

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

ERCD Report 0403

Noise Exposure Contours for Stansted Airport 2003

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SUMMARY

This report describes the calculations of the aircraft noise exposure around London Stansted Airport for the year 2003 and compares both the input data and the resulting contours, together with the areas and populations within the contours, with those for 2002.

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Population data used in this report are based on 1991 and 2001 Census data (updated in 1999 and 2002) supplied by CACI Information Services.

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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 Stansted Airport for the year 2003 and compares both the air traffic information and the noise contours with those for 2002. The 2003 contours shown in this report take into account the topography around Stansted by accounting for terrain height in the modelling process. This is discussed in more detail in Section 1.6.

Estimates of the populations within the 2003 contours are based on the 2001 census (updated by CACI in 2002). Comparisons with the earlier 1991 census dated (updated in 1999) are also shown in this report.

The average daily aircraft movement rate was 6.8% higher in 2003 than in 2002. The actual modal split in 2003 was 67% south-west - 33% north-east compared with 64% south-west - 36% north-east in 2002. The standard modal split (20 year average) in 2003 was 74% south-west – 26% north-east.

Relative to 2002, the total area within the 57 dBA Leq (16-hour) contour increased by 5% and the population within this contour increased by 15%.

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1 INTRODUCTION

- 1.1 The amount of aircraft noise experienced by people living around London (Stansted) 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, R&D Report 9842 and ERCD Report 0104¹ (Refs 2, 3 and 4 respectively). Technical terms used here are described in those references.
- 1.2 This document contains small scale (1:150,000) diagrams of the 2003 Stansted Leq contours. Contours overlaid on OS maps to scale 1:50,000, or in AutoCad DXF format on 3½ inch diskettes, are available for purchase from the Department for Transport, Aviation Environmental Division, Zone 1/33, Great Minster House, 76 Marsham Street, London SW1P 4DR, telephone 020-7944-5494, e-mail address aed@dft.gsi.gov.uk. The previous practice of producing translucent acetate overlays to scale 1:50,000 has now been discontinued.
- 1.3 This report provides supporting information and compares both the aircraft operations and the resulting noise contours with those for 2002 (Ref 5).
- 1.4 New analyses of radar and noise data were undertaken in 2003, 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.
- 1.5 To remove the effect of year-on-year weather fluctuations on aircraft operations in order to clarify underlying trends, two sets of contours for 2003 have been generated; (i) the *actual* modal split and (ii) the “*standard*” modal split. In 2003 the actual modal split was 67% south-west - 33% north-east compared to 64% south-west - 36% north-east in 2002. For 2002 the standard modal split was 75% south-west - 25% north-east (based on the 20 year Leq period average 1983 to 2002 inclusive); for 2003 the standard modal split was 74% south-west - 26% north-east (based on the 20 year Leq period average 1984 to 2003 inclusive). This report compares both actual and standard contours for 2002 and 2003.

¹ Work on this Report has, for some time, been integrated into updating European Noise Modelling Guidance, which will culminate in an updated ECAC/CEAC Document 29, ‘Methodology for Computing Noise Contours around Civil Airports’. A proposal from the AIRMOD Technical Subgroup is to be considered by Directors General in Summer 2004. 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.

- 1.6 The 2003 contours shown in this report take into account the topography around Stansted 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 surfaces and noise screening/reflection effects due to topographical features were not taken into account. ERCD holds terrain height data² 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.

2 AIRCRAFT OPERATIONS

2.1 Flight Tracks

- 2.1.1 For the purpose of computing noise contours, Stansted traffic has, in previous years, been divided into non-circuit and circuit movements. Non-circuit movements were flights to/from another airport whilst circuit movements were those made by training flights involving 'touch and go' or 'go-around' operations for which separate flight profiles of height and speed versus track distance were defined. There were no circuit movements at Stansted during the 2002 and 2003 Leq periods.
- 2.1.2 The 2003 calculations were based on updated mean tracks and track dispersions for all outbound routes from Runways 23 and 05 (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 2003.
- 2.1.3 Radar measurements of arrival tracks between the stack and Runways 23 and 05 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 2003 measurements of arrivals on Runway 23 showed that, within the area of interest, 61% of aircraft approached from the western side of the airport and 39% from the eastern side of the airport. The comparable percentages for arrivals on Runway 05 were 87% from the western side and 13% from the eastern side of the airport. For Runway 23 the spur route segments joined the runway extended centre-line at distances ranging from 8 to 24 kilometres from touchdown, for Runway 05 the distances ranged from 6 to 20 kilometres; in both cases most joining points were toward the upper end of these ranges with only a very small number joining at the shorter distances.

² Meridian[®] 2 data revised 2003.

2.2 Flight Profiles and Noise Emissions

- 2.2.1 For 2003, 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. Noise event levels were then determined from a database expressing SEL³ 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.
- 2.2.2 Examination of the 2003 radar data indicated that, as in the preceding years, at distances greater than 10 kilometres to touchdown, the average aircraft heights for arrivals on Runway 05 were generally somewhat lower than on Runway 23. This follows the introduction of Continuous Descent Approach (CDA) procedures for Runway 23 arrivals via the Abbott stack from the 4 November 1999 and the extension to all Runway 23 arrivals in 2000 (section 2.21 paragraph 10, AD2-EGSS-1-11 of the UK AIP). Accordingly, for the 2003 calculations, separate Runway 23 and 05 descent profiles were used to describe arrivals by all aircraft types at Stansted.

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 2003 average Leq 16-hour day movement rate was 6.8% higher than in 2002.
- 2.3.2 Table 2 compares the distribution of aircraft departures by route for 2002 and 2003. The percentages of use of each runway direction - the actual modal splits for 2003 were 67% south-west - 33% north-east, compared with 64% south-west - 36% north-east in 2002.

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

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 2002 and 2003. 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 2002	AVERAGE NUMBER 2003	PERCENTAGE OF TOTAL 2003 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2002 MOVEMENTS
	PROPELLER AIRCRAFT				
1	Small props	1.6	2.1	0.4	+0.1
2	Large props	31.1	20.4	4.2	-2.4
	CHAPTER 3 JETS				
3	Short-haul	325.7	380.1	78.9	+12.1
4	Wide-body twins	6.3	4.6	1.0	-0.4
5	2nd gen wide body multis*	9.4	8.5	1.8	-0.2
	LARGE CHAPTER 2/3 JETS				
6	1st gen wide-body multis*	1.9	1.8	0.4	0.0
	2nd GENERATION TWIN JETS				
7	Narrow body twins (including Chapter 2 and hushkitted versions)	71.6	62.8	13.0	-2.0
	1st GENERATION JETS				
8	Narrow body multis (including hushkitted versions)	3.4	1.5	0.3	-0.4
	TOTAL MOVEMENTS	451.0	481.8	100.0	+6.8

* Multi-engined (3 or 4) aircraft

2.3.4 Short haul Chapter 3 jets (noise class 3) showed the largest percentage increase in movements per average summer day rising from 325.7 in 2002 to 380.1 in 2003. Operations by 1st and 2nd generation jets (noise classes 7 and 8) both decreased in 2003.

2.3.5 Figure 2 illustrates the changing distribution of traffic (both circuit and non-circuit prior to 2002) among these classes over the sixteen years from 1988 to 2003⁴ inclusive.

⁴ The 1990 to 2003 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 2003 (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 map in Figure 3. In Figure 4 three of these, for 57, 63 and 69 dBA Leq, are compared with the non adjusted contours for 2002.

3.1.2 The total areas and populations⁵ enclosed by each of the contours are listed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2002 ACTUAL	2003 ACTUAL Terrain adj		2002 ACTUAL (1999 CACI data)	2003 ACTUAL (2002 CACI data) Terrain adj	
>57	31.7	33.3	+5.0	2.0	2.3	+15.0
>60	19.3	19.9	+3.1	1.3	1.3	0.0
>63	11.3	11.7	+3.5	0.3	0.5	*
>66	6.3	6.6	+4.8	0.1	0.2	*
>69	3.4	3.5	+2.9	<0.1	<0.1	*
>72	1.7	1.8	+5.9	<0.1	<0.1	*

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

From 2002 to 2003 the areas within the Leq contours all increased ranging from 5.9% at 72 dBA Leq to 2.9% at 69 dBA Leq. The population within the terrain adjusted 2003 57 dBA Leq contour increased by 15% relative to 2002. Percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because the contours may be different in shape as well as size and 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. It can be seen from Figure 4 that the non adjusted 2002 and the terrain adjusted 2003 Leq contours are generally very similar. However, the 2003 57dBA Leq contour fingers associated with departures on the Clacton (CLN) route and arrivals on Runway 23 have increased very slightly, this reflects the 6.8% increase in traffic, the 3% change in modal split and the substantial increase of departure traffic on the CLN route in 2003 (see Table 2).

3.1.3 The table below compares the areas enclosed by each of the 2003 contours for both terrain and non-terrain adjusted scenarios. It can be seen that the inclusion

⁵ The population estimates shown in this Report are based on 1991 and 2001 census data (updated by CACI Ltd in 1999 and 2002). Note also that area and population figures presented in this Report are cumulative.

of the terrain adjustment in the 2003 Stansted contours has slightly reduced the size of the 57 to 63 dBA Leq contours but the 69 dBA Leq contour has increased by 2.9%. The sizes of the 66 and 72 dBA Leq contours remain unaffected.

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE
	2003 ACTUAL Non-Terrain adj	2003 ACTUAL Terrain adj	
>57	33.7	33.3	-1.2
>60	20.3	19.9	-2.0
>63	11.8	11.7	-0.8
>66	6.6	6.6	0.0
>69	3.4	3.5	+2.9
>72	1.8	1.8	0.0

3.1.4 The next table compares the populations enclosed by each of the 2003 terrain adjusted contours using the earlier 1991 census data (updated in 1999) and the latest 2001 census data (updated in 2002).

Leq LEVEL dBA	POPULATION (000's)		PERCENTAGE CHANGE
	2003 (Terrain adj) ACTUAL (1999 CACI data)	2003 (Terrain adj) ACTUAL (2002 CACI data)	
>57	2.3	2.3	0.0
>60	1.3	1.3	0.0
>63	0.4	0.5	*
>66	0.1	0.2	*
>69	<0.1	<0.1	*
>72	<0.1	<0.1	*

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

The 2001 census data (as updated by CACI in 2002) has barely affected the populations enclosed by each of the 2003 terrain adjusted contours.

3.2 'Standard' contours

3.2.1 In Figure 5 the standard terrain adjusted 2003 contours (57, 63 and 69 dBA Leq) are compared with the standard non adjusted contours for 2002. These show what the noise exposures would have been if the 2003 and 2002 modal split had mirrored a long-term rolling average modal split. The 2002 standard contours were based on the 20 year average modal split from 1983 to 2002 inclusive of 75% south-west / 25% north-east; those for 2003 were based on the 20 year average modal split from 1984 to 2003 inclusive which was 74% south-

west / 26% north-east. The associated areas and populations are displayed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2002 STANDARD	2003 STANDARD Terrain adj		2002 STANDARD (1999 CACI data)	2003 STANDARD (2002 CACI data) Terrain adj	
>57	31.9	33.5	+5.0	2.3	2.9	+26.1
>60	19.3	20.0	+3.6	1.2	1.3	+8.3
>63	11.3	11.7	+3.5	0.4	0.5	*
>66	6.3	6.6	+4.8	0.1	0.2	*
>69	3.4	3.5	+2.9	<0.1	<0.1	*
>72	1.8	1.8	0.0	<0.1	<0.1	*

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

3.2.2 The standard contours 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 south-westerly to north-easterly operations for the two years. It can be seen from Figure 5 that the standard terrain adjusted 2003 contours are very slightly larger than the non adjusted 2002 contours, more so at the ‘tips’ of the contours (directly underneath the flight tracks) than to the side. This reflects the overall increase in traffic in 2003. With the exception of the 72 dBA Leq contour, the areas within the standardised 2003 terrain adjusted contours are all slightly higher than for the standardised non-adjusted 2002 contours. The enclosed populations within the terrain corrected 2003 contours are also higher than those for 2002. The population within the 2003 terrain adjusted 57 dBA Leq contour increased by 26.1%. It can be seen from Figure 5 that this is mainly because the ‘tips’ of the 2003 standardised 57dBA Leq contour associated with Runway 23 departures on the CLN route and Runway 23 arrivals expanded slightly and extended into Little Hallingbury to the south of the airport and Thaxted to the north east of the airport to a greater extent than in 2002.

4 STANSTED TRAFFIC AND NOISE: HISTORICAL TRENDS

4.1 Figure 6 shows how the average mode 57 dBA Leq contours, based on actual modal splits⁶, have changed since 1988 by comparison with the *total annual* aircraft movements.

4.2 Annual movements at Stansted rose steadily between 1990 and 2001 showing particularly rapid growth between 1997 and 1999. The number of movements

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.

in 2001 and 2002 were very similar but in 2003 the annual figure rose by 9.3% over the preceding year.

- 4.3 Up to 1998, areas and populations within the 57 dBA Leq contours have generally risen in line with movements but in 1999, despite the high traffic growth, the area within the 57 dBA Leq contour fell by 19%. This decrease was attributable to fewer operations of older, noisier, Chapter 2 aircraft – in particular those by the BAC 1-11 which fell by 64% in that year.
- 4.4 The 2003 area and population have increased slightly relative to 2002 mainly due to the increase in traffic.

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Noise Exposure Contours for Stansted Airport 2002
ERCDC Report 0303

Table 1

**DISTRIBUTION OF STANSTED AVERAGE DAILY AIRCRAFT MOVEMENTS
 BY TYPE 0700-2300 LOCAL TIME, 16 JUNE - 15 SEPTEMBER**

AIRCRAFT TYPE(S)	NOISE CLASS	AVERAGE NUMBER 2002	AVERAGE NUMBER 2003	PERCENTAGE OF TOTAL 2003 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2002 MOVEMENTS
Small Props	1	1.6	2.1	0.4	+0.1
Large Props	2	31.1	20.4	4.2	-2.4
B737-300,400,500	3	119.1	149.8	31.1	+6.8
B737-600,700	3	3.8	14.7	3.1	+2.4
B737-800,900	3	108.0	143.4	29.8	+7.8
B757E (RB211-535E4, E4B)	3	5.4	7.6	1.6	+0.5
B757C (RB211-535C)	3	0.2	0.1	0.0	0.0
B757P (Pratt and Whitney)	3	0.2	0.3	0.1	0.0
BAe146	3	47.6	30.3	6.3	-3.8
A319C (CFM-56)	3	0.0	1.9	0.4	+0.4
A319V (IAE-V2500)	3	0.0	0.1	0.0	0.0
A320C (CFM-56)	3	4.3	8.0	1.7	+0.8
A320V (IAE-V2500)	3	4.1	2.0	0.4	-0.5
A321C (CFM56)	3	3.3	4.0	0.8	+0.2
A321V (IAE-V2500)	3	0.0	0.5	0.1	+0.1
Business Jet (Ch 3)	3	12.0	12.4	2.6	+0.1
CRJ Canadair Regional Jet	3	0.7	0.0	0.0	-0.2
ERJ Embraer EMB 135/145	3	4.8	2.2	0.5	-0.6
F100	3	11.8	0.1	0.0	-2.6
MD80	3	0.4	2.7	0.6	+0.5
B767-200	4	0.0	0.6	0.1	+0.1
B767-300G (General Electric)	4	1.1	1.7	0.4	+0.1
B777-200G (General Electric)	4	0.1	0.2	0.0	0.0
A300	4	1.7	1.2	0.2	-0.1
A310	4	3.4	0.8	0.2	-0.6
A330	4	0.0	0.1	0.0	0.0
B747-400G (General Electric)	5	3.0	3.3	0.7	+0.1
B747-400P (Pratt and Whitney)	5	0.0	0.1	0.0	0.0
B747SP	5	0.5	0.3	0.1	0.0
MD11	5	5.9	4.8	1.0	-0.2
B747-200, -300 (Ch 3)	6	1.6	1.4	0.3	0.0
DC10	6	0.2	0.2	0.0	0.0
Tristar	6	0.1	0.2	0.0	0.0
B737-200 (Ch3)	7	71.3	62.5	13.0	-2.0
DC9 (Ch 3)	7	0.1	0.1	0.0	0.0
Business Jet (Ch 2)	7	0.2	0.2	0.0	0.0
B707, DC8*	8	0.2	0.4	0.1	0.0
B727 (Ch 3)	8	2.7	0.5	0.1	-0.5
Tu154M*	8	0.3	0.6	0.1	+0.1
VC10,IL62	8	0.2	0.0	0.0	0.0
TOTAL MOVEMENTS		451.0	481.8	100.0	+6.8

* In 2002 and 2003 all Chapter 3 versions

Table 2:

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

SOUTH WESTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2002	PERCENTAGE OF TOTAL DEPARTURES 2003	CHANGE (% OF TOTAL)
BUZ/BKY/CPT	36.7	37.3	+0.6
CLN	8.9	19.5	+10.6
DVR/LAM/LYD	18.4	10.2	-8.2
VFR**	0.0	0.0	0.0
PERCENTAGE SOUTH WEST	64.0	67.0	+3.0
NORTH EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2002	PERCENTAGE OF TOTAL DEPARTURES 2003	CHANGE (% OF TOTAL)
BUZ/BKY/CPT	20.4	17.5	-2.9
CLN	5.4	9.2	+3.8
DVR/LAM/LYD	10.2	6.3	-3.9
VFR**	0.0	0.0	0.0
PERCENTAGE NORTH EAST	36.0	33.0	-3.0

* See Figure 1.

** Refers to aircraft (normally small non-jets) flying under Visual Flight Rules.

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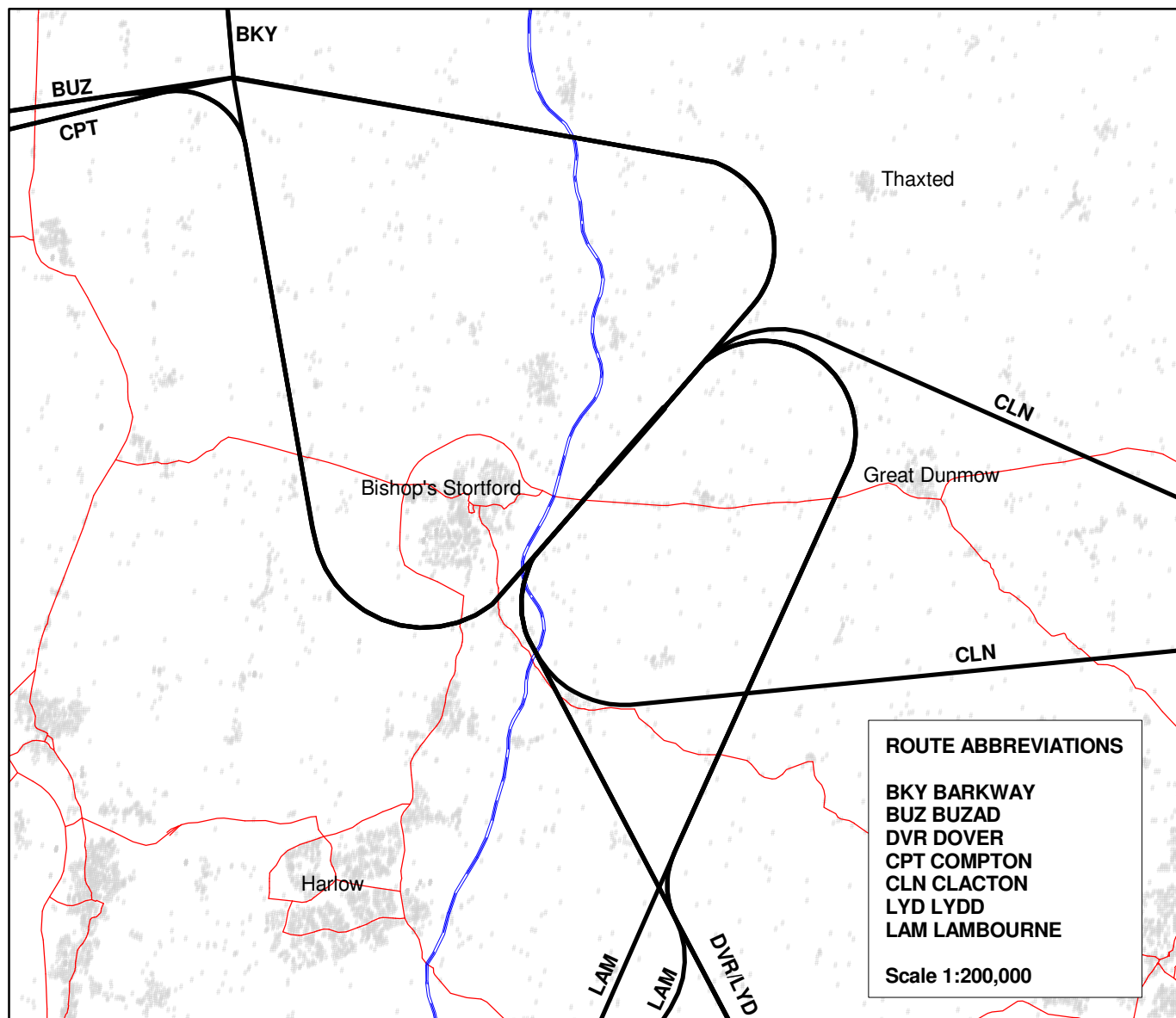


Figure 1: London Stansted Airport Standard Instrument Departure Routes

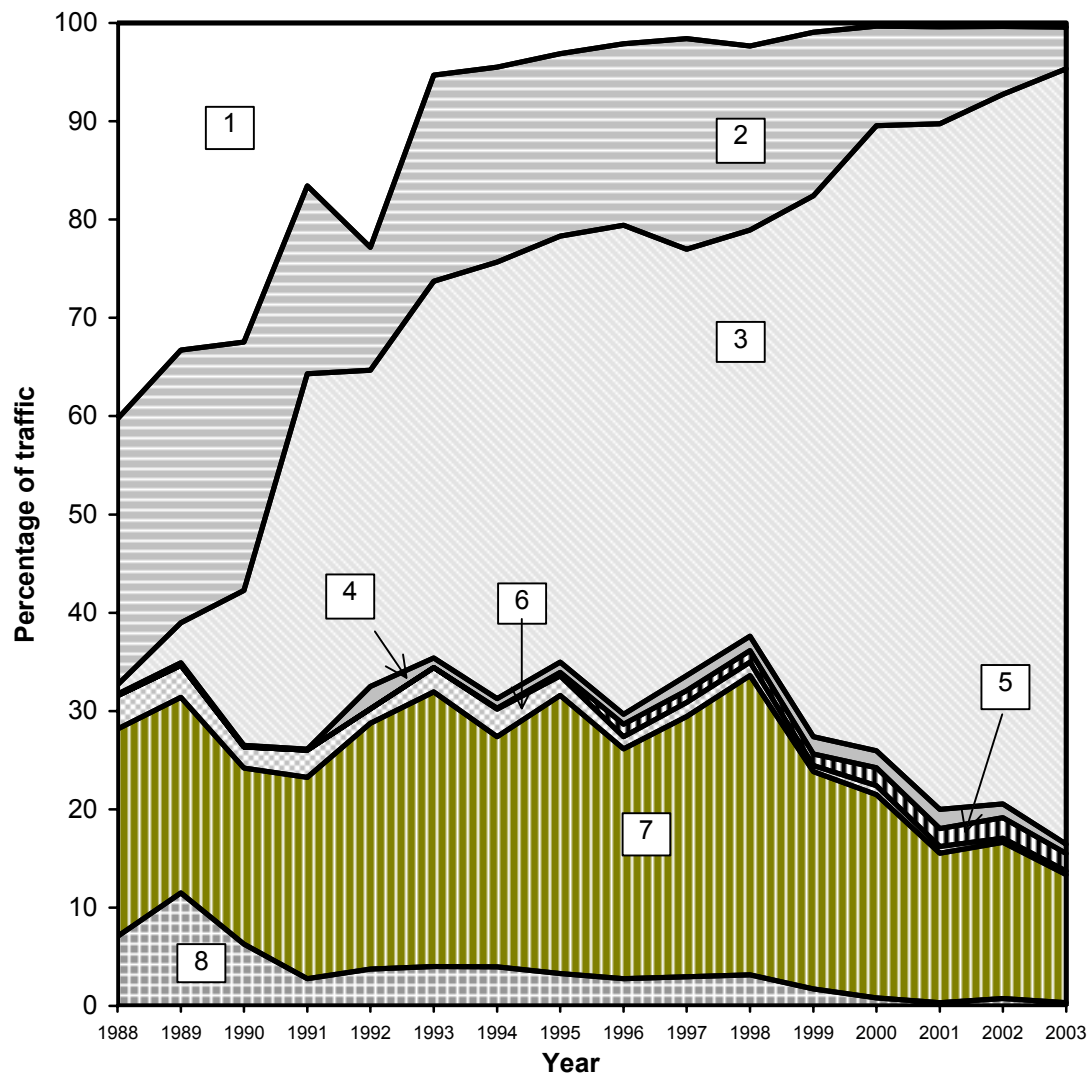


Figure 2: Noise Class of Stansted aircraft 1988 - 2003

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

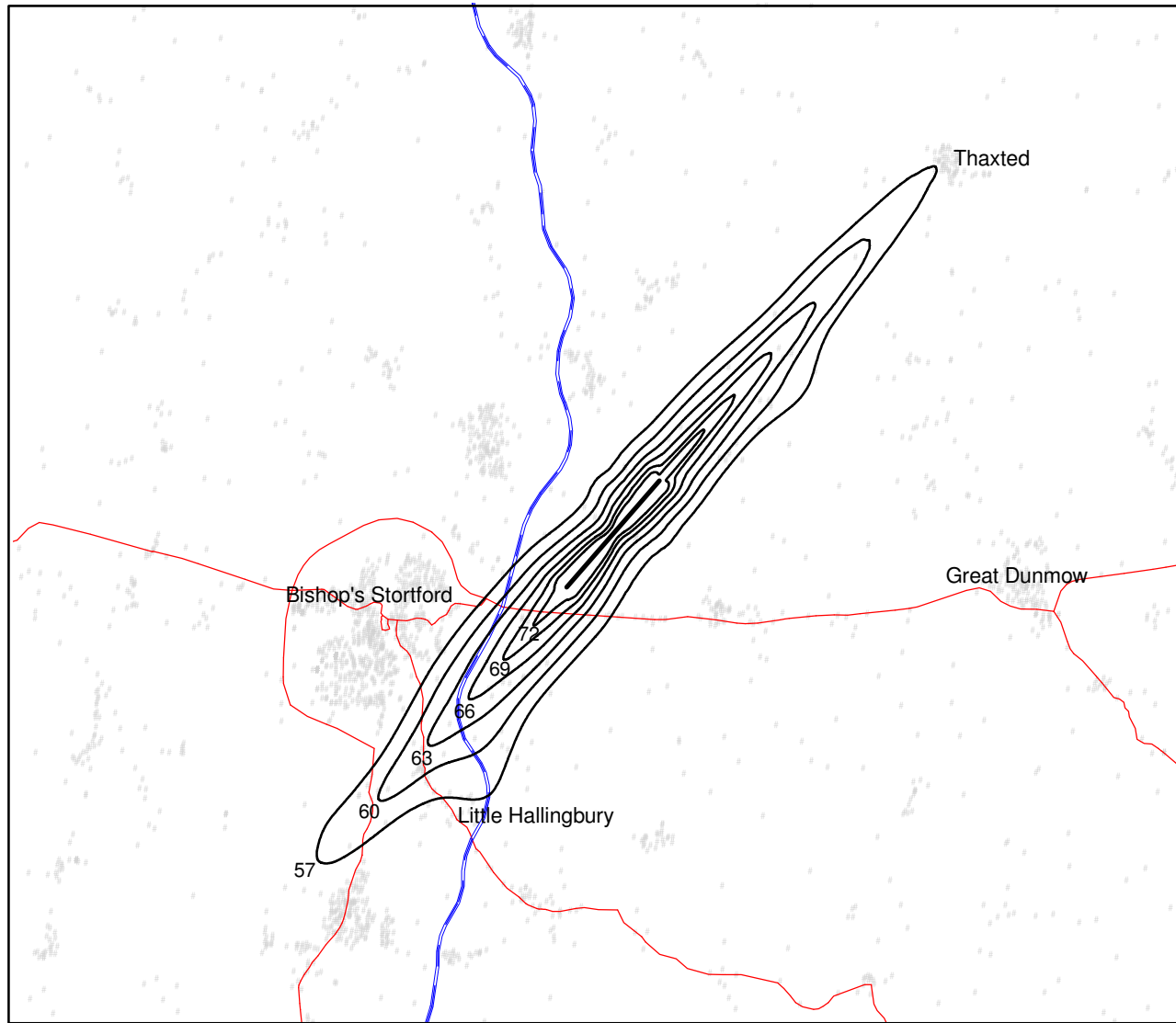
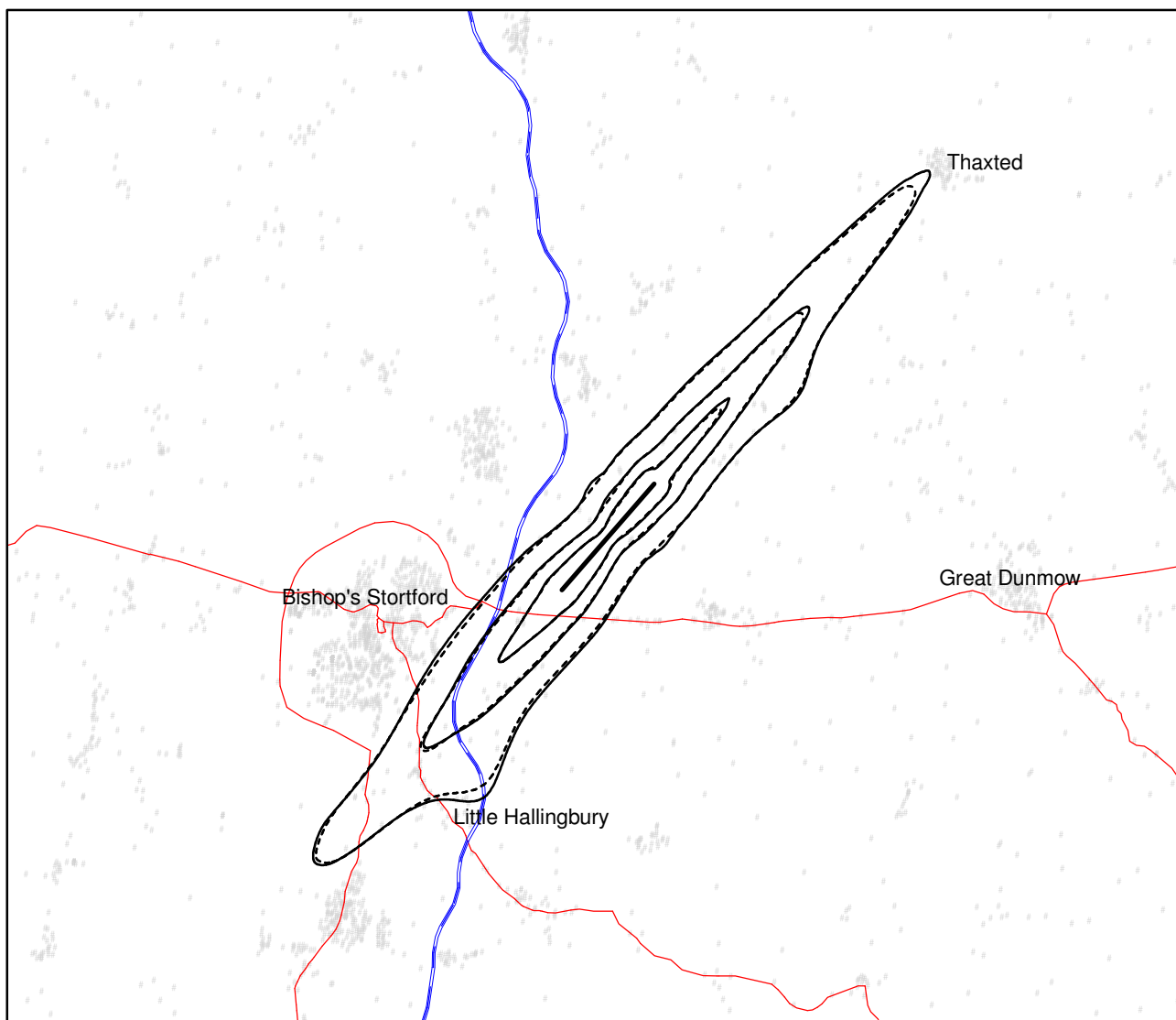


Figure 3: Stansted actual 2003 average mode (67% SW - 33% NE) terrain adjusted 16 hr Leq on population map



**Figure 4: Stansted actual 57, 63 and 69 Leq contours - 2002 dotted (64% SW - 36% NE) - 2003 solid (67% SW - 33% NE)
(2003 contours include terrain adjustment)**

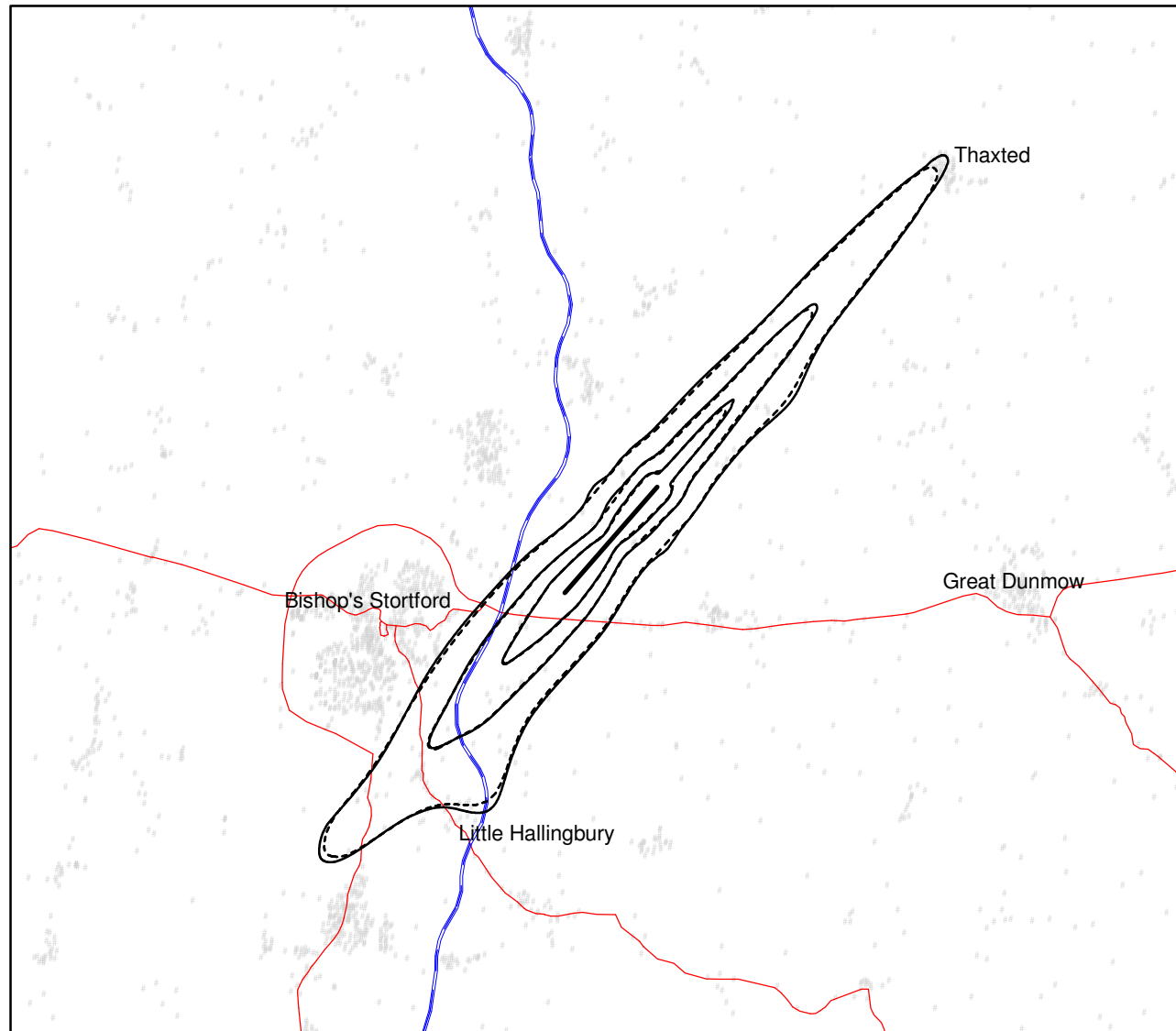


Figure 5: Stansted standard 57, 63 and 69 Leq contours - 2002 dotted (75% SW - 25% NE) - 2003 solid (74% SW - 26% NE) (2003 contours include terrain correction)

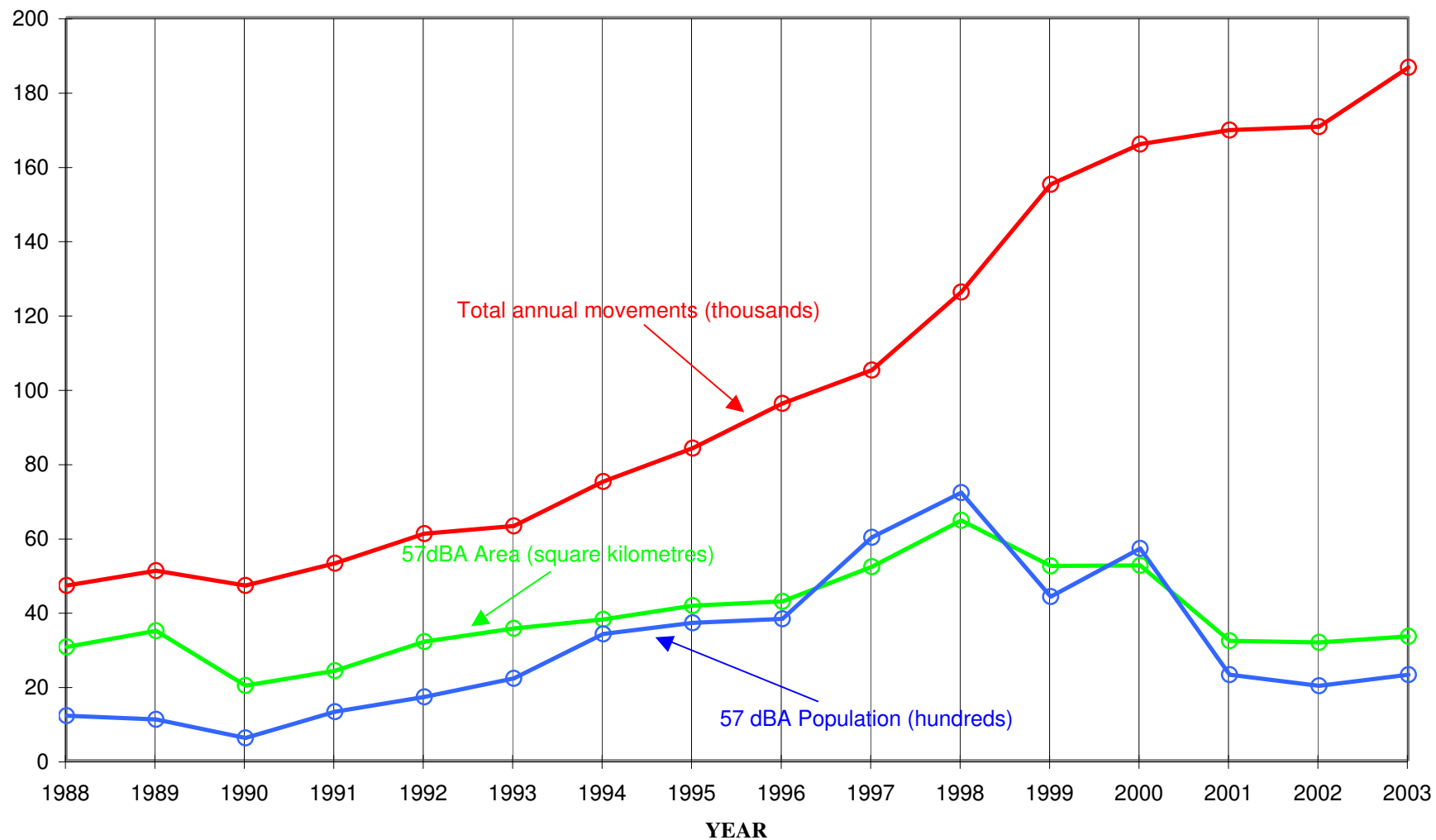


Figure 6: Stansted traffic and noise 1988 - 2003