table 11 – Person Event Index and Average Exposure Index – Current and Future

Note 1: Indices relate to people affected by noise greater than 90 dB(A) SEL and 95 dB(A) SEL.

The above indicates that in the future, a significant number of people will become exposed each night to levels of noise greater than 90 dB(A) SEL and also some to 95 dB(A) SEL or higher although on average, each person is only exposed around twice per night. An examination of the population so exposed shows that even for those most often affected, 95 dB(A) SEL is only exceeded 2.3 times per night and 90 dB(A) SEL exceeded 3.9 times per night. These lie well within the limits set out in Table 7 above.

Despite the low numbers of aircraft movements proposed at night, it is appropriate to give consideration to the introduction of some measures to protect these residents prior to night-time activity exposing dwellings to a certain level of noise exposure. It is proposed to introduce a night noise quota count limit as part of the Night Flying Policy and this will assist in limiting movements at night by the noisier aircraft types. Section 3.2 of this report sets out the night noise quota count and movement limit proposed by the airport. Appendix B provides details of the schemes in place at other airports to mitigate the effects of night noise and includes information on night noise quota counts where applicable and also details of sound insulation scheme trigger levels. At Manston Airport, the $L_{Aeq,8h}$ unit would be an appropriate means of introducing control since it takes account of the noise level and number of movements that take place within a period. Given the small number of individual aircraft events, it would not be appropriate to control aircraft by way of the 90 dB(A) SEL unit.

It has been shown in this report that 55 dB $L_{Aeq,8h}$ reflects the level at which there is some onset of a risk of sleep disturbance whereas 57 dB $L_{Aeq,8h}$ is the value suggested in PPG 24 for introducing sound insulation to dwellings around Stansted Airport. Other UK airports operate sound insulation schemes relating to night time traffic and operate similar schemes based on night-time contours in the range 55 dB $L_{Aeq,8h}$ (Robin Hood Doncaster Sheffield Airport) to 59 dB $L_{Aeq,8h}$ (Liverpool John Lennon Airport).

For Manston, in light of its relatively small size, it is suggested that consideration is given to introducing a sound insulation scheme to protect dwellings exposed to 57 dB $L_{Aeq,8h}$ at night, with a view to, over time, protecting dwellings down to a level of 55 dB $L_{Aeq,8h}$ at night. A trigger level of 57 dB $L_{Aeq,8h}$ is consistent with guidance set out in PPG 24 and in line with what occurs at some other UK airports whilst the lower level of 55 dB $L_{Aeq,8h}$ represents an aspirational target consistent with the more stringent night-time traffic related sound insulation schemes in operation within the UK. In addition, to protect those people who are likely to become regularly exposed to 95 dB(A) SEL or more, it is suggested that any sound insulation scheme includes this eligibility criterion.

With these measures in place, together with a suitable night noise quota count limit and aircraft movement limit relating to the mix of aircraft assumed in this report, the proposed night-time aircraft activities in 2018 at Manston Airport are not expected to have any significant noise impact on the local community.

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APPENDIX A
ASSUMPTIONS USED IN THE DERIVATION OF NOISE CONTOURS AND SEL FOOTPRINTS

A.1 INTRODUCTION

Noise contours are predicted based on actual and predicted aircraft movements using the Federal Aviation Administration (FAA) Integrated Noise Model (INM) Version 7.0b aircraft noise prediction software. This contour methodology is recognised worldwide and is in accordance with the methodology used for strategic noise mapping under the Environmental Noise (England) Regulations 2006.

This appendix sets out the assumptions used in the computation of the night-time airborne aircraft noise contours.

A.2 THE AIRPORT

The runway, bearing 10/28, has a (True) bearing of 101.24°, is 2752 m long and 61 m wide. There are no displaced runway approach thresholds.

A.3 AIRCRAFT OPERATIONS

General

Aircraft movement data, supplied by the Airport, has been processed in relation to aircraft type, departure and arrival route, stage length and runway usage to enable input into the noise computation program, the Integrated Noise Model (INM). This section of the report describes how this information has been compiled in a form suitable for analysis purposes and considers the following:

- Traffic distribution by aircraft type
- Flight tracks
- Dispersion
- Flight profiles
- Traffic distribution by route.

This data has been processed into a form suitable for use with the INM model after clarifications from the airport and assumptions made by BAP based on previous experience.

Traffic distribution by aircraft type

Details of the aircraft type and predicted annual movements in 2010 and 2018 as supplied by the Airport are given in Table A.1 and Table A.2 respectively.

Type	Aircraft	Period 2300-0700
Fixed-wing	A306	13
	A30B	5
	A332	1
	B742	7
	B744	13
	C550	1
	DC8-60	1
	DH8D	1
	GLF5	1
	MD11	13
	MD83	1
Rotary-wing	A139	2
	R22	20

Table A.1 – Annual aircraft night-time movements by aircraft type 2010

Type	Aircraft	Period			
		2300- 0700	*2300-2330*	*2330-0600*	*0600-0700*
Passenger	A320	671	*305*	*61*	*305*
	A340	112	*51*	*10*	*51*
	B737-800	671	*305*	*61*	*305*
	B757	224	*102*	*20*	*102*
	DH8-Q400	335	*152*	*30*	*152*
	E195	224	*102*	*20*	*102*
Freight	A300	39	*8*	*24*	*8*
	A310	39	*8*	*24*	*8*
	A330	39	*8*	*24*	*8*
	B747-400	293	*55*	*183*	*55*
	B747-800	84	*16*	*52*	*16*
	DC10	94	*24*	*47*	*24*
	DC8-60	63	*16*	*31*	*16*
	MD11	118	*24*	*71*	*24*

Table A.2 – Annual aircraft movements by aircraft type 2018

The 8 hour night-time period is between 2300 and 0700 hours.

Flight Tracks

Flight tracks similar to a SID or a STAR are not available for the Airport. Flight tracks required for INM noise contour generation have been developed based on information provided by the Airport and are based on the Airport's Noise Abatement Procedures..

Aircraft departing the Runway 10 climb straight ahead until passing 4 DME where they are directed by ATC. Aircraft departing the Runway 28 climb straight ahead to 1.5 DME where they then turn right onto a bearing of 310º (Magnetic) until they pass 5 DME where they are then directed by ATC.

Preliminary analysis showed that the SEL contours under consideration in this study do not extend as far as 4 DME and 5 DME for runways 10 and 28 respectively and therefore separate tracks have not been developed beyond these locations.

Circuits are not applicable to aircraft operating at night.

Arriving aircraft are assumed to follow the extended centre line of the runways, compatible with the use of the Instrument Landing System (ILS).

The arrival, departure and circuit tracks have been arrived at through consultation with the Airport and Air Traffic Control.

Arrival and departure routes are shown in Figure 1.

Dispersion

Aircraft on departure are allocated a departure route to follow. In practice, this route is not followed precisely by all aircraft allocated to this route. The actual pattern of departing aircraft is dispersed about the route's main track. The degree of dispersion is normally a function of the distance travelled by an aircraft along the route after take-off and also on the form of route.

When considering many departures, it is commonly found that the spread of aircraft approximates to a "normal distribution" pattern, the shape or spread of which will vary with distance along the route. A simplified mathematical model can be adopted to represent a normal distribution of events, based on standard deviations. Airport noise modelling commonly assumes that there are five "dispersed" tracks associated with each departure route; these comprise the Main Track of each route and the two Sub Tracks either side.

The allocation of movements adopted in this case to each track is as follows:

- 53.3% departures along the Main Track

- 22.2% departures along each of the two inner Sub Tracks either side of the Main Track and offset by a distance of 1.355 standard deviations
- 1.15% departures along each of the two outer Sub Tracks either side of the Main Track and offset by a distance of 2.71 standard deviations.

This dispersion model has been applied to a typical departure offset profile determined from data collected at other similar airports.

The resultant dispersion scenario for all routes is shown in Table A.3.

Distance from SOR, km	Outer Track Displacement(1), m	Distance from SOR, km	Outer Track Displacement(1), m
0.0	0	7.5	1007
3.5	105	8.0	1109
4.0	211	8.5	1184
4.5	323	9.0	1260
5.0	434	9.5	1324
5.5	556	10.0	1387
6.0	678	10.5	1444
6.5	792	11.0 and above	1500
7.0	905		

Table A.3 – Assumed route dispersion

Note 1: 2.71 x Standard Deviation.

Flight profiles

For the departure movements the INM model offers a number of standard flight profiles for most aircraft types, and in particular for the larger aircraft types. These relate to different departure weights which are greatly affected by the length of the flight, and consequently the fuel load. In the INM model this is referred to as the stage length and is in increments of 500 and then 1000 nm. The INM model assumes all aircraft take off with a full passenger load irrespective of stage length. As the stage length increases the aircraft has to depart with greater fuel and so its flight profile is slightly lower than when a shorter stage length is flown.

Stage lengths for the passenger aircraft types are given in Table A.4. These are based on destinations.

Aircraft	Destination	Stage length
A320	S. Spain	2
A340	US, Florida	6
B737-800	Mallorca	2
B757	US, E. coast	5
DH8-Q400	Domestic/Near Europe	1
E195	Rome/Warsaw	2

Table A.4 – Passenger aircraft stage lengths

As the freight aircraft types are generally flying out empty or to destinations within 500 nm, the stage length for all these aircraft types is 1.

Traffic distribution by route

The assumed runway utilisation for the aircraft is 33% easterly (Runway 10) and 67% westerly (Runway 28) for both arrivals and departures for 2018. This is consistent with the runway utilisation observed for night movements in 2010.

Aircraft movements are equally split between arrivals and departures.

A.4 INM MODEL

General

All contours and areas are determined using the Integrated Noise Model (INM) version 7.0b software.

The Integrated Noise Model (INM) software evaluates aircraft noise in the vicinity of airports using flight track information, aircraft fleet mix, standard defined aircraft profiles, user-defined aircraft profiles and terrain where information is available. INM is used to produce noise exposure contours as well as predict noise levels at specific user-defined sites.

Assumptions

Manston Airport data relevant to the INM study is taken from the latest edition of the UK Aeronautical Information Package.

A 3.0° approach angle is used for all aircraft and the ground topography is assumed to be flat. The INM default headwind of 14.8 km/hr and all-soft ground lateral attenuation is assumed.

Following a number of validation studies at other airports by BAP, it has been found necessary to modify the input assumptions to better reflect actual operations and resulting noise levels for a number of aircraft types. These are the Bombardier Dash 8 Series 400 aircraft (designated

DHC8-400), and the Embraer E195 (designated E195). Also, as the Boeing 747-800 aircraft (designated B748) is not currently in operation and is not an available INM type, a substitution is required for this aircraft with an assumption made of the aircraft's likely noise characteristics.

It is very unlikely that the Douglas DC8-60 (designated DC860) will operate in the future with the engines given in the INM model. For future scenarios the input assumptions for the Douglas DC8-60 have been modified based on certification data[8][9] for hush-kit variants of the DC8-60 and noise measurements at Manson Airport.

The noise characteristics of these aircraft have been adjusted by both modifying the actual movement numbers and aircraft type. These modifications are detailed in Table A.5.

Aircraft	**INM Type Substitution**	**Modification to Movement Numbers**	
		Departures	**Arrivals**
DHC8-400	DHC6/SD330	1.0 x DHC6	1.3 x SD330
E195	A319-131	2.0 x A319-131	2.0 x A319-131
B748	747400	0.5 x 747400	0.5 x 747400
DC8-60 (2018)	DC860	0.5 x DC860	0.3 x DC860

Table A.5 – Modifications to INM assumptions

A summary of the aircraft types and movements numbers used in the for generation of the night-time $L_{Aeq,8h}$ contours are given in Table A.6 and Table A.7. These tables summarise the resulting movements by INM aircraft type and take into consideration those aircraft for which a substitution or modification to the initial INM assumptions has been made and the associated INM aircraft type is given. Details of the procedural profiles associated with each aircraft type and INM stage length can be found in the INM 7.0b documentation.

[8] FAA (2011) *Aircraft noise levels* [Online], Available: http://www.faa.gov/about/office_org/headquarters_offices/apl/noise_emissions/aircraft_noise_levels/ [25/10/2011]

[9] EASA (2011) *Noise* [Online], Available: http://www.easa.eu.int/certification/type-certificates/noise.php [25/10/2011]

Aircraft Description	INM Aircraft Type	Runway 10		Runway 28	
		Arrivals	Departures	Arrivals	Departures
Boeing 747-200	74720B	0.0	1.0	5.0	1.0
Boeing 747-400	747400	5.0	0.0	3.0	5.0
Airbus A300-622R	A300-622R	0.0	4.0	3.0	6.0
Airbus A300B4-200	A300B4-203	2.0	1.0	1.0	1.0
Airbus A330-301	A330-301	1.0	0.0	0.0	0.0
Douglas DC8-60	DC860	0.0	1.0	0.0	0.0
De Havilland DHC-6 Twin Otter	DHC6	0.0	0.0	0.0	1.0
Gulfstream GV	GV	0.0	0.0	0.0	1.0
McDonnell Douglas MD-11	MD11GE	4.0	3.0	0.0	6.0
McDonnell Douglas MD-83	MD83	1.0	0.0	0.0	0.0
Mitsubishi MU-300-10	MU3001	0.0	1.0	0.0	0.0
Shorts 330	SD330	0.0	0.0	0.0	0.0
Robinson R-22	R22	10.0	10.0	0.0	0.0
Sikorsky S-61	S61	1.0	1.0	0.0	0.0
	Totals	**24**	**22**	**12**	**21**

Table A.6 – Aircraft types used in night-time contours INM study (including subs. and modifications) 2010

Aircraft Description	INM Aircraft Type	Runway 10		Runway 28	
		Arrivals	Departures	Arrivals	Departures
Airbus A300B4-200/CF6-50C2	A300B4-203	6	6	13	13
Airbus A310-304/CF6-80C2A2	A310-304	6	6	13	13
Airbus A319-131/V2522-A5	A319-131	74	74	150	150
Airbus A320-211/CFM56-5A1	A320-211	111	111	225	225
Airbus A330-301/CF6-80 E1A2	A330-301	0	6	0	13
Airbus A340-211/CFM 56-5C2	A340-211	18	18	37	37
Boeing 737-800	737800	111	111	225	225
Boeing 747-400	747400	55	55	112	112
Boeing 757-200/RB211-535E4	757RR	37	37	75	75
De Havilland DHC-6 Twin Otter	DHC6	0	55	0	112
Douglas DC8-60	DC860	3	5	7	10
McDonnell Douglas DC10-10	DC1010	16	16	32	32
McDonnell Douglas MD-11	MD11GE	19	19	39	39
Shorts 330	SD330	72	0	146	0
	Totals	**529**	**521**	**1074**	**1058**

Table A.7 – Aircraft types used in night-time contours INM study (including subs. and modifications) 2018

A.5 CONTOUR AREAS AND POPULATION COUNTS

Dwelling counts and population numbers have been determined from a consideration of 2010 Census data by postcode location provided by CACI Ltd.

The areas of, and the population and dwelling numbers under, the $L_{Aeq,8h}$ night-time contours for 2010 and 2018 are given in Table A.8 and Table A.9 respectively.

Level	Area, km^2	Population	Dwellings
48	1.1	0	0
51	0.7	0	0
54	0.5	0	0
55	0.4	0	0
57	0.3	0	0
60	0.1	0	0
63	0.1	0	0
66	> 0.1	0	0
69	> 0.1	0	0
72	> 0.1	0	0

Table A.8 – Areas, population and dwelling counts for night-time contours 2010 (dB $L_{Aeq,8h}$)

Level	Area, km^2	Population	Dwellings
48	12.4	11622	5338
51	7.1	6386	2873
54	4.0	1250	638
55	3.3	984	516
57	2.3	155	72
60	1.4	0	0
63	0.9	0	0
66	0.6	0	0
69	0.4	0	0
72	0.2	0	0

Table A.9 – Areas, population and dwelling counts for night-time contours 2018 (dB $L_{Aeq,8h}$)

The areas of, and the population and dwelling numbers under, the SEL footprints for the Boeing 737-800, the Boeing 747-400 and the McDonnell Douglas MD-11 are given in Table A.10.

Op.	Level	Boeing 737-800			Boeing 747-400			McDonnell Douglas MD-11		
		Area, km^2	Pop.	Dwell.	Area, km^2	Pop.	Dwell.	Area, km^2	Pop.	Dwell.
App. Rwy 10	85	4.9	606	297	14.6	2713	1274	6.2	695	330
	90	1.5	0	0	5.3	670	321	1.8	0	0
	95	0.5	0	0	1.9	44	31	0.6	0	0
Dep. Rwy 10	85	11.5	17871	8069	20.5	31127	14155	11.1	14698	6641
	90	5.4	2195	1068	8.0	9279	4166	5.4	1047	512
	95	2.0	95	48	3.1	133	64	2.5	127	61
App. Rwy 28	85	4.9	11487	5385	14.6	19041	8998	6.2	12116	5712
	90	1.5	4254	1908	5.3	11767	5490	1.8	5333	2417
	95	0.5	70	29	1.9	5815	2599	0.6	70	29
Dep. Rwy 28	85	11.6	1942	958	20.5	2452	1172	11.2	1997	982
	90	5.4	592	302	8.1	905	448	5.4	654	324
	95	2.0	109	52	3.1	218	117	2.5	136	77

Table A.10 – Areas and population/dwellings counts for aircraft noise footprints (dB SEL)

APPENDIX B
NIGHT NOISE LIMITATIONS - 2010