Environmental Research and Consultancy Department
Directorate of Airspace Policy
Civil Aviation Authority

ERCD Report 0602

Noise Exposure Contours for Gatwick Airport 2005

D J Monkman
D P Rhodes
J Deeley

Prepared by the Civil Aviation Authority on behalf of the Department for Transport, London, December 2006

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SUMMARY

This report describes the calculations of the aircraft noise exposure around London Gatwick Airport for the year 2005 and compares both the input data and the resulting contours, together with the areas and populations within the contours, with those for 2004.

Prepared by the CAA on behalf of the Department for Transport, December 2006

The authors of this report are employed by the Civil Aviation Authority. The work reported herein was carried out on behalf of the Department for Transport.

Any views expressed are not necessarily those of the Secretary of State for Transport.

Population data used in this report are based on 2001 Census data (updated in 2003 and 2004) supplied by CACI Information Services.

EXECUTIVE SUMMARY

For every year, the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority estimates the noise exposures around the London Airports (Heathrow, Gatwick and Stansted) on behalf of the Department for Transport (DfT). The magnitude and extent of the aircraft noise around these airports are depicted on maps by *contours* of constant aircraft noise index (Leq) values. The contours are generated by a computer model validated with noise measurements, which calculates the emissions and propagation of noise from arriving and departing air traffic.

This report presents the results for London Gatwick Airport for the year 2005 and compares both the air traffic information and the noise contours with those for 2004. As for 2004, the 2005 contours shown in this report take into account the topography around Gatwick by accounting for terrain height in the modelling process.

Estimates of the populations within the 2004 contours are based on the 2001 census (updated by CACI in 2003), populations within the 2005 contours are also based on the 2001 census but updated by CACI in 2004.

The average daily aircraft movement rate was 3.2% higher in 2005 than in 2004. The modal split in 2005 was 68% west - 32% east compared with 77% west - 23% east in 2004. The standard modal split (20 year average) in 2005 was 72% west – 28% east.

Relative to 2004, the total area within the 2005 terrain adjusted 57 dBA Leq (16-hour) contour increased by 2.7% and the population within this contour increased by 4.4%.

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1 INTRODUCTION

1.1 The amount of aircraft noise experienced by people living around London (Gatwick) Airport during the summer (mid June – mid September) of each year is estimated by the Environmental Research and Consultancy Department of the Civil Aviation Authority on behalf of the Department for Transport (DfT). The noise exposure measure is the Equivalent Continuous Sound Level, Leq (16-hour) in dBA. The background to the use of this index is explained in DORA Report 9023 (Ref 1). The method by which noise maps, or contours of Leq, are prepared using the ANCON Noise Model is described in DORA Report 9120 and R&D Report 9842 (Refs 2 and 3). Following work into updating European noise modelling guidance, which has culminated in an updated ECAC Document 29[1] ('Methodology for Computing Noise Contours around Civil Airports'), the ANCON model itself was also amended prior to production of the 2005 contours.

1.2 The updated ANCON Noise Model (version 2.3) now incorporates revised algorithms for an improved lateral attenuation adjustment. These revised lateral attenuation algorithms, together with other improvements to the ANCON noise model are described in a separate document (Ref 4). The effects of the changes on the 2005 contours are discussed in paragraph 3.2.2 but more detailed comparisons of the effects of the changes on the contours are given in Reference 4. Technical terms used here are described in those references.

1.3 This report contains small scale (1:150,000) diagrams of the 2005 Gatwick Leq contours. Contours overlaid on Ordnance Survey (OS) digital maps, or in AutoCad DXF format, are available for download from the Department for Transport website at www.dft.gov.uk. Additionally, printed contours overlaid on OS maps to scale 1:50,000 are available for purchase from the Department for Transport, Aviation Environmental Division, Zone 1/22, Great Minster House, 76 Marsham Street, London, SW1P 4DR, telephone 020 7944 5494, e-mail address aed@dft.gsi.gov.uk.

1.4 This report provides supporting information and compares both the aircraft operations and the resulting noise contours with those for 2004 (Ref 5).

1.5 New analyses of radar and noise data were undertaken in 2005, and the calculations incorporate revised mean tracks and associated dispersions for departing aircraft, together with revised 'spurs' to model the arrival flight track dispersion. Height/speed departure and arrival profiles have also been updated for each aircraft type where the data has shown this to be necessary.

1.6 To remove the effect of year-on-year weather fluctuations on aircraft operations in order to clarify underlying trends, two sets of contours for 2005 have been generated; (i) the *actual* modal split and (ii) the "*standard"* modal split. In 2005 the actual modal split was 68% west - 32% east compared to 77% west - 23% east in 2004. For 2004 the standard modal split was 73% west - 27% east (based on the 20 year Leq period average 1985 to 2004 inclusive); for 2005 the standard modal split was 72% west - 28% east (based on the 20 year Leq period average 1986 to 2005 inclusive). This report compares both actual and standard contours for 2004 and 2005.

1.7 As in 2004, the 2005 contours shown in this report take into account the topography around Gatwick by accounting for terrain height in the modelling process. This was achieved by geometrical corrections for source-receiver distance and elevation angles, other more complex effects such as lateral attenuation from uneven ground

[1] ECAC Document 29 3rd Edition was approved by the Directors General in December 2005 and published on the ECAC web site (www.ecac-ceac.org) in July 2006. ERCD played a major role in the production of the proposal, in particular the formulation and implementation of revised algorithms for an improved lateral attenuation adjustment.

surfaces and noise screening/reflection effects due to topographical features were not taken into account. ERCD holds terrain height data[2] obtained from Ordnance Survey on a 200m by 200m grid for England and Wales. Interpolation was performed to generate height data at each of the calculation points on the 100m by 50m receiver grid for use by the ANCON noise model. This is of particular relevance on the western side of the airport around the high ground in the vicinity of Russ Hill.

2 AIRCRAFT OPERATIONS

2.1 Flight Tracks

2.1.1 The 2005 calculations were based on updated mean tracks and track dispersions for all outbound routes from Runways 26L and 08R (see Figure 1 for route designations). These were determined from radar data (extracted from the airport's Noise and Track Keeping (NTK) monitoring system) for the summer of 2005. The 2005 radar data indicated that, as in preceding years, a small proportion of departures by some propeller aircraft deviated from the Standard Instrument Departure (SID) routeings and special routes and dispersions were defined for these operations. Such deviations are consistent with the rules laid down in the UK Aeronautical Information Publication (AIP) which states that certain propeller aircraft may be permitted to depart from the Noise Preferential Routes (NPRs) by Air Traffic Control.

2.1.2 In 2005, a small percentage (0.04%) of movements used the emergency runways 26R and 08L. A check confirmed that this had a negligible effect on the noise contours; accordingly, for the calculations, this traffic was allocated to the main runways 26L and 08R.

2.1.3 Radar measurements of arrival tracks between the stacks and Runways 26L and 08R confirmed that the continued use of evenly spaced 'spurs' remained a realistic method for modelling the dispersion of arrival tracks about the extended runway centre lines. The 2005 measurements showed that, within the area of interest, 99.7% of (westerly) arrivals on Runway 26L joined the extended runway centre-line from the south and 0.2% from the north. The remaining 0.1% were aligned with the extended runway centre-line itself. The comparable percentages for (easterly) arrivals on Runway 08R were 98.0% from the south, 1.3% from the north and 0.7% along the extended runway centre-line. The majority of aircraft joined the centre lines at distances greater than 11 kilometres from threshold – only a very small number of aircraft joined at shorter distances.

2.2 Flight Profiles and Noise Emissions

2.2.1 For 2005, the average flight profiles of height and speed versus track distance for each aircraft type were reviewed, and updated where necessary, for both departures and arrivals. For the 2005 calculations three additional aircraft types (the B767-300R, the B777-300G and the B747-400P) were added to the Gatwick database. Noise event levels were then determined from a database expressing SEL[3] as a function of engine power setting and slant distance to the receiver – the so-called 'noise-power-distance (NPD)' relationship. The engine power settings required for the aircraft to follow the measured average height and speed profiles were calculated from data describing aircraft performance characteristics within each of the different aircraft type categories.

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[2] Meridian® 2 data revised 2005.

[3] Sound Exposure Level in dBA; a measure of noise event level which accounts for both the duration and intensity of noise.

2.2.2 Following extensive noise measurements of arrivals to Gatwick (and Heathrow and Stansted) in 2005, the Airbus A320 family of aircraft have had their noise levels increased slightly (by about 1dB) at distances ranging from 8 to 20 kilometres from the landing runway threshold.

2.3 Traffic Distribution by Aircraft Type and Route

2.3.1 The aircraft movements conventionally used to determine Leq are the daily averages of those which take place in the 16-hour day, 0700-2300 local time, during the 92-day period 16 June to 15 September inclusive. Table 1, which displays the distribution of movements by aircraft type, shows that the 2005 average Leq (16-hour) day movement rate was 3.2% higher than in 2004.

2.3.2 Table 2 compares the distribution of aircraft departures by route for 2004 and 2005. The percentages of use of each runway direction - the "modal split" - for 2005 were 68% west - 32% east compared to 77% west – 23% east in 2004.

2.3.3 The table below lists the 'average summer day' movements by eight noise classes of aircraft (ranked in ascending order of noise emission, i.e. from least to most noisy) during 2004 and 2005. Table 1 and Figure 2 (at the end of the Report) state which specific aircraft types fall into which categories.

NOISE CLASS	AIRCRAFT	AVERAGE NUMBER 2004	AVERAGE NUMBER 2005	PERCENTAGE OF TOTAL 2005 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2004 MOVEMENTS
	PROPELLER AIRCRAFT				
1	Small props	0.2	0.3	0.0	0.0
2	Large props	20.2	20.1	2.8	0.0
	CHAPTER 3 JETS				
3	Short-haul	546.5	571.6	80.9	+3.7
4	Wide-body twins	84.4	82.6	11.7	-0.3
5	2nd gen wide body multis*	8.9	10.8	1.5	+0.3
	LARGE CHAPTER 2/3 JETS				
6	1st gen wide-body multis*	10.4	9.1	1.3	-0.2
	2 nd GENERATION TWIN JETS				
7	Narrow body twins (including Chapter 2 and hushkitted versions)	12.9	11.2	1.6	-0.2
	1 st GENERATION JETS				
8	Narrow body multis (including hushkitted versions)	1.3	1.1	0.2	0.0
	TOTAL MOVEMENTS	684.8	706.8	100.0**	+3.2**

* Multi-engined (3 or 4) aircraft
** May not sum exactly due to rounding

2.3.4 It can be seen from the above table that the largest percentage increase occurred in noise class 3 (short haul Chapter 3 Jets) which rose from 546.5 movements per day in 2004 to 571.6 per day in 2005.

2.3.5 Figure 2 illustrates the changing distribution of traffic among these classes over the twenty-two years from 1984 to 2005[4] inclusive.

[4] The 1990 to 2005 percentages shown in Figure 2 relate to the average 16 hour Leq-day; before 1990 the percentages relate to the average 12 hour NNI-day (0700-1900 Local Time). Also, the percentages before 1992 are based on departures only, from 1992 they relate to total movements.

3 NOISE CONTOURS

3.1 'Actual' contours

3.1.1 The actual Leq contours for 2005 (i.e. those depicting actual terrain adjusted average mode Leq exposures), from 57 to 72 dBA in steps of 3dB, are overlaid on a background population map in Figure 3. In Figure 4 three of these, for 57, 63 and 69 dBA Leq, are compared with the actual contours for 2004. Examination of Figure 4 shows the effect on the contours due to the change in modal split. The 2005 contours associated with westerly departures have elongated slightly whilst those associated with westerly arrivals have decreased reflecting the 9% change in modal split between the two years.

3.1.2 The total areas and populations[5] enclosed by each of the contours are listed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2004 ACTUAL	2005 ACTUAL		2004 ACTUAL (2003 CACI data)	2005 ACTUAL (2004 CACI data)	
>57	48.0	49.3	+2.7	4.5	4.7	+4.4
>60	28.6	28.9	+1.0	1.5	1.6	+6.7
>63	16.7	16.9	+1.2	0.6	0.7	*
>66	9.2	9.5	+3.3	0.3	0.3	*
>69	4.8	5.1	+6.3	0.1	0.1	*
>72	2.5	2.7	+8.0	<0.1	<0.1	*

* Percentage changes not shown because of the relatively low numbers and limited resolution of the estimates.

Relative to 2004, the areas within the 2005 Leq contours have all increased ranging from 1.0% at 60 dBA Leq to 8.0% at 72 dBA Leq**.** These increases in area are attributable to the overall increase in traffic and the slight increase in the arrival noise levels of the Airbus A320 family of aircraft at distances greater than 8 kilometres from threshold. Examination of Table 1 shows that the number of movements by the A319C aircraft with CFM-56 engines rose from an average of 66.4 per day in 2004 to 108.8 per day in 2005 (63.9% increase). Percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed populations because the contours may be different in shape as well as size and slight movement of contour line(s) from year to year, especially in or around relatively highly populated areas, can cause a disproportionate change in enclosed population. Based on the updated 2004 CACI data the population enclosed within the 2005 57dBA Leq contour increased by 4.4% (using the earlier 2003 CACI data would have yielded the same result). This is mainly because the 2005 57dBA Leq contour to the north of the airport (associated with easterly departures from Runway 08R) expanded slightly and encroached into Horley to a greater extent than it did in 2004.

[5] The population estimates shown in this Report are based on 2001 census data (updated by CACI Ltd in 2003 and 2004). Note also that area and population figures presented in this Report are cumulative.

3.2 'Standard' contours

3.2.1 In Figure 5 the standard terrain adjusted 2005 contours (57, 63 and 69 dBA Leq) are compared with the standard 2004 contours. These show what the noise exposures would have been if the 2004 and 2005 modal splits had mirrored the 20-year rolling average. The average modal split for the years 1986 to 2005 inclusive (used for the 2005 terrain adjusted standard contours) was 72% west - 28% east, the average modal split for the years 1985 to 2004 (used for the terrain corrected 2004 standard contours) was 73% west 27% east. The associated areas and populations are displayed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2004 STANDARD	2005 STANDARD		2004 STANDARD (2003 CACI data)	2005 STANDARD (2004 CACI data)	
>57	48.0	49.3	+2.7	4.6	4.8	+4.3
>60	28.6	28.9	+1.0	1.5	1.5	0.0
>63	16.7	16.9	+1.2	0.6	0.7	*
>66	9.2	9.5	+3.3	0.3	0.3	*
>69	4.8	5.1	+6.3	0.1	0.1	*
>72	2.5	2.7	+8.0	<0.1	<0.1	*

* Percentage changes not shown because of the relatively low numbers and limited resolution of the estimates.

The areas within the standardised 2005 terrain adjusted Leq contours are all slightly higher than those for the standardised 2004 contours ranging from a 1.0% increase at 60 dBA Leq to 8.0% at 72 dBA Leq. Based on the 2004 CACI data the population within the 57 dBA Leq contour increased by 4.3% (using the earlier 2003 CACI data would have yielded the same result). This is mainly because the 2005 57 dBA Leq contour to the north of the runway extended into Horley to a slightly greater extent than in 2004.

3.2.2 The standard contours generally provide a clearer indication than the actual contours of 'fleet noise level' changes because they minimise the effect of any difference between the ratios of westerly to easterly operations for the two years. It can be seen from Figure 5 that the 2005 contours are generally very similar to those for 2004. For 2005, there has been a slight 're-distribution' of noise to the sides of the main runway (most noticeable at 57 dBA Leq). This is a consequence of the revised lateral attenuation algorithms, together with the other improvements, used for the 2005 contours (ANCON Version 2.3). The effects of the changes on the 2005 contours due to the updated model are discussed in more detail in Reference 4.

4 GATWICK TRAFFIC AND NOISE: HISTORICAL TRENDS

4.1 Figure 6 shows how the average mode 57 dBA Leq contours, based on actual modal splits[6], have changed since 1988 by comparison with the *total annual* aircraft movements.

4.2 From 1988 to 1993, the areas within the 57 dBA Leq contours diminished markedly and then increased slightly until 1996. From 1996 onwards the areas decreased slightly each year but levelled off between 1999 and 2000. In 2001 the area decreased by 22% relative to the previous year and in 2002 the contour area decreased by 19% relative to 2001. Since 2002, the areas have increased slightly each year.

4.3 The population numbers within the contours generally move in line with the areas.

4.4 Aircraft movements bottomed out in 1991 (the year of the Gulf War) and did not return to 1990 levels until 1995. From 1995 to 2000 they increased steadily. From 2000 to 2002 movements decreased, possibly as a consequence of 11th September 2001. There was little change in the total annual number of movements from 2002 to 2003. The total annual movement figure for 2005 was 4.0% higher than that for 2004 compared with the 3.2% increase for the 16 hour average summer day.

[6] Actual modal split data are used in this figure because contours based on standard modal split are a relatively recent innovation and data prior to 1995 are not available.

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The Use of Leq as an Aircraft Noise Index
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3 Ollerhead J B, Rhodes D P, Viinikainen M S, Monkman D J, Woodley A C
The UK Civil Aircraft Noise Contour Model ANCON:
Improvements in Version 2
R&D Report 9842, June 1999

4 Rhodes D P, Monkman D J, Woodley A C
The CAA Aircraft Noise Contour Model: ANCON Version 2.3
ERCD Report 0606 (to be published shortly)

5 Monkman D J, Rhodes D P, Deeley J
Noise Exposure Contours for Gatwick Airport 2004
ERCD Report 0502, August 2005

Table 1:

DISTRIBUTION OF GATWICK AVERAGE DAILY AIRCRAFT MOVEMENTS BY TYPE (0700-2300 LOCAL TIME, 16 JUNE - 15 SEPTEMBER)

AIRCRAFT TYPE(S)	NOISE CLASS	AVERAGE NUMBER 2004	AVERAGE NUMBER 2005	PERCENTAGE OF TOTAL 2005 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2004 MOVEMENTS
Small Props	1	0.2	0.3	0.0	0.0
Large Props	2	20.2	20.1	2.8	0.0
B737-300, 400, 500	3	221.0	207.2	29.3	-2.0
B737-600, 700	3	21.0	8.3	1.2	-1.9
B737-800, 900	3	18.1	18.6	2.6	+0.1
B757E (RB211-535E4, E4B)	3	77.3	80.7	11.4	+0.5
B757P (Pratt and Whitney)	3	0.0	0.4	0.1	+0.1
BAe146	3	35.9	36.4	5.1	+0.1
A319C (CFM-56)	3	66.4	108.8	15.4	+6.2
A319V (IAE-V2500)	3	0.5	6.1	0.9	+0.8
A320C (CFM-56)	3	23.6	28.6	4.0	+0.7
A320V (IAE-V2500)	3	39.3	36.4	5.1	-0.4
A321C (CFM56)	3	4.7	1.9	0.3	-0.4
A321V (IAE-V2500)	3	19.8	20.4	2.9	+0.1
Business Jet (Ch 3)	3	4.0	3.1	0.4	-0.1
Bombardier Regional Jet 100/200	3	5.5	5.1	0.7	-0.1
Embraer EMB 135/145	3	5.1	4.6	0.7	-0.1
F100	3	2.0	0.1	0.0	-0.3
MD80	3	2.3	3.0	0.4	+0.1
MD90	3	0.0	1.9	0.3	+0.3
B767-200	4	9.1	4.8	0.7	-0.6
B767-300G (General Electric)	4	14.2	14.2	2.0	0.0
B767-300P (Pratt and Whitney)	4	8.2	9.5	1.3	+0.2
B767-300R (Rolls Royce)**	4	0.0	0.1	0.0	0.0
B767-400	4	0.2	0.0	0.0	0.0
B777-200G (General Electric)	4	18.8	20.2	2.9	+0.2
B777-200R (Rolls Royce)	4	8.4	8.2	1.2	0.0
B777-300G (General Electric)**	4	0.0	1.1	0.2	+0.2
B777-300R (Rolls Royce)	4	0.0	0.4	0.1	+0.1
A300	4	6.6	6.0	0.8	-0.1
A310	4	2.3	2.9	0.4	+0.1
A330	4	16.6	15.2	2.2	-0.2
B747-400G (General Electric)	5	8.0	8.5	1.2	+0.1
B747-400P (Pratt & Whitney)**	5	0.0	0.5	0.1	+0.1
A340	5	0.9	1.4	0.2	+0.1
MD11	5	0.0	0.4	0.1	+0.1
B747-200, 300 (Ch 3)	6	3.4	2.7	0.4	-0.1
DC10	6	7.0	6.1	0.9	-0.1
Tristar	6	0.0	0.3	0.0	0.0
B737-200 (Ch3)	7	12.8	11.2	1.6	-0.2
Business Jet (Ch 2)	7	0.1	0.0	0.0	0.0
Tu154M*	8	1.3	1.1	0.2	0.0
TOTAL MOVEMENTS		684.8	706.8	100.0***	+3.2***

* In 2004 and 2005 all Chapter 3 versions.

** New type for 2005

*** May not sum exactly due to rounding

Table 2:

PERCENTAGE OF GATWICK AVERAGE DAILY AIRCRAFT DEPARTURES BY ROUTE*
(0700-2300 LOCAL TIME, 16 JUNE - 15 SEPTEMBER)

WESTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2004	PERCENTAGE OF TOTAL DEPARTURES 2005	CHANGE (% OF TOTAL)
LAM/CLN/BIG/DVR	30.7	27.8	-2.9
HAR/BOG	21.3	18.5	-2.8
KEN/SAM	24.7	21.5	-3.2
SFD	0.0	0.0	0.0
WIZ/TIG	0.3	0.2	-0.1
PERCENTAGE WEST	77.0	68.0	-9.0
EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2004	PERCENTAGE OF TOTAL DEPARTURES 2005	CHANGE (% OF TOTAL)
LAM	2.6	3.3	+0.7
CLN/BIG/DVR	6.5	9.9	+3.4
KEN/SAM	6.6	9.0	+2.4
SFD	7.3	9.8	+2.5
PERCENTAGE EAST	23.0	32.0	+9.0

* See Figure 1.

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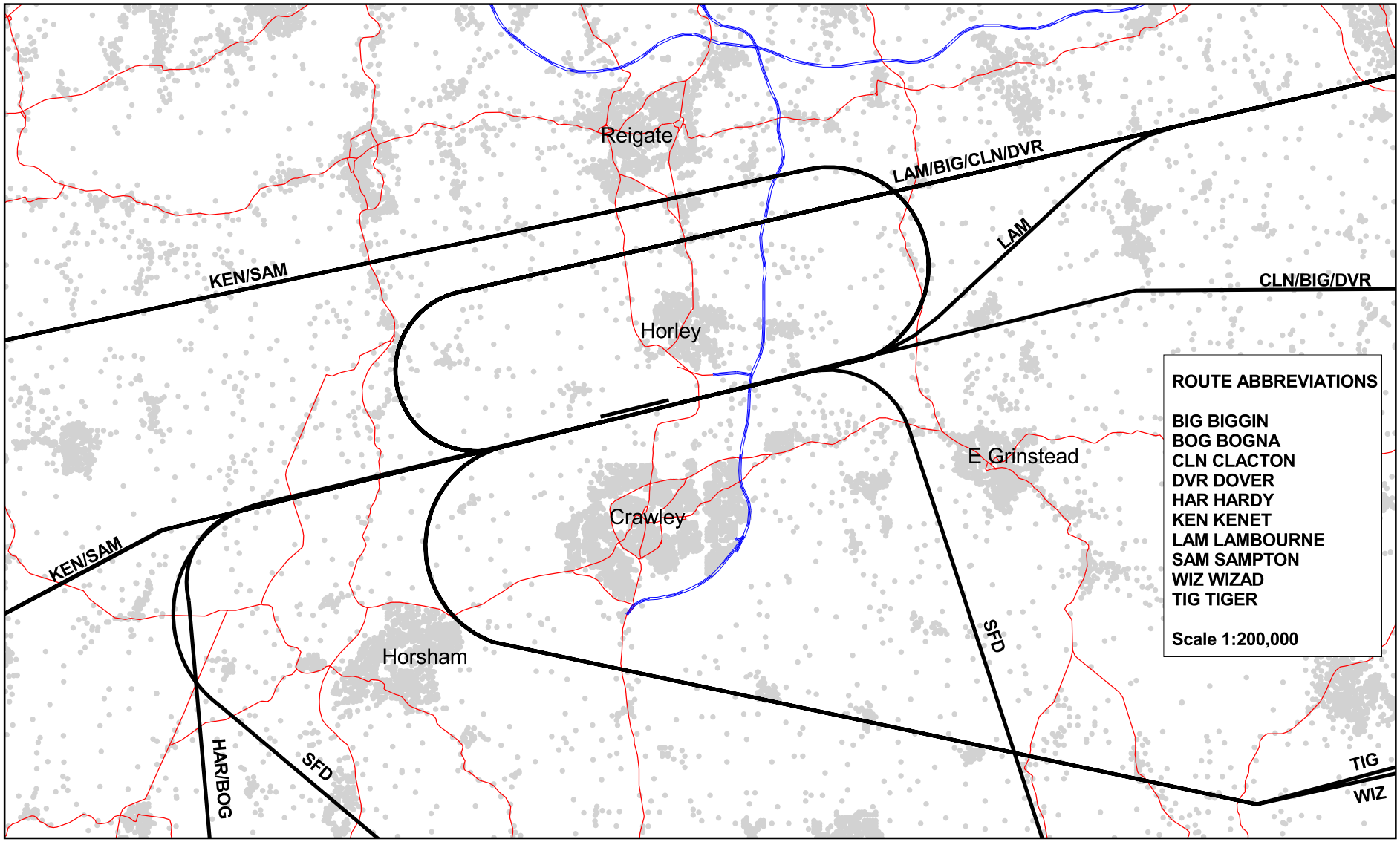
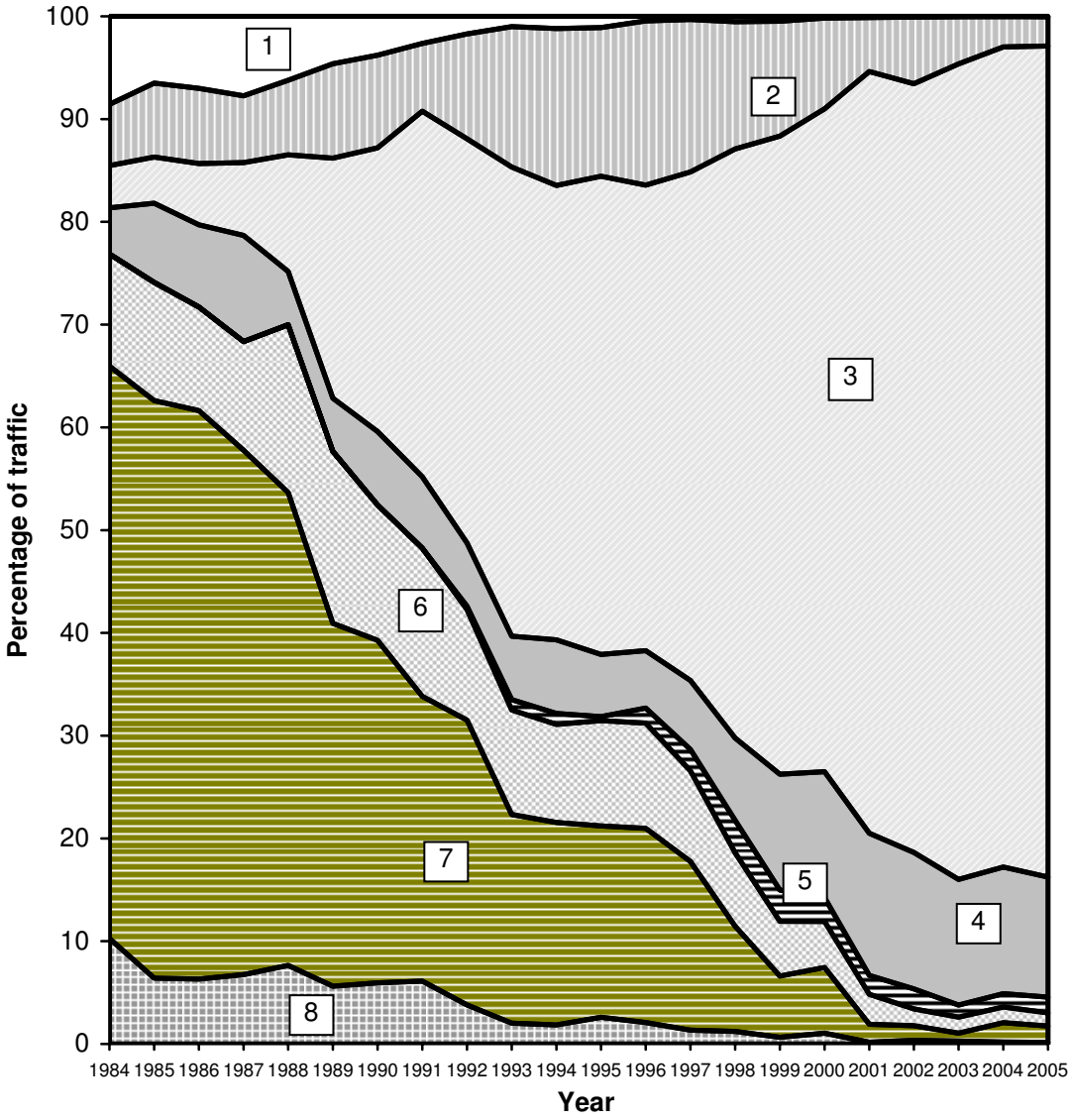


Figure 1: London Gatwick Airport Standard Instrument Departure Routes



Propeller aircraft:

1 Small props: Single and twin pistons and turboprop light, business and commuter aircraft

2 Large props: 2- & 4-propeller transports; eg SF340 BAe-ATP, ATR42, F50, HS748, Saab 2000, Electra, Hercules, Viscount, Vanguard

Chapter 3 jets:

3 Short-haul: eg A320, BAe146, B717, B737-300, B757, F100, MD80, RJ50, re-engined narrow-bodies, some business jets

4 Wide-body twins: A300, A310, A330, B767, B777

5 2nd gen. wide-body multis*: A340, MD11, B747-400

Large Chapter 2/3 jets:

6 1st gen. wide-body multis* (Chapter 2 & 3): 'Classic' 747, Tristar, DC-10, An124, IL76, IL86

2nd generation twin jets:

7 Narrow body twins (including hushkitted versions): eg F28, BAC1-11, DC-9, B737-200, Tu134, other business jets

1st generation jets: (including hushkitted versions)

8 eg Trident, B707, DC-8, B727, IL62, Tu154

* Multi = 3- or 4- engined aircraft

Figure 2: Noise Class of Gatwick aircraft 1984 - 2005

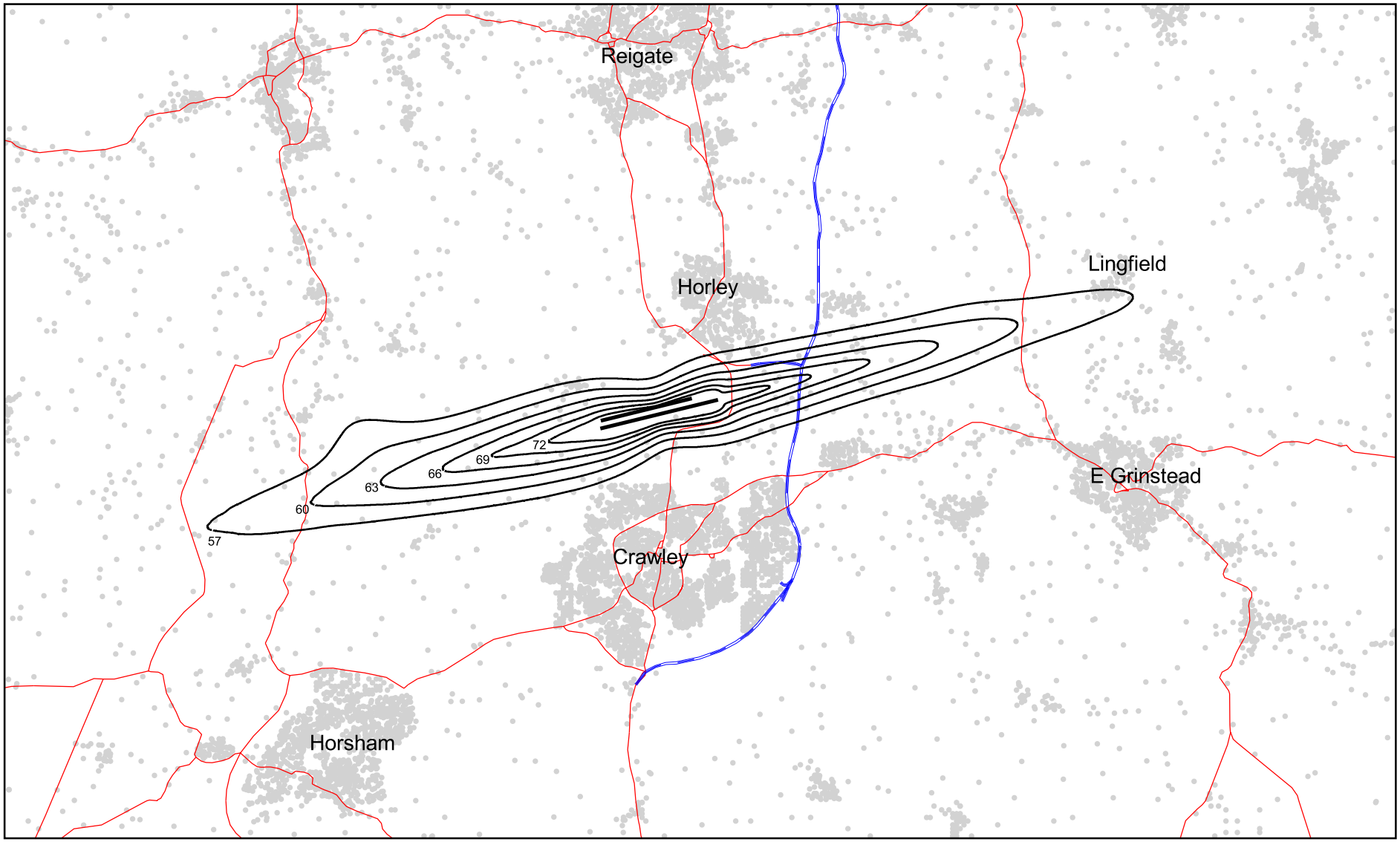


Figure 3: Gatwick actual 2005 average mode (68% west - 32% east) terrain adjusted 16hr Leq on population map

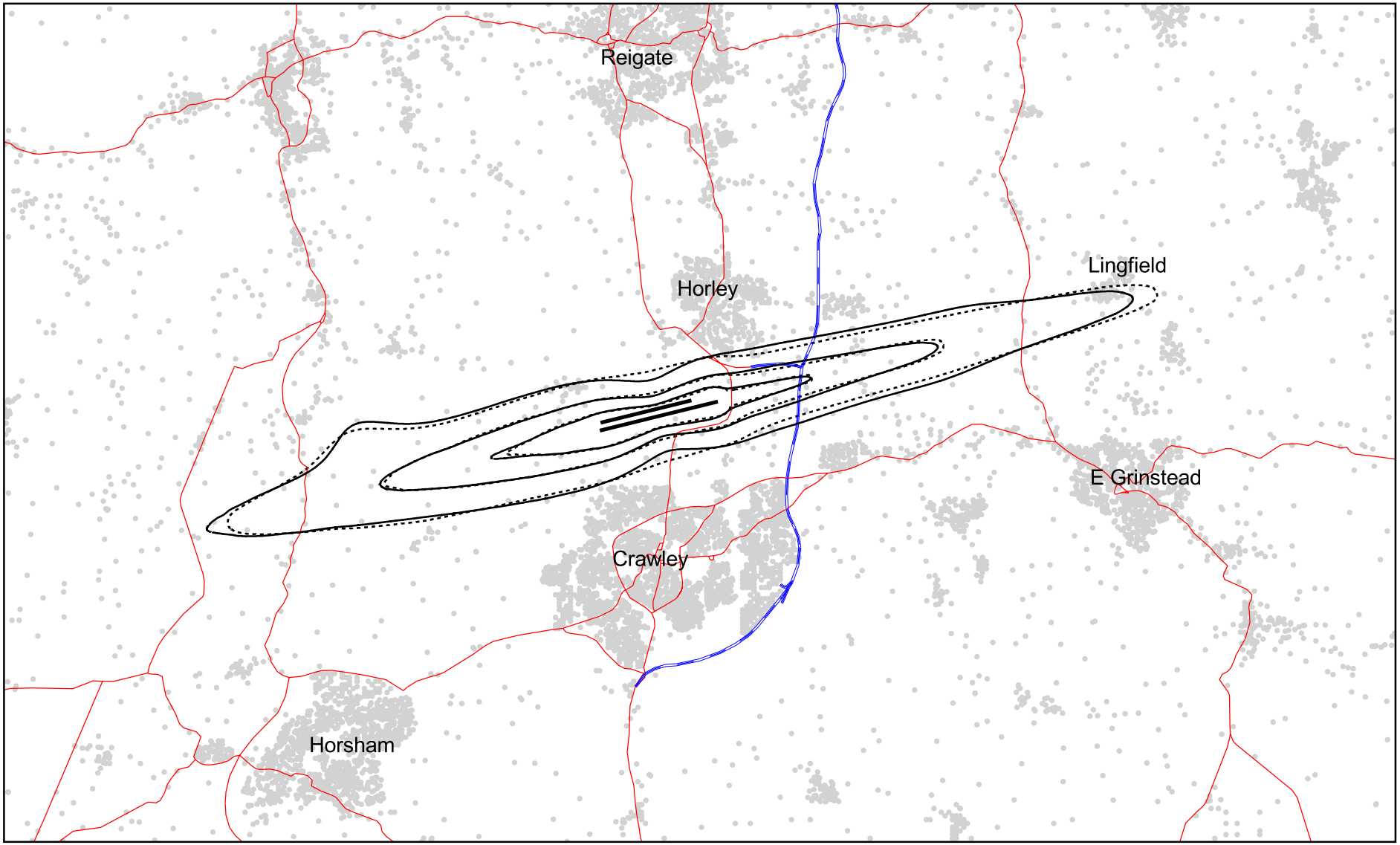


Figure 4: Gatwick actual 57, 63 and 69 Leq contours - 2004 dotted (77% west - 23% east) - 2005 solid (68% west - 32% east)

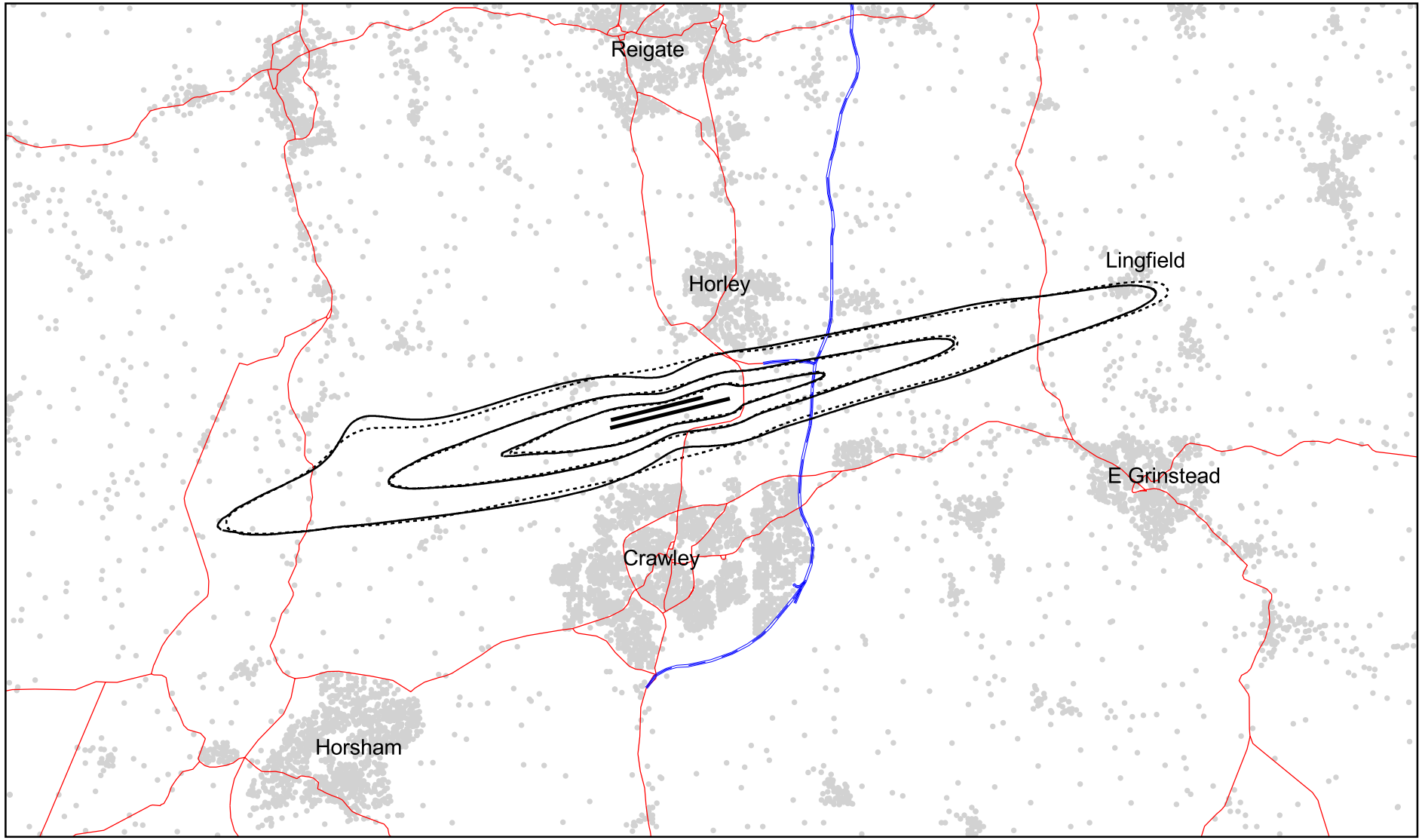


Figure 5: Gatwick standard 57, 63 and 69 Leq contours - 2004 dotted (73% west - 27% east) - 2005 solid (72% west - 28% east)

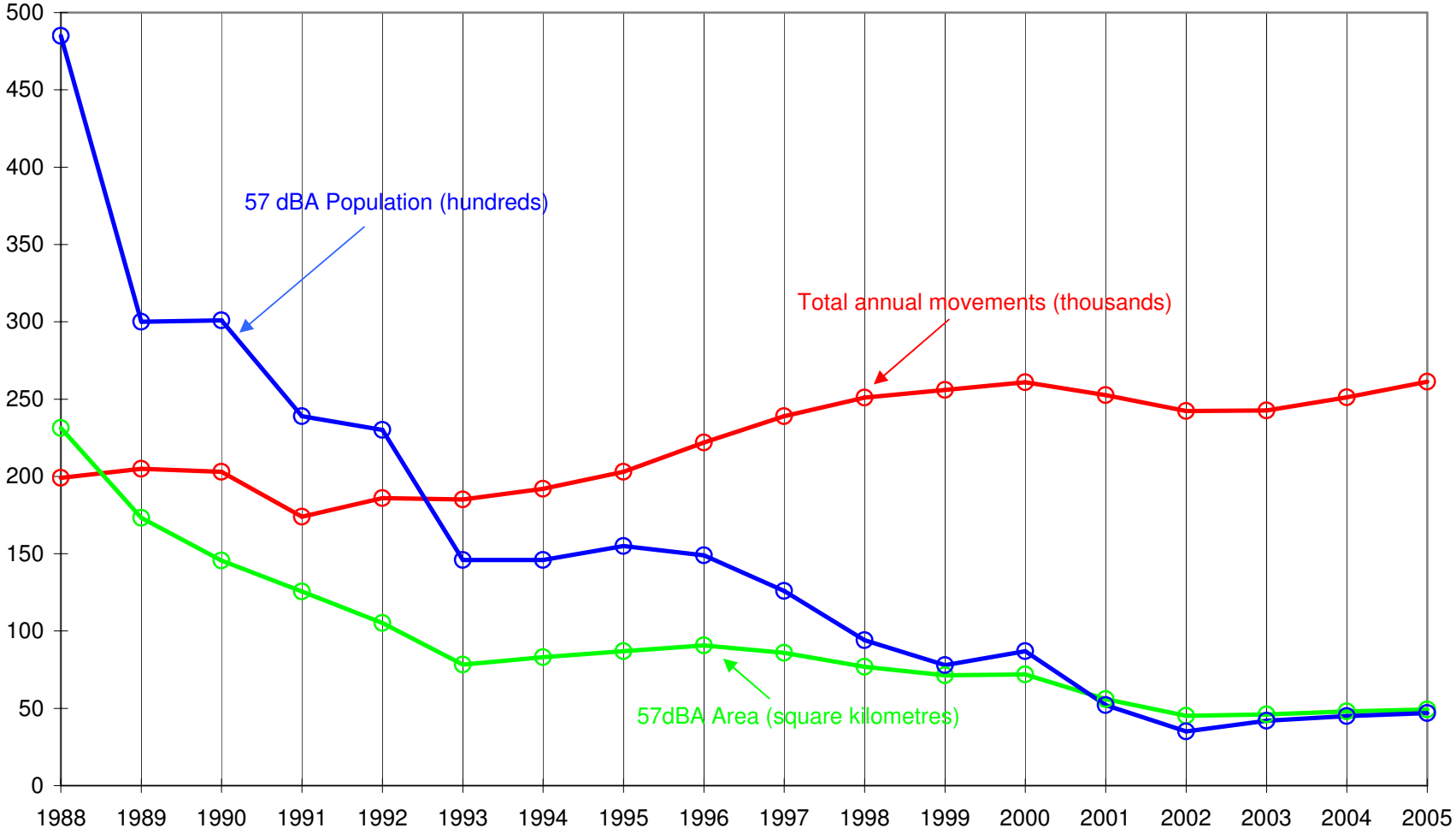


Figure 6: Gatwick traffic and noise 1988 - 2005