Environmental Research and Consultancy Department
Civil Aviation Authority

ERCD REPORT 1501

Noise Exposure Contours for Heathrow Airport 2014

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Prepared by the Civil Aviation Authority on behalf of the Department for Transport, August 2015

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Summary

This report presents the year 2014 average summer day and night noise exposure contours for London Heathrow Airport.

The 57 dBA Leq day contour area for 2014 based on the actual runway modal split (68% west / 32% east) was calculated to be 104.9 km^2, 2% smaller than in 2013 (2013: 107.3 km^2). The population enclosed within the 2014 actual 57 dBA Leq day contour increased by 2% to 270,100 (2013: 264,250). The 48 dBA Leq night actual modal split (66% west / 34% east) contour area was 114.2 km^2, a 5% decrease from 2013 (2013: 120.5 km^2), enclosing a population of 364,400 (2013: 421,250), a 13% reduction.

August 2015

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 2011 Census data (updated for 2014) supplied by CACI Information Services.

Contents

Glossary

AIP	Aeronautical Information Publication
ANCON	The UK civil aircraft noise contour model, developed and maintained by ERCD.
ATC	Air Traffic Control
CAA	Civil Aviation Authority – the UK's independent specialist aviation regulator.
dB	Decibel units describing sound level or changes of sound level.
dBA	Units of sound level on the A-weighted scale, which incorporates a frequency weighting approximating the characteristics of human hearing.
DfT	Department for Transport (UK Government)
ERCD	Environmental Research and Consultancy Department of the Civil Aviation Authority.
ILS	Instrument Landing System
Leq	Equivalent sound level of aircraft noise in dBA, often called 'equivalent continuous sound level'. For conventional historical contours this is based on the daily average movements that take place within the 16-hour period (0700-2300 local time) over the 92-day summer period from 16 June to 15 September inclusive.
NPD	Noise-Power-Distance
NPR	Noise Preferential Route
NTK	Noise and Track Keeping monitoring system. The NTK system associates radar data from air traffic control radar with related data from both fixed (permanent) and mobile noise monitors at prescribed positions on the ground.
OS	Ordnance Survey®, Great Britain's national mapping agency.
SEL	The Sound Exposure Level of an aircraft noise event is the steady noise level, which over a period of *one second* contains the same sound energy as the whole event. It is equivalent to the Leq of the noise event normalised to one second.
SID	Standard Instrument Departure

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Executive Summary

This report presents year 2014 average summer day and night noise exposure contours generated for London Heathrow Airport.

The noise modelling used radar and noise data from the Heathrow Noise and Track Keeping (NTK) system. Mean flight tracks and lateral dispersions for each route, and average flight profiles of aircraft height, speed and thrust for each aircraft type, were calculated using these data.

Analysis of the 2014 summer traffic data for Heathrow revealed that average daily movements for the 16-hour daytime period (1260.6) increased marginally, by 0.1% (2013: 1258.8). There were on average 80.1 movements per 8-hour night over the summer period (2013: 82.4), a 3% reduction from 2013.

The results showed that the area of the 2014 day actual modal split (68% west / 32% east) 57 dBA Leq contour decreased by 2% to 104.9 km^2 (2013: 107.3 km^2), which is the smallest ever area calculated for Heathrow. The population count within the 2014 actual 57 dBA Leq day contour increased by 2% to 270,100 (2013: 264,250). The area changes were primarily the result of the significant rise in the percentage of easterly movements, which tends to reduce the contour area at Heathrow. The 2% population increase can be attributed to changes in the contour shape.

The area of the 2014 day standard modal split (77% west / 23% east) 57 dBA Leq contour decreased by 1% to 106.6 km^2 (2013: 107.9 km^2), and the associated population count was 266,700, marginally higher than in 2013 (2013: 266,050).

The area of the 2014 actual modal split (66% west / 34% east) 48 dBA Leq night contour was 114.2 km^2, 5% smaller than in the previous year (2013: 120.5 km^2), enclosing a population of 364,400, a decrease of 13% (2013: 421,250). The area reduction can be attributed to the 3% drop in movements, which included a notable decrease for the noise dominant type, the Boeing 747-400 with Rolls-Royce engines. The 48 dBA population count decreased by 13% in 2014 due to a combination of the contour area decrease and changes in the contour shape.

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1 Introduction

1.1 Background

1.1.1 Each year the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority (CAA) calculates the noise exposure around London Heathrow Airport on behalf of the Department for Transport (DfT). A computer model, ANCON, validated with noise measurements, is used to estimate the noise exposure. The model calculates the emission and propagation of noise from arriving and departing air traffic.

1.1.2 The noise exposure metric used is the Equivalent Continuous Sound Level, or Leq 16-hour (0700-2300 local time), which is calculated over the 92-day summer period from 16 June to 15 September. The background to the use of this index is explained in DORA Report 9023 (**Ref 1**).

1.1.3 Noise exposure is depicted in the form of noise contours, i.e. lines joining places of constant Leq, akin to the height contours shown on geographical maps or isobars on a weather chart. In the UK, Leq noise contours are normally plotted at levels from 57 to 72 dBA, in 3 dB steps.[1] The 57 dBA level denotes the approximate onset of significant community annoyance.

1.1.4 Following the publication of the Aviation Policy Framework in March 2013 (**Ref 2**), there is now a commitment by the DfT to produce night (2300-0700) noise contours on an annual basis for the designated airports. Night-time 8-hour Leq contours have therefore been calculated for Heathrow from 48 to 72 dBA in 3 dB steps in accordance with standard practice. Average summer night contours were first calculated for Heathrow for the year 2013.

1.1.5 This report contains small-scale diagrams of the year 2014 Heathrow Leq contours overlaid onto Ordnance Survey® (OS) base maps. Diagrams in Adobe® PDF and AutoCAD DXF format are also available for download from the GOV.UK website[2].

1.1.6 The objectives of this report are to explain the noise modelling methodology used to produce the year 2014 day and night Leq contours for Heathrow Airport, to

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[1] Aircraft noise contours are also produced on behalf of airports for the specific purpose of meeting the requirements of the Environmental Noise (England) Regulations 2006, which implemented Directive 2002/49/EC, Assessment and Management of Environmental Noise, in England. These are based on annual average values and require the use of different parameters (L_{day}, $L_{evening}$, L_{night}, $L_{eq,16hr}$ and L_{den} at 5 dB steps), so it is not possible to draw meaningful conclusions between the two types of contour maps. Further details about Directive 2002/49/EC are available on the Department for Environment, Food and Rural Affairs website at *www.gov.uk/defra* as well as ERCD Reports 1204, 1205 and 1206 (available from *www.caa.co.uk*), which cover Heathrow, Gatwick and Stansted 2011 noise mapping respectively.

[2] https://www.gov.uk/government/publications/noise-exposure-contours-around-london-airports

present the calculated noise contours and to assess the changes from the previous year (**Ref 3**).

1.2 Heathrow Airport

1.2.1 Heathrow Airport is situated approximately 13 miles (21 km) west of the city of London. It is surrounded by suburban housing, business premises and mixed-use open land to the north and south, suburban housing and business premises to the east, and several large reservoirs, mixed-use open land, housing and business premises to the west (**Figure 1**).

1.2.2 Heathrow Airport has two runways: Runway 09L/27R to the north, which is 3,901 m long, and Runway 09R/27L to the south, which is 3,660 m long. The landing threshold[3] for Runway 09L is displaced by 306 m. The landing threshold for Runway 09R is also displaced, by 307 m. There are currently five passenger terminals.[4] The layout of the runways, taxiways and passenger terminals in 2014 is shown in **Figure 2**.[5]

1.2.3 In the 2014 calendar year, there were approximately 473,000 aircraft movements (2013: 472,000) at Heathrow Airport, handling 73.4 million passengers (2013: 72.4 million).[6]

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[3] The runway threshold marks the beginning of the runway available for landing aircraft. A *displaced* threshold is a runway threshold that is not located at the physical end of the runway. A displaced threshold is often employed to give arriving aircraft sufficient clearance over an obstacle.

[4] Terminal 2 closed for rebuilding work in November 2009 but re-opened in June 2014.

[5] UK AIP (24 Jul 2014) AD 2-EGLL-2-1

[6] Source: Civil Aviation Authority (www.caa.co.uk/airportstatistics)

2 Noise contour modelling methodology

2.1 ANCON noise model

2.1.1 Noise contours were calculated with the UK civil aircraft noise model ANCON (version 2.3), which is developed and maintained by ERCD on behalf of the DfT. A technical description of ANCON is provided in R&D Report 9842 (**Ref 4**). The ANCON model is also used for the production of annual contours for Gatwick and Stansted airports, and a number of other UK airports.

2.1.2 ANCON is fully compliant with the latest European guidance on noise modelling, ECAC.CEAC Doc 29 (3rd edition), published in December 2005 (**Ref 5**). This guidance document represents internationally agreed best practice as implemented in modern aircraft noise models.

2.2 Radar data

2.2.1 The noise modelling carried out by ERCD made extensive use of radar data extracted from Heathrow Airport's Noise and Track Keeping (NTK) system. Most large airports have NTK systems, which take data from Air Traffic Control (ATC) radars and combine them with flight information such as call sign, tail number, aircraft type and destination. Analyses of departure and arrival flight tracks, and flight profiles, were based on year 2014 summer radar data.

2.3 Flight tracks

2.3.1 Aircraft departing Heathrow are required to follow specific flight paths called Noise Preferential Routes (NPRs) unless directed otherwise by ATC. NPRs were designed to avoid the overflight of built-up areas where possible. They establish a path from the take-off runway to the main UK air traffic routes and form the first part of the Standard Instrument Departure routes (SIDs). The Heathrow NPR/SID routes are illustrated in **Figure 3**.

2.3.2 Associated with each NPR is a lateral swathe, which is defined by a pair of lines that diverge at 10 degrees from a point 2,000 m from start-of-roll, leading to a corridor extending 1.5 km either side of the nominal NPR centreline. Within this swathe the aircraft are considered to be flying on-track. The swathe takes account of various factors that affect track-keeping, including tolerances in navigational equipment, type and weight of aircraft, and weather conditions – particularly winds that may cause drifting when aircraft are turning. Aircraft reaching an altitude of 4,000 ft at any point along an NPR may be turned off the route by ATC onto more direct headings to their destinations – a practice known as 'vectoring'. ATC may also vector aircraft from NPRs below this altitude for safety reasons, including in certain weather conditions (for example, to avoid storms).

2.3.3 Departure and arrival flight tracks were modelled using radar data extracted from the Heathrow NTK system over the 92-day summer period, 16 June to 15 September 2014. Mean flight tracks were calculated from 24-hour data since both day and night contours were being produced. A number of westerly and easterly departure trial routes were in operation over the 2014 summer period[7], so separate mean flight tracks were generated to account for them.

2.3.4 **Figure 4** shows a sample of radar flight tracks from a day in August 2014. In-house radar analysis software was used to calculate mean departure flight tracks and associated lateral dispersions for each NPR/SID. Arrival tracks for Runways 27L, 27R, 09L and 09R were modelled using evenly spaced 'spurs' about the extended runway centrelines. The majority of arriving aircraft joined the centrelines at distances between 13 and 31 km from threshold when Heathrow was operating in westerly mode, and at distances between 11 and 33 km in easterly mode.

2.4 Flight profiles

2.4.1 For each ANCON aircraft type, average flight profiles of height, speed and thrust versus track distance (for departures and arrivals separately) were reviewed and updated where necessary, using year 2014 summer radar data. The engine power settings required for the aircraft to follow the average height and speed profiles were calculated from data describing aircraft performance characteristics within each of the different aircraft type categories.

2.4.2 Daytime flight profiles were generated as in previous years. A separate night-time departure profile was also produced for the noise dominant aircraft type operating at night, the B744R[8], as it was sufficiently different from the daytime profile. All other aircraft types operating at night were modelled with daytime profiles.

2.4.3 The application of reverse thrust following touchdown was modelled for all ANCON types where applicable. Reverse thrust was included in both the day and night contours.

2.5 Noise emissions

2.5.1 At Heathrow, the NTK system captures data from both fixed and mobile noise monitors around the airport. Noise event data for individual aircraft operations are then matched to operational data provided by the airport. The Heathrow NTK

[7] Westerly trial routes operated between 25 August and 12 November 2014, whilst easterly trial routes operated between 28 July and 12 November 2014.

[8] Boeing 747-400 with Rolls-Royce engines

system employs 12 fixed monitors (positioned approximately 6.5 km from start-of-roll), together with a number of mobile monitors that can be deployed anywhere within the NTK radar coverage area.[9]

2.5.2 The noise data collected are screened by ERCD with reference to several criteria so that only high quality data are used in the analysis. First of all, noise data that lie outside a 'weather window' are discarded. This ensures that the data used are not affected by adverse meteorological conditions such as precipitation and strong winds. Secondly, the maximum noise level of the aircraft event must exceed the noise monitor threshold by at least 10 dB to avoid underestimates of the Sound Exposure Level (SEL). Thirdly, only measurements obtained from aircraft operations that pass through a 60-degree inverted cone, centred at the noise monitor, are retained in order to minimise the effects of lateral attenuation[10] and lateral directivity[11].

2.5.3 The ANCON model calculates aircraft noise using a noise database expressing SEL as a function of engine power setting and slant distance to the receiver – also known as the 'Noise-Power-Distance' (NPD) relationship. The ANCON noise database is continually reviewed and updated with adjustments made annually when measurements show this to be necessary.

2.6 Traffic distributions

2.6.1 The Leq contours are based on the daily average movements that take place during the 16-hour day (0700-2300 local time) and 8-hour night (2300-0700 local time), over the 92-day summer period from 16 June to 15 September inclusive. The source of this information is the NTK system, which stores radar data supplemented by daily flight plans. Traffic statistics from NTK data were cross-checked with runway logs supplied by NATS[12] and close agreement was found.

Daytime traffic distribution by noise class

2.6.2 The average number of daily movements at Heathrow over the 2014 summer day period (1260.6) was 0.1% higher than in the previous year (2013: 1258.8).

2.6.3 **Table 1a** lists the average summer day movements[13] by eight noise classes of aircraft, ranked in ascending order of noise emission, i.e. from least to most noisy,

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[9] Further information on the noise monitors can be found in CAP 1149 (**Ref 6**).

[10] Lateral attenuation is the excess sound attenuation caused by the ground surface, which can be significant at low angles of elevation.

[11] Lateral directivity is the non-uniform directionality of sound radiated laterally about the roll axis of the aircraft – this is influenced to a large extent by the positioning of the engines.

[12] NATS is the provider of air traffic control services to Heathrow Airport.

[13] Includes departures and arrivals.

in 2013 and 2014. As in 2013, short-haul 'Chapter 3' and 'Chapter 4'[14] jet aircraft (Noise Class 3) formed the highest proportion of movements (65%), but were 2% fewer in number in 2014 (note: an estimated 98% of the aircraft within Noise Class 3 for the 2014 daytime period were compliant with the 'Chapter 4' noise standard).

2.6.4 The numbers of wide-body twin-engine aircraft (Noise Class 4), which comprised 25% of the total traffic, were 7% higher in 2014. There was, however, a 2% decrease in movements within Noise Class 5 (i.e. second generation wide-body 3/4-engine aircraft). The numbers of aircraft in Noise Classes 2 and 6 were insignificant, and there were no aircraft within Noise Classes 1, 7 and 8.

2.6.5 **Figure 5** illustrates the changing distribution of traffic among the 8 noise classes over the period 1988 to 2014 inclusive. The shift towards 'Chapter 3' and 'Chapter 4' aircraft (i.e. Noise Classes 3 to 5) over the years can be seen, with short-haul jet aircraft (Noise Class 3) dominating the fleet mix.

Night-time traffic distribution by noise class

2.6.6 The average number of movements per 8-hour night in 2014 was 80.1 (2013: 82.4), a 3% decrease from the previous year. The majority of night movements (71%) were arrivals.

2.6.7 **Table 1b** lists the average summer night movements by 8 noise classes of aircraft, ranked in ascending order of noise emission, i.e. from least to most noisy, in 2014. Wide-body twin-engine aircraft (Noise Class 4) formed the highest proportion of movements (46%). (Note: in 2014 an estimated 97% of the aircraft within Noise Class 3 for the night period were compliant with the 'Chapter 4' noise standard).

2.6.8 The second largest grouping was Noise Class 5 (e.g. B744R) with 29%, followed by Noise Class 3 (e.g. A320) with 25%. There were insignificant numbers in Noise Classes 1 and 2, and no movements by aircraft in Noise Classes 6, 7 and 8.

Daytime traffic distribution by ANCON aircraft type

2.6.9 A more detailed breakdown of the year 2014 average summer day movements, indicating the ANCON types that fall into each noise class, is provided in **Table 2a**.

2.6.10 The largest increase within Noise Class 3 was for the EA320V, which was up by 23 daily movements (note: ANCON type descriptions can be found in **Table 2a**). This increase was offset partially by a reduction in EA319V movements (down by 17).

[14] Aircraft whose certificated noise levels are classified by the ICAO *Standards and Recommended Practices – Aircraft Noise: Annex 16 to the Convention on International Civil Aviation* into 'Chapter 3' and 'Chapter 4' types - these are typically characterised by modern, quieter, high-bypass turbofan aircraft. The 'Chapter 4' standard is more stringent than the 'Chapter 3' standard.

2.6.11 Within Noise Class 4, there were significant movement increases for the ANCON types B773G (up by 24) and B788 (up by 15). These were offset by reductions in numbers of the B772R (down by 11) and B763R (down by 9).

2.6.12 There was a notable movement decreases in Noise Class 5 for the B744G/P/R aircraft (down by 7) and also the EA34 (down by 3). They were offset by movement increases for aircraft types such as the EA38R (up by 4) and EA346 (up by 3).

2.6.13 **Figure 6a** illustrates the numbers of movements by ANCON aircraft type for the 2014 average summer day. It can be seen that the Airbus A319/320/321 aircraft dominated the movements at Heathrow. In particular, the EA320V (238 movements per day), EA319V (197 per day) and EA320C (134 per day) were the three most frequent ANCON types.

2.6.14 On average there were 57 daily movements of the B744R ANCON type, the noise dominant aircraft at Heathrow in terms of departure noise. The B744R contributed the highest level of departure 'noise energy', which is a function of both aircraft noise level and movement numbers. Arrival noise was dominated by the short-haul Airbus aircraft family (e.g. EA320V, EA319V and EA320C).

Night-time traffic distribution by ANCON aircraft type

2.6.15 A more detailed breakdown of the year 2014 average summer night movements, indicating the ANCON types that fall into each noise class, is provided in **Table 2b**. The highest increase was in Noise Class 4 for the B788, up by 2 per night. The largest decrease was for the B744R (Noise Class 5), down by 3 movements per night (-19%).

2.6.16 **Figure 6b** illustrates the numbers of movements by ANCON aircraft type for the 2014 average summer night. The most frequent type at night was the B744R with 13 per night. The B772G had the second highest number of movements at 8 per night. Arrivals accounted for 71% of night movements.

Daytime traffic distribution by NPR/SID route

2.6.17 **Figure 7a** shows the distribution of aircraft departures by NPR/SID route for the 2014 summer day period, including distribution figures from 2013 for comparison. The percentage loadings on the routes were comparable to 2013, with the westerly WOB/BPK routes taking the highest proportion of traffic over the summer day period (26%), followed by the westerly DVR/DET route (17%). The main decrease was on the westerly WOB/BPK routes (down by 4%), while increases of 1-2% were found on each of the easterly routes.

Night-time traffic distribution by NPR/SID route

2.6.18 **Figure 7b** shows the distribution of aircraft departures by NPR/SID route for the 2014 summer night period, including distribution figures from 2013 for comparison. The westerly DVR/DET routes took the highest proportion of traffic over the summer night period (28%), followed by the easterly DVR/DET routes

(15%). There were higher proportions of traffic on most of the easterly routes in 2014.

2.7 Runway modal splits

2.7.1 In general, aircraft will take-off and land into a headwind to maximise lift during take-off and landing. The wind direction, which varies over the course of a year, will therefore have an important influence on the usage of runways[15]. The ratio of westerly (27L/27R) and easterly (09L/09R) operations is referred to as the *runway modal split*.

2.7.2 Two sets of contours have been produced for the year 2014 average summer day:

(i) Contours using the 'actual' modal split over the Leq day period; and

(ii) Contours assuming the 'standard' modal split over the Leq day period, i.e. the long-term modal split calculated from the 20-year rolling average; for 2014, this is the 20-year period from 1995 to 2014. Use of the standard modal split enables year-on-year comparisons without the runway usage significantly affecting the contour shape.

2.7.3 The actual and standard daytime modal splits for 2014 and the previous year are summarised in the table below:

<u>Heathrow summer day runway modal splits for 2014 and 2013</u>

Modal split scenario	**% west (Runway 27L/27R)**	**% east (Runway 09L/09R)**
Actual 2014	68%	32%
Actual 2013	74%	26%
Standard 2014	77%	23%
Standard 2013	77%	23%

2.7.4 The percentage of westerly movements in 2014 (68%) was 6% lower than in 2013. This was due to extended periods of easterly operations at the start and end of the 92-day summer period with twice the normal proportion of easterly operations. In contrast, August saw extended periods of westerly operations with half the normal proportion of easterly operations. The 2014 standard modal split was unchanged from 2013. Historical runway modal splits at Heathrow for the past 20 years are illustrated in **Figure 8**.

[15] At Heathrow, a 'westerly preference' for aircraft operations is employed, which means that the airport will operate in westerly mode even if there is a light tailwind. This is done to reduce the use of easterly SIDs, which tend to overfly more populated areas compared to the westerly SIDs.

2.7.5 At Heathrow, the runway modal split can have an important influence on the area of the 57 dBA Leq contour. In theory, the 57 dBA contour area would be maximised if (all other things being equal) the airport operated solely in westerly mode over the whole summer period. With a decreasing proportion of westerly movements (and hence an increasing proportion of easterly movements), the 57 dBA contour area would become smaller, reaching a theoretical minimum at a runway modal split of around 40% west / 60% east.

2.7.6 The effect of modal split on the 57 dBA contour area appears to be due to two factors: firstly, the interaction between the noise generated from the two separate runways at Heathrow, and secondly, operations in accordance with the 'Cranford Agreement'[16], which places a restriction on departures from Runway 09L when the airport is operating in easterly mode.

2.7.7 Higher proportions of easterly movements at Heathrow would, in theory, help to reduce the 57 dBA contour area. It should, however, be noted that if the proportion of easterly movements were to rise above about 40%, the population count within the 57 dBA contour would start to increase sharply because of the relatively densely populated areas located to the east of the airport.

2.7.8 The night-time actual runway modal split for the 2014 summer period was 66% west / 34% east (2013: 77% west / 23% east).

2.8 Topography

2.8.1 The topography around Heathrow Airport was modelled by accounting for terrain height. 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.

2.8.2 ERCD holds OS terrain height data[17] on a 200 metre by 200 metre grid for the whole of England. Interpolation was performed to generate height data at each of the calculation points on the receiver grid used by the ANCON noise model. The terrain heights in the vicinity of Heathrow Airport are depicted diagrammatically in **Figure 9**.

[16] The 'Cranford Agreement' was a Government undertaking given at a meeting of the Cranford Residents' and District Amenities Association in 1952, that as far as practicable, the northern runway would not be used for take-offs to the east due to the proximity of Cranford to the east end of the runway. Following public consultation, a decision was made in 2009 by the Government to end the Cranford Agreement. This would allow for the more even spreading of noise around Heathrow. However, new taxiways would need to be built in order to implement the full alternation of easterly operations. The airport operator has applied for planning permission from the London Borough of Hillingdon for these works, but the application was rejected in February 2014.

[17] Meridian™ 2

2.9 Population and 'Points of Interest' databases

2.9.1 Estimates were made of the numbers of people and households enclosed within the noise contours. The population data used in this report are a 2014 update of the latest 2011 Census supplied by CACI Limited[18]. Within the extent of the 2014 actual modal split 57 dBA Leq contour, it was found that the population count using the 2014 population database was 1% higher than if the previous 2013 database had been employed. Thus the 2014 population database update had a slight impact on population counts.

2.9.2 The CACI population database contains data referenced at postcode level. Population and household numbers for each postcode are assigned to a single co-ordinate located at the postcode's centroid. The postcode data points and associated population counts for the area around Heathrow Airport are illustrated in **Figure 10**.

2.9.3 Estimates have also been made of the numbers of noise sensitive buildings situated within the daytime contours, using the *InterestMap*™[19] 'Points of Interest' (2014) database. For the purpose of this study, the noise sensitive buildings that have been considered are schools, hospitals and places of worship.

[18] www.caci.co.uk

[19] InterestMap™ is distributed by Landmark Information Group Ltd and derived from Ordnance Survey 'Points of Interest' data.

3 Noise contour results

3.1 Day actual modal split contours

3.1.1 The Heathrow 2014 day Leq noise contours generated with the actual 2014 summer day period runway modal split (68% west / 32% east) are shown in **Figure 11a**. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.1.2 Cumulative estimates of areas, populations and households within the 2014 day actual modal split contours are provided in the table below:

Heathrow 2014 day actual contours – area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 57	104.9	270,100	105,200
> 60	57.3	121,800	46,400
> 63	33.8	47,100	17,700
> 66	19.5	12,400	4,700
> 69	9.4	3,300	1,200
> 72	5.1	300	100

Note: Populations and households are given to the nearest 100.

3.1.3 The 2014 day actual modal split 57 dBA Leq contour enclosed an area of 104.9 km^2 and a population of 270,100.

3.1.4 Estimates of the cumulative numbers of noise sensitive buildings within the 2014 day actual modal split contours are provided in the table below:

Heathrow 2014 day actual contours – noise sensitive building estimates

Leq (dBA)	Schools	Hospitals	Places of worship
> 57	186	4	124
> 60	58	0	50
> 63	18	0	17
> 66	7	0	4
> 69	1	0	1
> 72	0	0	0

3.2 Night actual modal split contours

3.2.1 The Heathrow 2014 night Leq noise contours generated with the actual 2014 summer night period runway modal split (66% west / 34% east) are shown in **Figure 11b**. The contours are plotted from 48 to 66 dBA at 3 dB intervals (note: the 69 and 72 dBA contours have been omitted from the diagram for clarity).

3.2.2 Cumulative estimates of the areas, populations and households within the 2014 night actual modal split contours are provided in the following table:

Heathrow 2014 night actual contours – area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 48	114.2	364,400	147,200
> 51	66.4	179,700	70,200
> 54	36.0	76,200	28,700
> 57	18.6	34,800	13,100
> 60	9.6	10,500	3,900
> 63	5.1	2,200	800
> 66	2.8	200	100
> 69	1.7	< 100	< 100
> 72	1.2	0	0

Note: Populations and households are given to the nearest 100.

3.2.3 The 2014 night actual modal split 48 dBA Leq contour enclosed an area of 114.2 km^2 and a population of 364,400.

3.3 Day standard modal split contours

3.3.1 The Heathrow 2014 day Leq noise contours generated with the standard 2014 summer day period runway modal split (77% west / 23% east) are shown in **Figure 12**. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.3.2 Cumulative estimates of the areas, populations and households within the 2014 day standard modal split contours are provided in the following table:

Heathrow 2014 day standard contours – area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 57	106.6	266,700	104,100
> 60	58.2	120,500	45,800
> 63	33.7	46,000	17,300
> 66	19.9	13,400	5,100
> 69	9.6	3,600	1,400
> 72	5.1	200	100

Note: Populations and households are given to the nearest 100.

3.3.3 The 2014 day standard modal split 57 dBA Leq contour enclosed an area of 106.6 km^2 and a population of 266,700.

3.3.4 Estimates of the cumulative numbers of noise sensitive buildings within the 2014 day standard modal split contours are provided in the table below:

Heathrow 2014 day standard contours – noise sensitive building estimates

Leq (dBA)	Schools	Hospitals	Places of worship
> 57	176	4	123
> 60	66	0	52
> 63	16	0	19
> 66	7	0	4
> 69	2	0	1
> 72	0	0	0

4 Analysis of results

4.1 Day actual modal split contours – comparison with 2013 contours

4.1.1 The Heathrow 2014 day actual modal split Leq contours are compared against the 2013 day actual Leq contours in **Figure 13a**. The table below summarises the areas, populations and percentage changes from 2013 to 2014:

Heathrow day actual contours - area and population estimates for 2013 and 2014

Leq (dBA)	2013 Area (km^2)	2014 Area (km^2)	Area change (%)	2013 Pop.	2014 Pop.	Pop. change (%)
> 57	107.3	104.9	-2%	264,250	270,100	+2%
> 60	58.7	57.3	-2%	118,450	121,800	+3%
> 63	34.6	33.8	-2%	50,650	47,100	-7%
> 66	20.4	19.5	-4%	14,150	12,400	-12%
> 69	9.8	9.4	-4%	3,450	3,300	-4%
> 72	5.3	5.1	-4%	200	300	+50%

Note: The 2013 and 2014 day actual runway modal splits were 74% west / 26% east and 68% west / 32% east respectively.

4.1.2 The 57 dBA contour lobe formed by aircraft flying on the westerly WOB/BPK SIDs heading to the north-west of the airport retracted noticeably in 2014. This can be attributed to: (a) a 4% lower proportion of westerly WOB/BPK SID movements in 2014, and (b) a 41% reduction in movements of the noise dominant B747-400 aircraft on the WOB/BPK routes.

4.1.3 Higher proportions of aircraft flew on the easterly DVR/DET, MID/SAM and CPT routes in 2014 and the effects can be seen in the expansion of the contour lobe to the south-east of the airport between Feltham and Twickenham.

4.1.4 The eastern tips of the 57 dBA contour (due to westerly arrivals) have retracted as a result of the 6% lower proportion of westerly movements in 2014.

4.1.5 Relative to 2013, the areas of the 2014 contours have decreased by 2-4%. The 2% reduction in the 57 dBA contour area was mainly due to the 6% higher percentage of easterly movements in 2014, which tends to reduce the Heathrow 57 dBA contour area (as explained in section 2.7.5). In addition there were some changes to the fleet mix, which included a 9% decrease in movements of the noise dominant B747-400 aircraft.

4.1.6 The 2014 population count for the 57 dBA contour level increased by 2% despite the area reduction. This was caused by changes to the contour shape, which saw the 57 dBA contour expanding in the region between Feltham and Twickenham, and also to the west of Windsor, whilst contracting near Barnes and in the area west of Slough.

4.1.7 Percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because of the uneven distribution of populations around the airport.

4.2 Night actual modal split contours – comparison with 2013 contours

4.2.1 The Heathrow 2014 night actual modal split Leq contours are compared against the 2013 night actual Leq contours in **Figure 13b** (note: for clarity, only the 48, 54 and 60 dBA contour levels are shown in the diagram). The table below summarises the areas, populations and percentage changes from 2013 to 2014:

Heathrow night actual contours - area and population estimates for 2013 and 2014

Leq (dBA)	2013 Area (km^2)	2014 Area (km^2)	Area change (%)	2013 Pop.	2014 Pop.	Pop. change (%)
> 48	120.5	114.2	-5%	421,250	364,400	-13%
> 51	70.1	66.4	-5%	190,800	179,700	-6%
> 54	41.3	36.0	-13%	103,200	76,200	-26%
> 57	21.5	18.6	-13%	48,200	34,800	-28%
> 60	11.3	9.6	-15%	16,700	10,500	-37%
> 63	6.0	5.1	-15%	4,500	2,200	-51%
> 66	3.3	2.8	-15%	1,650	200	-88%
> 69	1.9	1.7	-11%	< 50	< 100	(n/a)
> 72	1.3	1.2	-8%	0	0	(n/a)

Note: The night actual runway modal splits were 77% west / 23% east in 2013 and 66% west / 34% east in 2014.

4.2.2 It can be seen that in 2014 there was a noticeable southwards shift in the noise contours, with a widening of the contours around the southern runway's extended centreline. This was due to re-surfacing works on the northern runway in 2014, which meant that a much higher proportion of traffic (62%) operated from the southern runway over the 2014 summer night period compared to the northern runway (38%).

4.2.3 The 48 dBA contour area decreased by 5%, with reductions of up to 15% also seen at the higher contour levels. The area changes can be attributed to the 3% reduction in traffic over the night period and a notable decrease in movements (3 fewer movements per night) for the noise dominant B744R ANCON type.

4.2.4 The effects of the 11% higher proportion of easterly movements in 2014 can be seen in the 48 dBA contour. The westerly departure contour lobe over Egham contracted, as did the arrival contour tip over Battersea. Extensions to the contour can be seen immediately to the south of Windsor (due to easterly arrivals on the southern runway) and between Feltham and Twickenham (from easterly departures turning to the south).

4.2.5 The 48 dBA population count decreased by 13% in 2014 due to the contour area decrease and changes in the contour shape, for example, the shortening of the westerly arrival contour lobe over densely populated areas of central London.

4.3 Day standard modal split contours – comparison with 2013 contours

4.3.1 The Heathrow 2014 day standard modal split Leq contours are compared against the 2013 day standard Leq contours in **Figure 14**. The table below summarises the areas, populations and percentage changes from 2013 to 2014:

Heathrow day standard contours - area and population estimates for 2013 and 2014

Leq (dBA)	2013 Area (km^2)	2014 Area (km^2)	Area change (%)	2013 Pop.	2014 Pop.	Pop. change (%)
> 57	107.9	106.6	-1%	266,050	266,700	0%
> 60	59.1	58.2	-2%	118,750	120,500	+1%
> 63	34.5	33.7	-2%	48,400	46,000	-5%
> 66	20.4	19.9	-2%	14,400	13,400	-7%
> 69	9.9	9.6	-3%	3,350	3,600	+7%
> 72	5.3	5.1	-4%	200	200	0%

Note: The 2013 and 2014 day standard runway modal splits were both 77% west / 23% east.

4.3.2 The 57 dBA contour lobe associated with westerly WOB/BPK departures retracted significantly in 2014 as a result of the 41% reduction in the noise dominant B747-400 aircraft movements on these routes. A similar effect is visible in the 57 dBA contour lobe formed by easterly BUZ/BPK departures turning to the north.

4.3.3 There was a noticeable expansion of the 57 dBA contour to the east of Windsor Great Park, which can be attributed to the use of the westerly trial routes associated with the SAM and MID NPRs/SIDs.

4.3.4 A slight elongation of the 57 dBA contour tips to the east of the airport arose from changes to the arrival aircraft fleet mix. These included increases in EA320V, B773G and B788 arrival movements, whilst numbers of EA319V, EA321C and B763R arrivals decreased.

4.3.5 The 57 dBA contour area in 2014 was 1% smaller than in 2013, reflecting changes to the fleet mix such as the fall by 7 daily movements (-9%) of the noise dominant B747-400 aircraft. Area decreases were also seen at the higher contour levels. The standardised contours normally provide a clearer indication than the actual contours of 'fleet noise level' changes from year to year because they minimise the effects of any difference between the ratios of westerly to easterly operations.

The 57 dBA standard contour results indicate that the actual modal split contour area was marginally smaller had there not been the significant increase in easterly mode operations in 2014.

4.3.6 There was no consistent pattern to the percentage changes in population across the various contour levels. However, the population count within the 57 dBA standard Leq contour for 2014 was almost the same as in 2013. Percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because of the uneven distribution of populations around the airport.

4.3.7 As explained in section 2.7.5, the runway modal split can affect the area enclosed by the 57 dBA Leq contour. The 2014 standard 57 dBA Leq contour (modal split 77% west / 23% east) had an area of 106.6 km^2, which was 2% larger than the 2014 actual 57 dBA Leq contour area of 104.9 km^2 (modal split 68% west / 32% east).

4.4 Day noise contour historical trend

4.4.1 **Figure 15** shows how the 57 dBA Leq day actual modal split contour has changed in area and population terms since 1988 by comparison with the total annual (365-day) aircraft movements. Please note that actual modal split data are used in this figure because standard modal split contours were not produced prior to 1995.

Movement trend

4.4.2 Against the trend of a general decrease in contour area, the number of annual aircraft movements has mostly risen up until 2007, with a major trough occurring in 1991, the year of the First Gulf War. The annual movement figure for 2001 was slightly lower than the preceding year and reflected the disruption to traffic following the terrorist attacks on 11 September 2001. The total annual movement figure for 2005 was 2% higher than that for 2004 compared with the 1% decrease for the 16-hour average summer Leq day. Movements during the summer 2005 period were affected by three days of industrial action in August and possibly by the terrorist attacks in central London on 7 July 2005. A separate analysis showed that total movements in July and August of 2005 were less than those for the same months in 2004.

4.4.3 The total annual movements in 2006 were 0.2% lower than in 2005. Traffic levels during the summer 2006 Leq period were affected by new tighter security restrictions, which were introduced in mid-August 2006. Flights at Heathrow were also disrupted in December 2006 by heavy fog.

4.4.4 Annual traffic levels rose by 1% in 2007, but fell in 2008 by 0.6% – this may be attributed to the economic downturn and fluctuating oil price. (Note: over the summer period only, traffic levels increased by 0.5%). In 2009, traffic levels dropped further, by 3%, as the global recession continued to impact upon the aviation industry.

4.4.5 Aircraft movements fell in 2010 for the third year in a row, this time by 2%, as a result of adverse winter weather conditions, the volcanic ash crisis in April and industrial action in May. (However, over the summer period only, movements were up by 3%).

4.4.6 Annual movements in 2011 staged a marked recovery from the falls seen in the previous three years, with an increase of 6% back to a level close to the last peak seen in 2007. Traffic levels dropped back slightly by about 1% in both 2012 and 2013 before rising marginally by 0.2% in 2014.

Area and population trend

4.4.7 The contour area figures give a better indication of the actual noise than the population figures because the latter are more susceptible to the runway modal split. This is particularly noticeable in 1995, which had an atypical modal split of 54% west / 46% east (compared with the 20-year average of 77% west / 23% east for that year). Also, 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 lines from year to year, especially in or around relatively highly populated areas, can cause a disproportionate change in enclosed population. The recorded increase in enclosed population between 1998 and 1999 reflected demographic changes that occurred between the 1991 Census and the subsequent update.

4.4.8 The sharp rate of decline in contour area recorded in the late eighties and early nineties has diminished. The area reductions in 2000 and 2001 reflect reduced numbers of Concorde movements in those years (2.5 per day in 2000 and 0.1 per day in 2001). This followed the grounding of Concorde after the crash at Paris, Charles de Gaulle airport in July 2000. Concorde movements in 2002 and 2003 never reached the level of 1999. The dashed line on the figure shows what the 2003 areas and populations would have been had there been no movements by Concorde in the Leq period for that year. In October 2003 Concorde was retired from service so there were no movements by Concorde from 2004 onwards.

4.4.9 From 2004 to 2008, the 57 dBA contour area at Heathrow was relatively steady, within a range from 117 to 123 km^2. However, in 2009 the contour area fell below this range to 112.5 km^2 as the global recession impacted upon the aviation industry, and dropped even further in 2010 to 108.3 km^2. The 2011 area saw a marginal increase to 108.8 km^2 as traffic levels rose slightly over the summer period. The area in 2012 increased slightly to 110.1 km^2, caused mainly by a significant increase in the proportion of westerly mode operations. However, the contour area in both 2013 and 2014 reduced to the smallest ever areas calculated for Heathrow, as runway usage shifted significantly in favour of easterly operations.

4.4.10 Between 2001 and 2009 the population count within the 57 dBA contour fluctuated between approximately 240,000 and 269,000. In 2010, the population count dropped below this range to its lowest ever value of 229,000. In line with the increase in contour area, the population increased to 243,000 in 2011, before dropping by 2% to 239,600 in 2012. In 2013 there was a significant rise in population, the result of a major update to the population database. Populations for 2014 were slightly higher than in 2013 despite an area reduction, mainly because of contour shape changes.

5 Conclusions

5.1 Year 2014 average summer 16-hour day and 8-hour night Leq noise exposure contours have been generated for Heathrow Airport using the ANCON noise model.

5.2 Overall daytime movements increased marginally by 0.1% in 2014 (1260.6) compared to 2013 (1258.8). The results show that the 2014 day actual modal split 57 dBA Leq contour area decreased by 2% to 104.9 km^2 (2013: 107.3 km^2), which is the smallest ever area calculated for Heathrow. The area decrease was primarily the result of the 6% higher proportion of easterly mode operations in 2014. However, the population count within the 2014 actual 57 dBA Leq contour increased by 2% to 270,100 (2013: 264,250), primarily due to changes in the contour shape.

5.3 The 2014 day standard modal split 57 dBA Leq contour area was 106.6 km^2, 1% smaller than in 2013 (2013: 107.9 km^2). The area reduction can be attributed to fleet mix changes, in particular the 9% reduction in movements by the noise dominant B747-400 aircraft. The population count within the 2014 day standard 57 dBA Leq contour was 266,700, similar to 2013 (2013: 266,050).

5.4 Night-time Leq contours have also been produced. The 2014 actual modal split 48 dBA night contour enclosed an area of 114.2 km^2 (2013: 120.5 km^2) with a population of 364,400 (2013: 421,250). The 5% area reduction in 2014 can be explained by the 3% decrease in night movements, which included a significant fall (-19%) in movements by the noise dominant B744R ANCON aircraft type. The population count reduction in 2014 by 13% was due to a combination of the area decrease and changes to the contour shape, such as the retraction of the westerly arrival contour lobe over central London.

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Table 1a Heathrow 2013 and 2014 average summer day movements by noise class

Noise Class	Description	2013 movements	2014 movements	Percentage of total 2014 movements	Change
PROPELLER AIRCRAFT					
1	Small propeller aircraft	< 0.1	0.0	0%	0.0 (*)
2	Large propeller aircraft	0.0	< 0.1	0%	0.0 (*)
CHAPTER 3/4 JETS **					
3	Short-haul aircraft	837.5	820.5	65%	-17.0 (-2%)
4	Wide-body twin-engine aircraft	295.3	316.3	25%	+21.0 (+7%)
5	2nd generation wide-body 3,4-engine aircraft	126.0	123.7	10%	-2.3 (-2%)
LARGE CHAPTER 2/3 JETS					
6	1st generation wide-body 3,4-engine aircraft	0.0	< 0.1	0%	0.0 (*)
2nd GENERATION TWIN JETS					
7	Narrow-body twin-engine aircraft *(including Ch.2 and hush-kitted versions)*	0.0	0.0	0%	0.0 (*)
1st GENERATION JETS					
8	Narrow-body 3,4-engine aircraft	0.0	0.0	0%	0.0 (*)
	TOTAL	1258.8	**1260.6**	100%	**+1.8 (+0.1%)**

* Percentage changes not shown due to low numbers and limited data resolution.

** An estimated 98% of *Noise Class 3* aircraft in the 2014 daytime period met the 'Chapter 4' noise standard (2013: 97%).

Note: Totals may not sum exactly due to rounding.

Table 1b Heathrow 2013 and 2014 average summer night movements by noise class

Noise Class	Description	2013 movements	2014 movements	Percentage of total 2014 movements	Change
		PROPELLER AIRCRAFT			
1	Small propeller aircraft	0.1	0.2	< 1%	+0.1 (*)
2	Large propeller aircraft	0.0	< 0.1	< 1%	0.0 (*)
		**CHAPTER 3/4 JETS ** **			
3	Short-haul aircraft	18.4	19.7	25%	+1.3 (+7%)
4	Wide-body twin-engine aircraft	35.7	36.9	46%	+1.2 (+3%)
5	2nd generation wide-body 3,4-engine aircraft	28.2	23.3	29%	-4.9 (-17%)
		LARGE CHAPTER 2/3 JETS			
6	1st generation wide-body 3,4-engine aircraft	0.0	0.0	0%	0.0 (*)
		2nd GENERATION TWIN JETS			
7	Narrow-body twin-engine aircraft *(including Ch.2 and hush-kitted versions)*	0.0	0.0	0%	0.0 (*)
		1st GENERATION JETS			
8	Narrow-body 3,4-engine aircraft	0.0	0.0	0%	0.0 (*)
	TOTAL	82.4	**80.1**	100%	**-2.3 (-3%)**

* Percentage changes not shown due to low numbers and limited data resolution.

** An estimated 97% of *Noise Class 3* aircraft in the 2014 night-time period met the 'Chapter 4' noise standard (2013: 96%).

Note: Totals may not sum exactly due to rounding.

Table 2a Heathrow 2013 and 2014 average summer day movements by ANCON aircraft type

Aircraft type	Noise class	ANCON type	2013	2014	Change
Small twin-turboprop	1	STT	< 0.1	0.0	0.0
Large twin-turboprop	2	LTT	0.0	< 0.1	0.0
Boeing 717	3	B717	0.1	0.2	+0.1
Boeing 737-300/400/500	3	B733	11.7	5.9	-5.8
Boeing 737-600/700	3	B736	23.5	24.5	+1.0
Boeing 737-800/900	3	B738	19.0	19.1	+0.1
Boeing 757-200 (RB211-535C engines)	3	B757C	1.0	0.8	-0.2
Boeing 757-200 (RB211-535E4/E4B engines)	3	B757E	15.9	8.0	-7.9
Boeing 757-200 (PW2037/2040 engines)	3	B757P	0.2	0.3	+0.1
Boeing 757-300	3	B753	0.0	< 0.1	0.0
BAe 146/Avro RJ	3	BA46	1.8	2.2	+0.4
Airbus A318	3	EA318	3.2	1.9	-1.3
Airbus A319 (CFM56 engines)	3	EA319C	49.3	58.8	+9.5
Airbus A319 (IAE V2500 engines)	3	EA319V	214.6	197.4	-17.2
Airbus A320 (CFM56 engines)	3	EA320C	136.1	133.7	-2.4
Airbus A320 (IAE V2500 engines)	3	EA320V	214.7	237.7	+23.0
Airbus A321 (CFM56 engines)	3	EA321C	40.9	28.9	-12.0
Airbus A321 (IAE V2500 engines)	3	EA321V	93.7	89.1	-4.6
Executive Business Jet (Chapter 3)	3	EXE3	0.3	0.6	+0.3
Bombardier CRJ900	3	CRJ900	2.1	1.7	-0.4
Embraer ERJ 135/145	3	ERJ	< 0.1	0.1	+0.1
Embraer E-170	3	ERJ170	< 0.1	0.0	0.0
Embraer E-190	3	ERJ190	3.3	2.0	-1.3
Fokker 100	3	FK10	4.7	7.5	+2.8
McDonnell Douglas MD-80 series	3	MD80	1.4	0.1	-1.3
Boeing 767-200	4	B762	0.9	< 0.1	-0.9
Boeing 767-300 (GE CF6-80 engines)	4	B763G	15.9	18.7	+2.8
Boeing 767-300 (PW PW4000 engines)	4	B763P	12.8	18.9	+6.1
Boeing 767-300 (RR RB211 engines)	4	B763R	45.1	36.1	-9.0
Boeing 767-400	4	B764	11.4	9.1	-2.3
Boeing 777-200 (GE GE90 engines)	4	B772G	33.2	32.7	-0.5
Boeing 777-200 (PW PW4000 engines)	4	B772P	9.3	10.1	+0.8
Boeing 777-200 (RR Trent 800 engines)	4	B772R	46.1	35.5	-10.6
Boeing 777-200LR/300ER (GE GE90 engines)	4	B773G	62.4	86.8	+24.4
Boeing 787-8	4	B788	6.9	21.4	+14.5
Airbus A300	4	EA30	3.7	3.6	-0.1
Airbus A310	4	EA31	0.4	0.5	+0.1
Airbus A330	4	EA33	47.3	43.0	-4.3
Airbus A340-200/300	5	EA34	10.4	7.4	-3.0
Airbus A340-500/600	5	EA346	18.7	21.5	+2.8
Airbus A380 (Engine Alliance GP7000 engines)	5	EA38GP	9.2	9.2	0.0
Airbus A380 (RR Trent 900 engines)	5	EA38R	10.8	15.1	+4.3
Boeing 747-400 (GE CF6-80F engines)	5	B744G	12.2	11.2	-1.0
Boeing 747-400 (PW PW4000 engines)	5	B744P	4.5	2.1	-2.4
Boeing 747-400 (RR RB211 engines)	5	B744R	60.2	56.9	-3.3
Boeing 747SP	5	B747SP	0.0	< 0.1	0.0

Aircraft type	Noise class	ANCON type	2013	2014	Change
Boeing 747-8	5	B748	0.0	0.2	+0.2
McDonnell Douglas MD-11	5	MD11	< 0.1	0.0	0.0
Boeing 747-100/200/300	6	B747	0.0	< 0.1	0.0
		TOTAL	1258.8	**1260.6**	**+1.8 (+0.1%)**

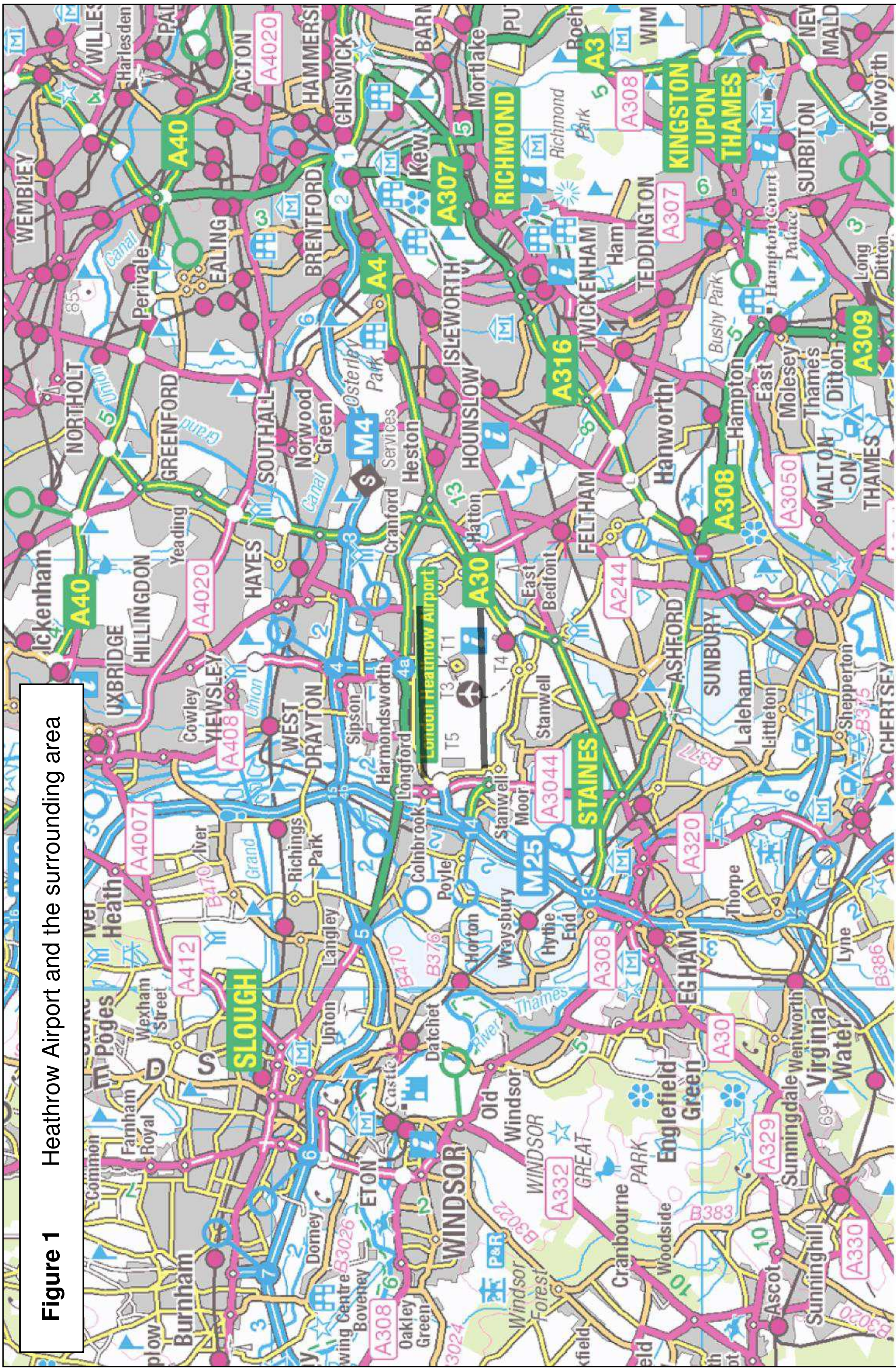
Note: Totals may not sum exactly due to rounding.

Table 2b Heathrow 2013 and 2014 average summer night movements by ANCON aircraft type

Aircraft type	Noise class	ANCON type	2013	2014	Change
Small twin-piston	1	STP	0.0	0.1	+0.1
Small twin-turboprop	1	STT	0.1	0.1	0.0
Large twin-turboprop	2	LTT	0.0	< 0.1	0.0
Boeing 737-300/400/500	3	B733	0.6	0.6	0.0
Boeing 737-600/700	3	B736	< 0.1	0.1	+0.1
Boeing 737-800/900	3	B738	0.8	0.8	0.0
Boeing 757-200 (RB211-535C engines)	3	B757C	0.4	0.5	+0.1
Boeing 757-200 (RB211-535E4/E4B engines)	3	B757E	1.2	0.5	-0.7
Boeing 757-200 (PW2037/2040 engines)	3	B757P	0.0	< 0.1	0.0
Airbus A319 (CFM56 engines)	3	EA319C	1.5	2.4	+0.9
Airbus A319 (IAE V2500 engines)	3	EA319V	4.1	4.5	+0.4
Airbus A320 (CFM56 engines)	3	EA320C	4.4	3.6	-0.8
Airbus A320 (IAE V2500 engines)	3	EA320V	1.9	2.5	+0.6
Airbus A321 (CFM56 engines)	3	EA321C	1.0	1.4	+0.4
Airbus A321 (IAE V2500 engines)	3	EA321V	2.2	2.5	+0.3
Executive Business Jet (Chapter 3)	3	EXE3	< 0.1	< 0.1	0.0
Bombardier CRJ900	3	CRJ900	< 0.1	0.0	0.0
Embraer ERJ 135/145	3	ERJ	0.1	< 0.1	0.0
Embraer E-170	3	ERJ170	< 0.1	0.0	0.0
Embraer E-190	3	ERJ190	< 0.1	0.1	+0.1
McDonnell Douglas MD-80 series	3	MD80	< 0.1	< 0.1	0.0
Boeing 767-200	4	B762	< 0.1	0.0	0.0
Boeing 767-300 (GE CF6-80 engines)	4	B763G	1.6	1.6	0.0
Boeing 767-300 (PW PW4000 engines)	4	B763P	1.0	2.5	+1.5
Boeing 767-300 (RR RB211 engines)	4	B763R	4.4	2.8	-1.6
Boeing 767-400	4	B764	1.1	1.3	+0.2
Boeing 777-200 (GE GE90 engines)	4	B772G	8.1	7.1	-1.0
Boeing 777-200 (PW PW4000 engines)	4	B772P	1.8	1.4	-0.4
Boeing 777-200 (RR Trent 800 engines)	4	B772R	4.8	4.1	-0.7
Boeing 777-200LR/300ER (GE GE90 engines)	4	B773G	7.4	8.4	+1.0
Boeing 787-8	4	B788	0.4	2.7	+2.3
Airbus A300	4	EA30	0.7	0.7	0.0
Airbus A330	4	EA33	4.3	4.4	+0.1
Airbus A340-200/300	5	EA34	1.3	0.9	-0.4
Airbus A340-500/600	5	EA346	4.4	3.4	-1.0
Airbus A380 (Engine Alliance GP7000 engines)	5	EA38GP	0.8	0.8	0.0
Airbus A380 (RR Trent 900 engines)	5	EA38R	4.7	4.6	-0.1
Boeing 747-400 (GE CF6-80F engines)	5	B744G	0.4	0.5	+0.1
Boeing 747-400 (PW PW4000 engines)	5	B744P	1.0	0.3	-0.7
Boeing 747-400 (RR RB211 engines)	5	B744R	15.6	12.7	-2.9
Boeing 747-8	5	B748	0.0	< 0.1	0.0
		TOTAL	82.4	**80.1**	**-2.3 (-3%)**

Note: Totals may not sum exactly due to rounding.

Figure 1 Heathrow Airport and the surrounding area



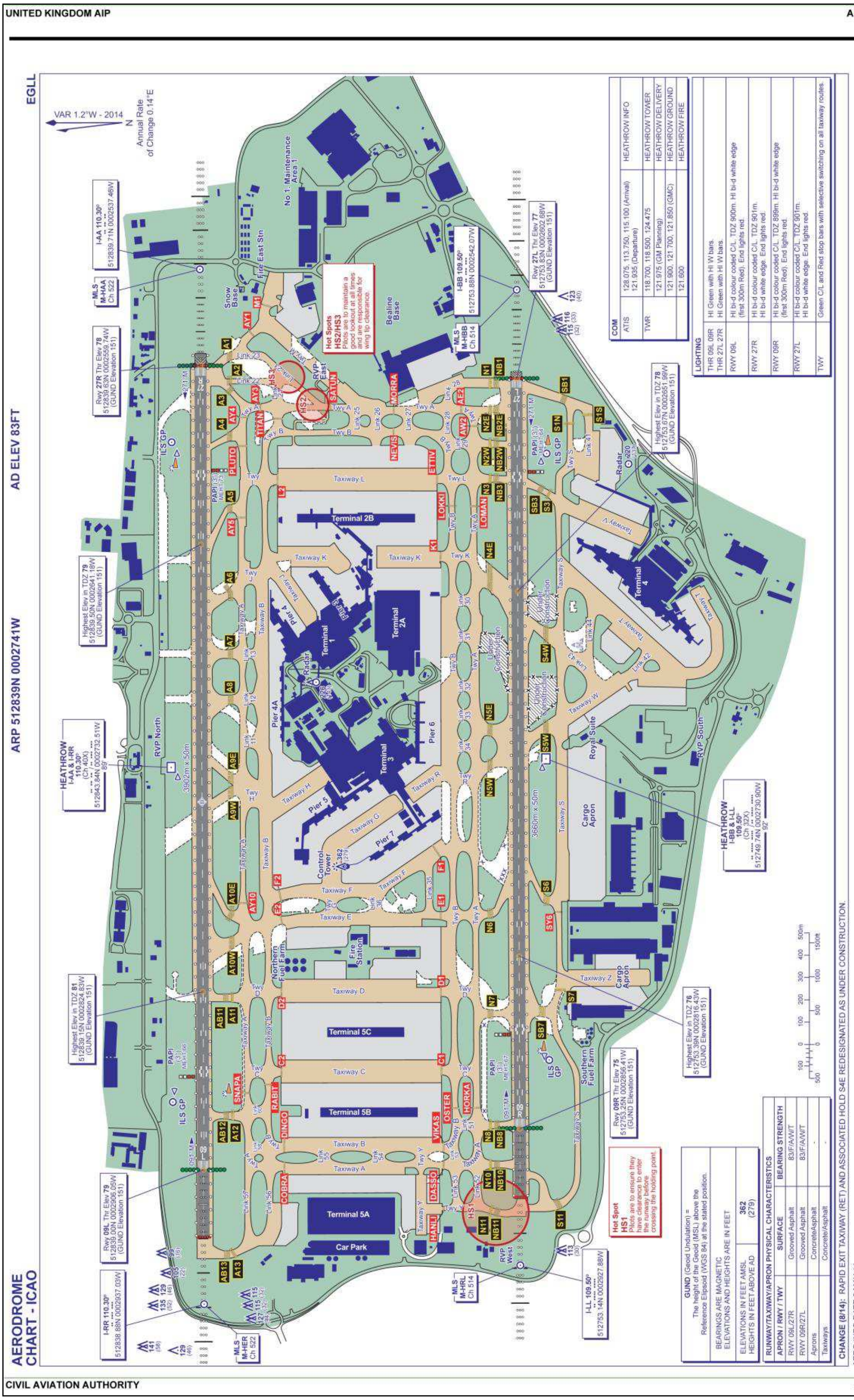
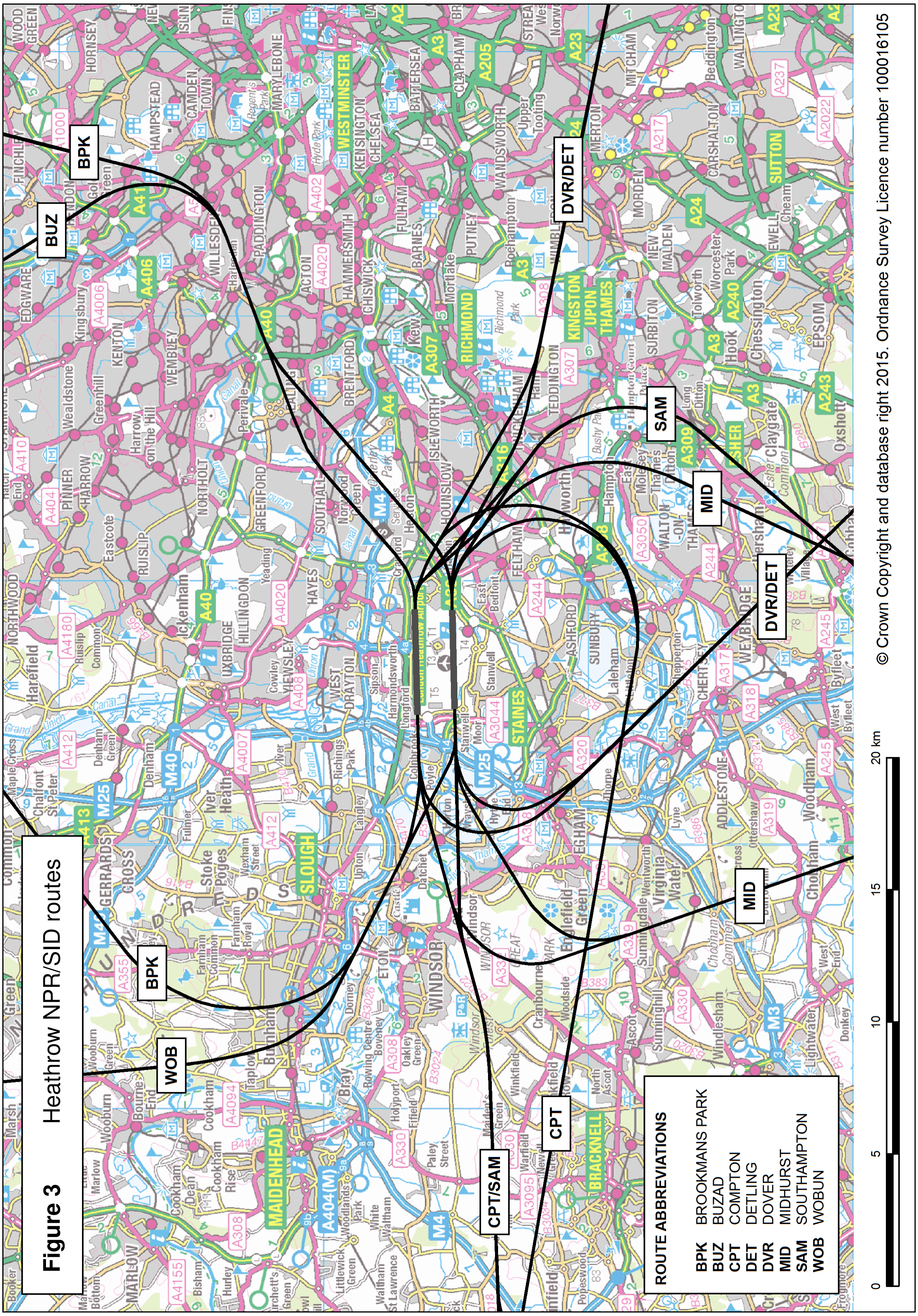


Figure 2 Heathrow Airport layout in 2014

Figure 3 Heathrow NPR/SID routes



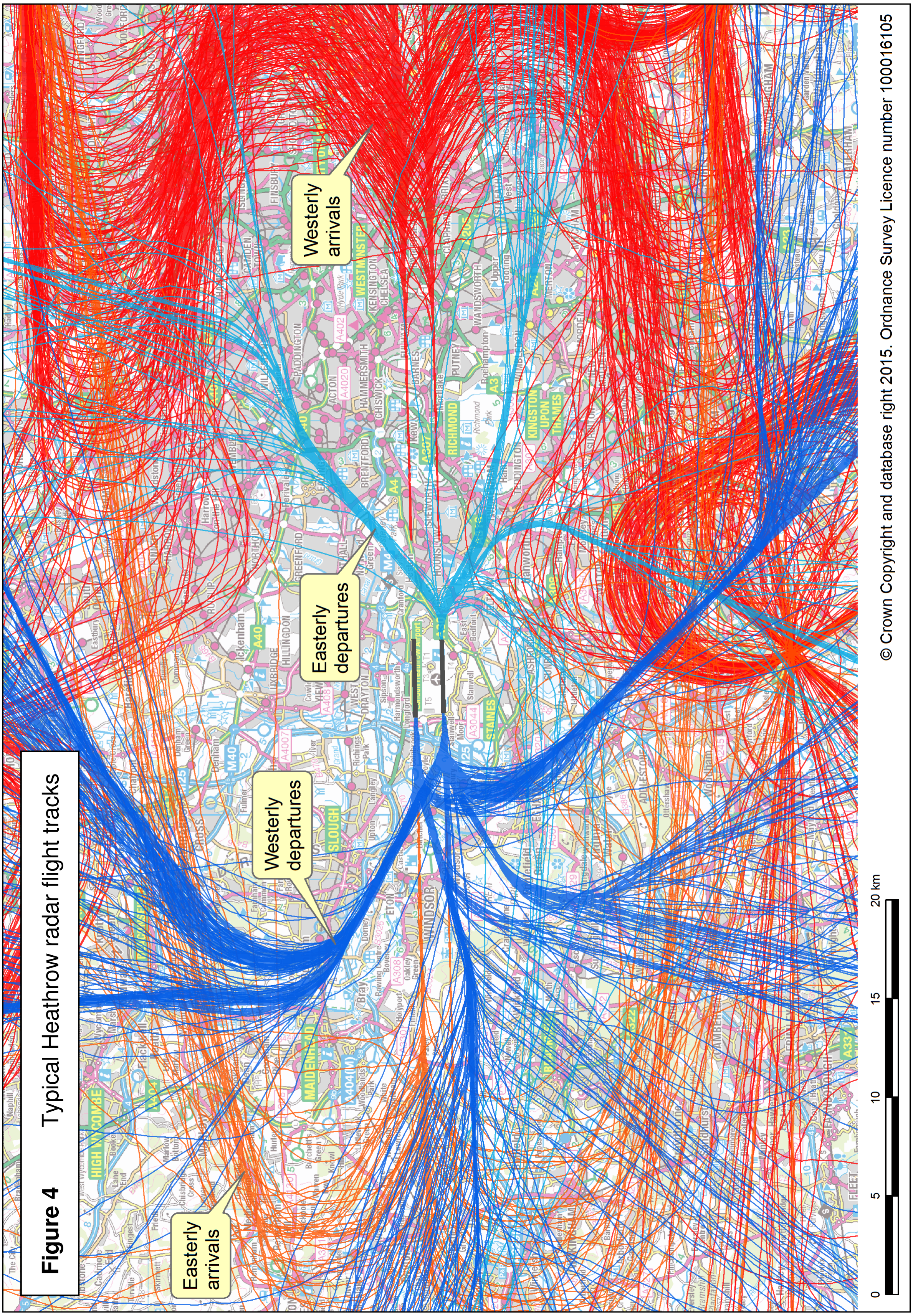
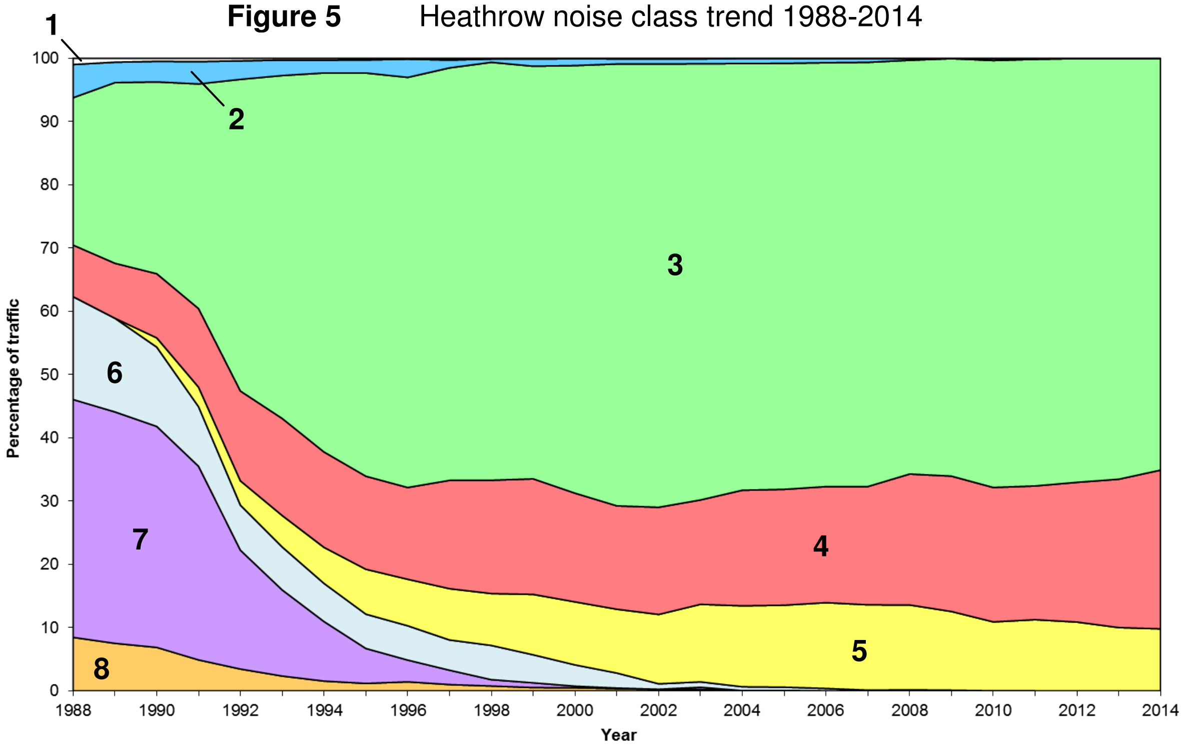


Figure 4 Typical Heathrow radar flight tracks

Figure 5 Heathrow noise class trend 1988-2014



Note: The percentages from 1990 onwards 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.

Key to noise classes

Propeller aircraft

1 Small props, e.g. single/twin piston and turboprop light aircraft
2 Large props, e.g. 2- and 4-propeller transports, e.g. ATR-42, BAe ATP

Chapter 3/4 jets

3 Short-haul, e.g. Airbus A320, Boeing 737-700
4 Wide-body twins, e.g. Boeing 767-300, Boeing 777-300
5 2nd generation wide-body 3/4-engine aircraft, e.g. Airbus A380, Boeing 747-400

Large Chapter 2/3 jets

6 1st generation wide-body 3/4-engine aircraft, e.g. Boeing 747-200

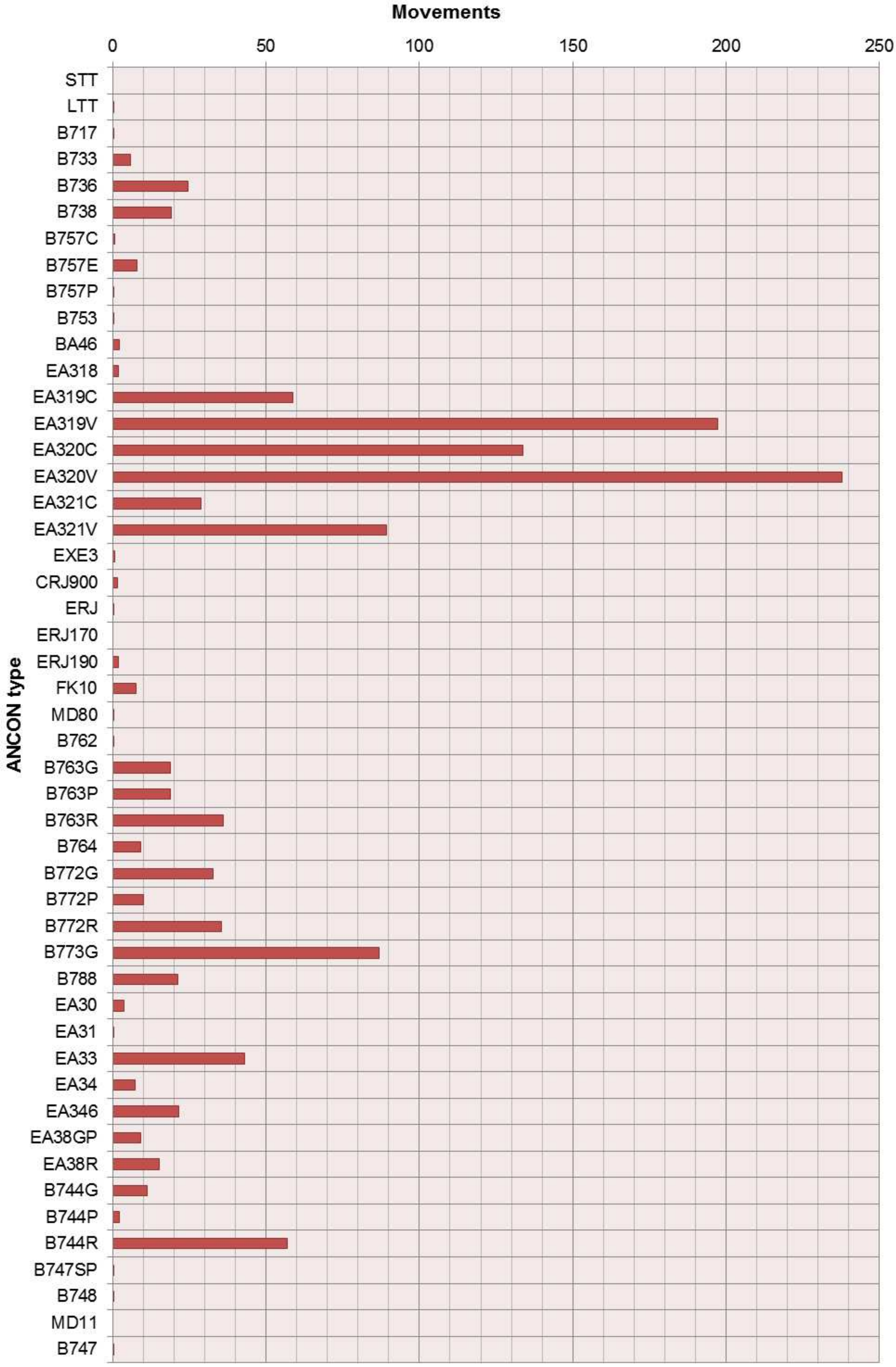
2nd generation twin jets

7 Narrow body twins (including hush-kitted versions), e.g. Boeing 737-200

1st generation jets

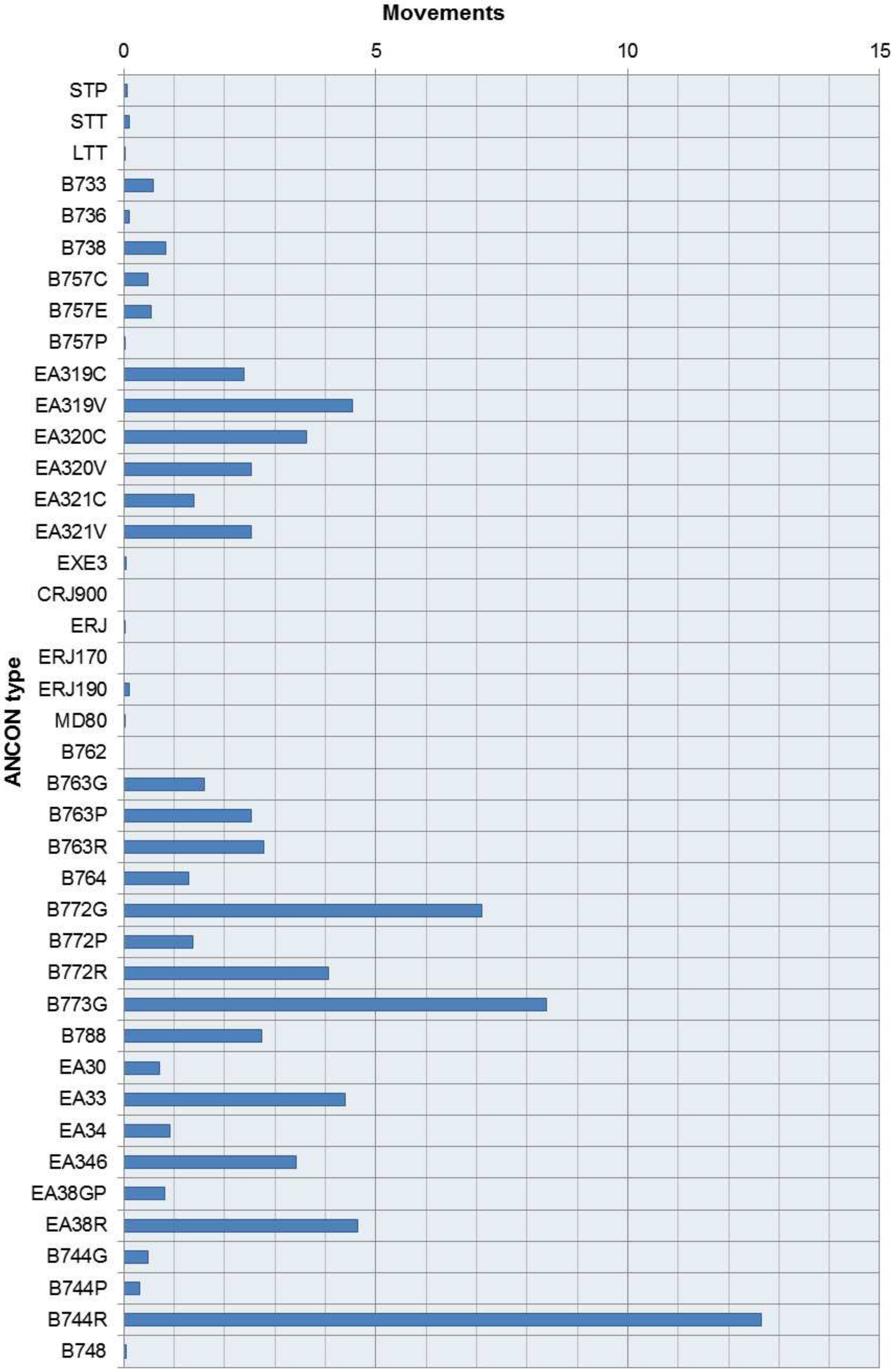
8 Narrow body 3/4-engine aircraft (including hush-kitted versions), e.g. Boeing 727

Figure 6a Heathrow 2014 average summer day movements by ANCON type



Note: the ANCON types are shown in the same order as in **Table 2a**.

Figure 6b Heathrow 2014 average summer night movements by ANCON type



Note: the ANCON types are shown in the same order as in **Table 2b**.

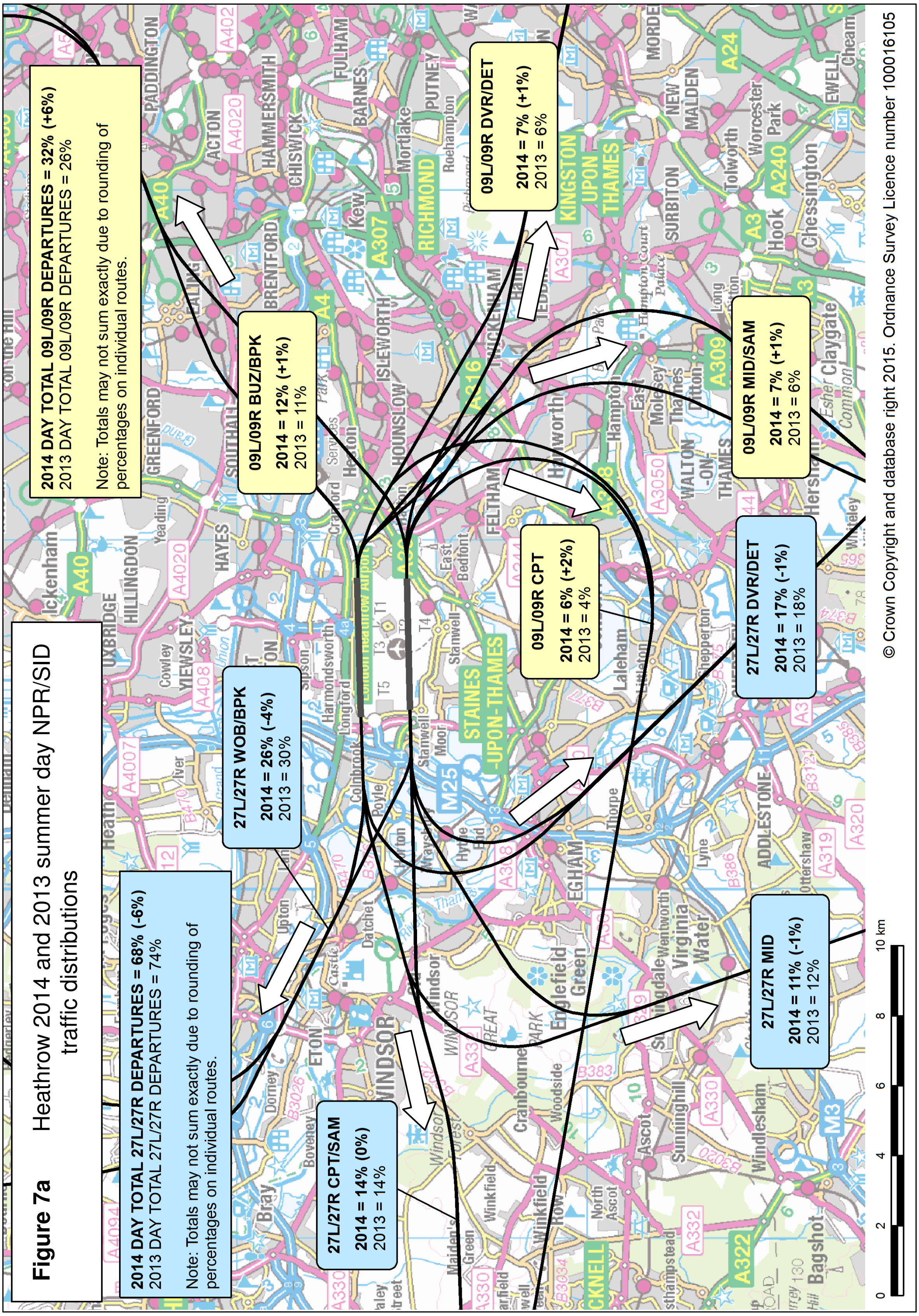


Figure 7a Heathrow 2014 and 2013 summer day NPR/SID traffic distributions

Figure 7b Heathrow 2014 and 2013 summer night NPR/SID traffic distributions

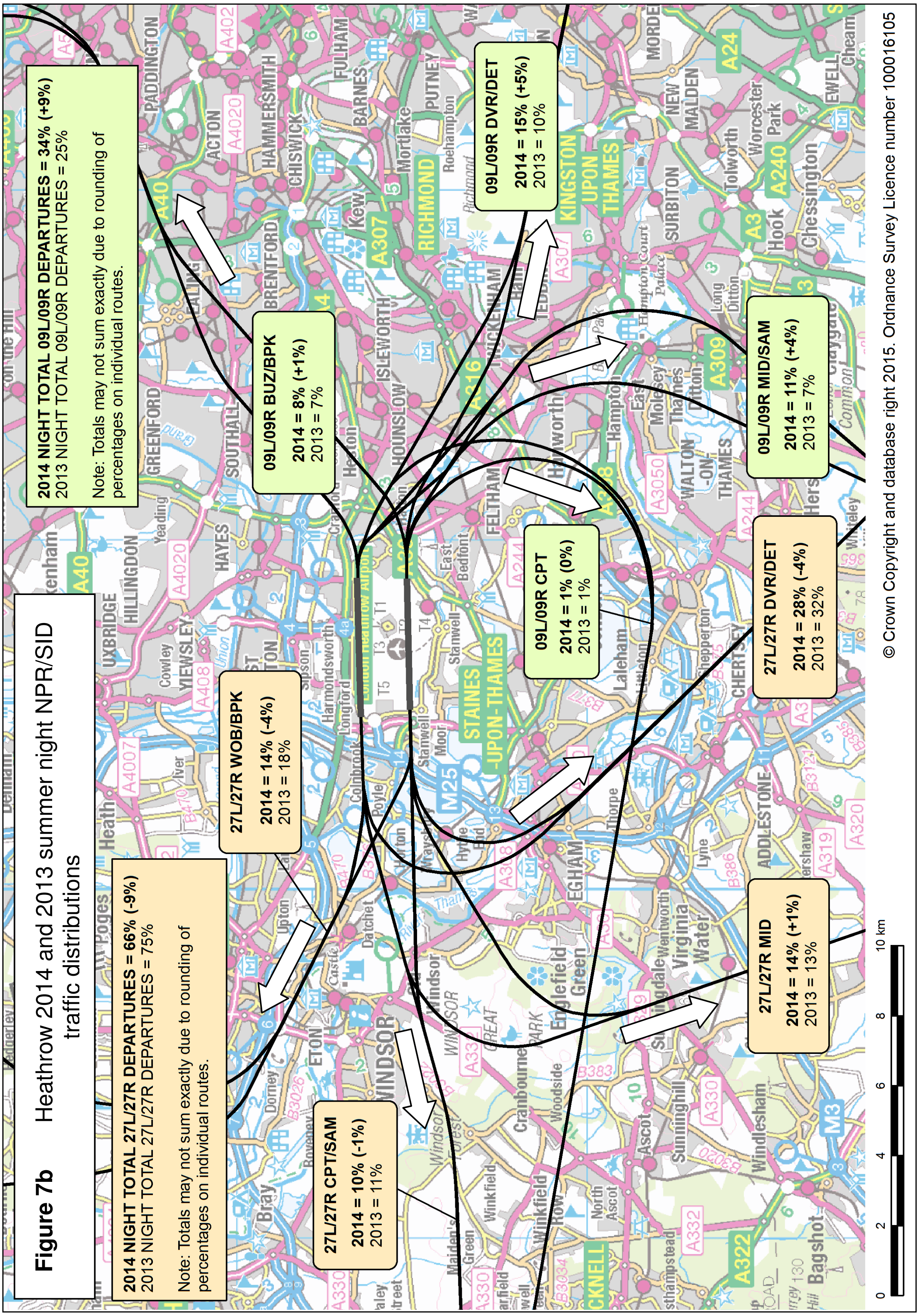


Figure 8 Heathrow average summer day runway modal splits 1995-2014

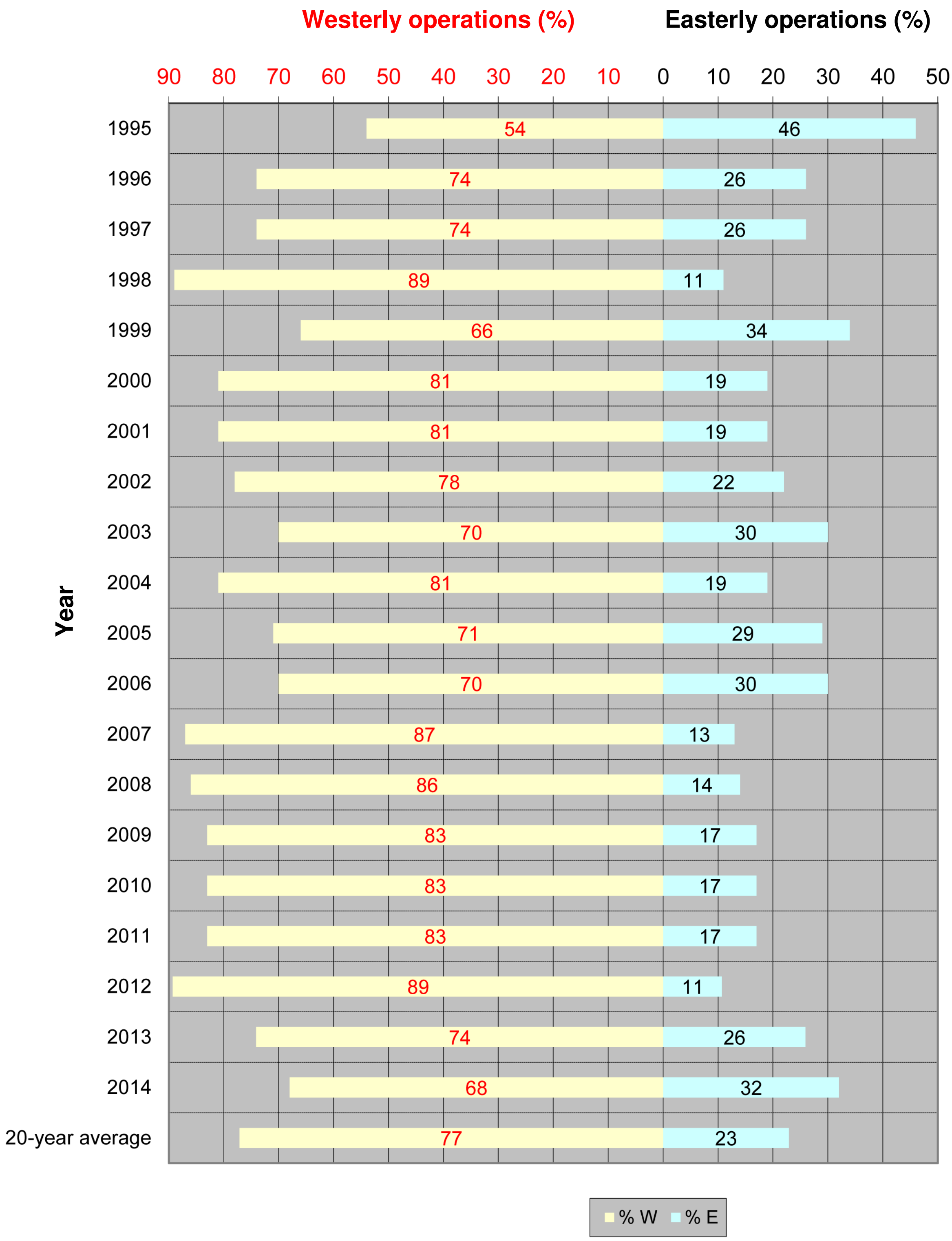


Figure 9 Topography around Heathrow Airport

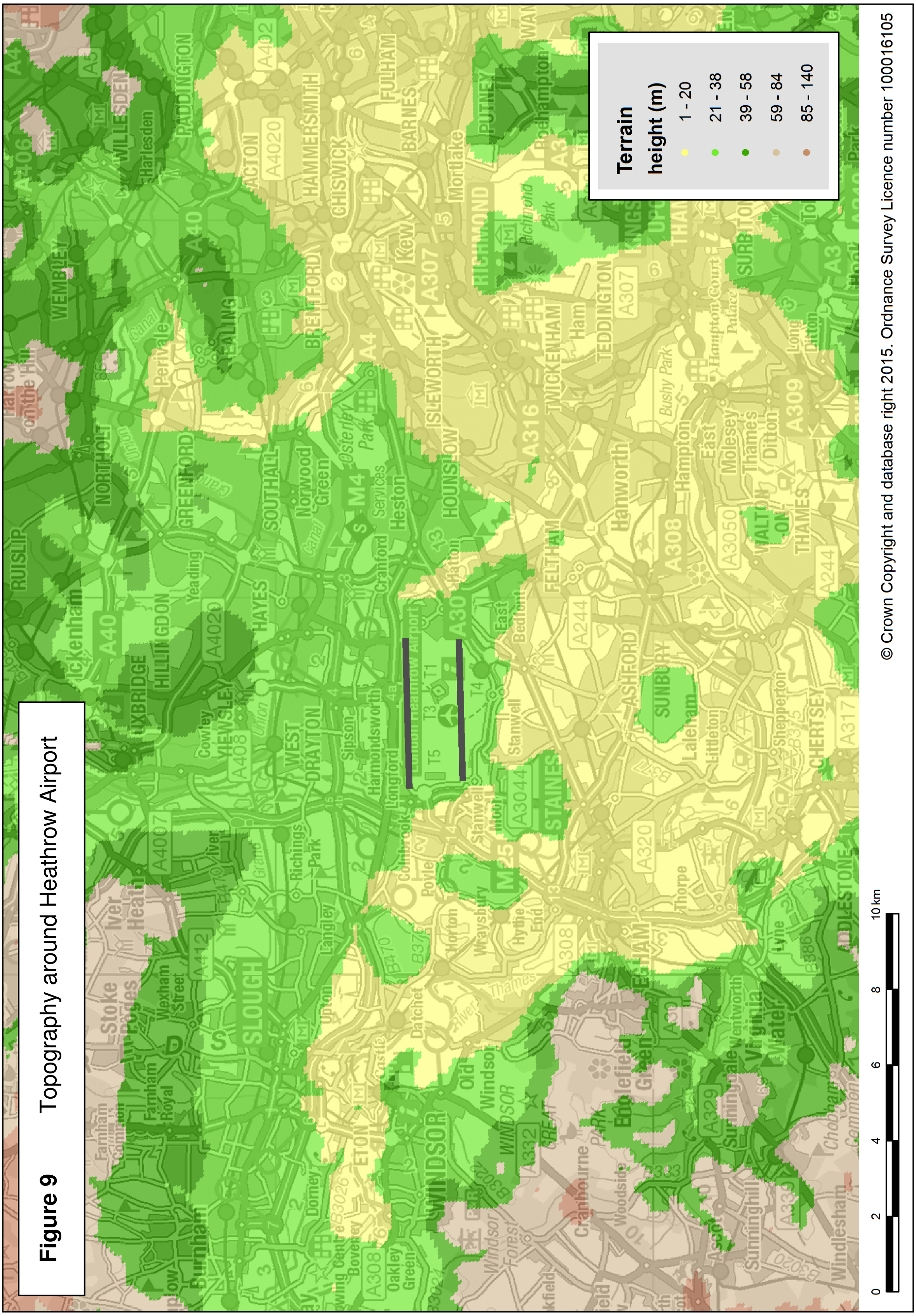


Figure 10 Population data points around Heathrow

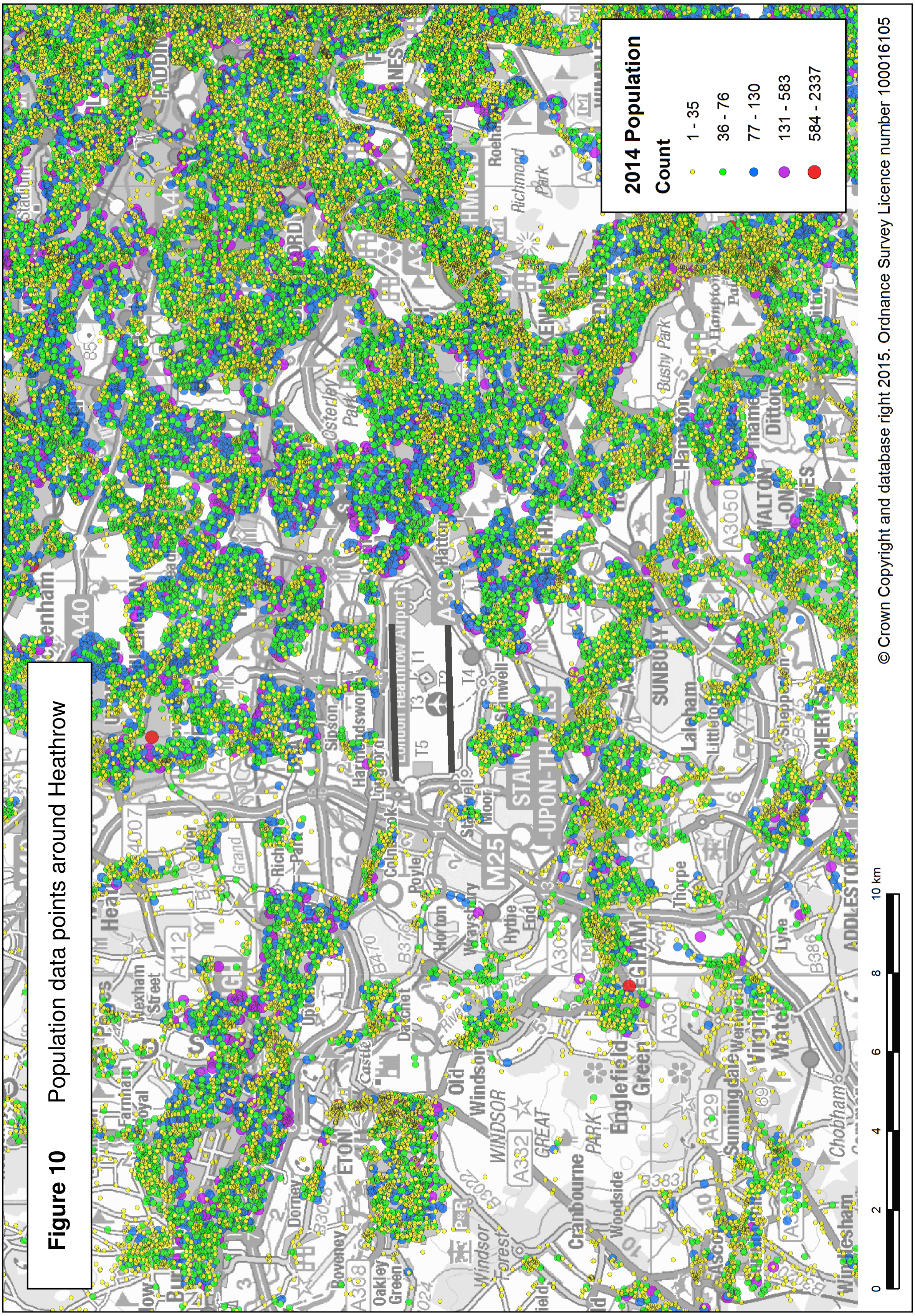


Figure 11a Heathrow 2014 day actual modal split (68% W / 32% E) Leq contours

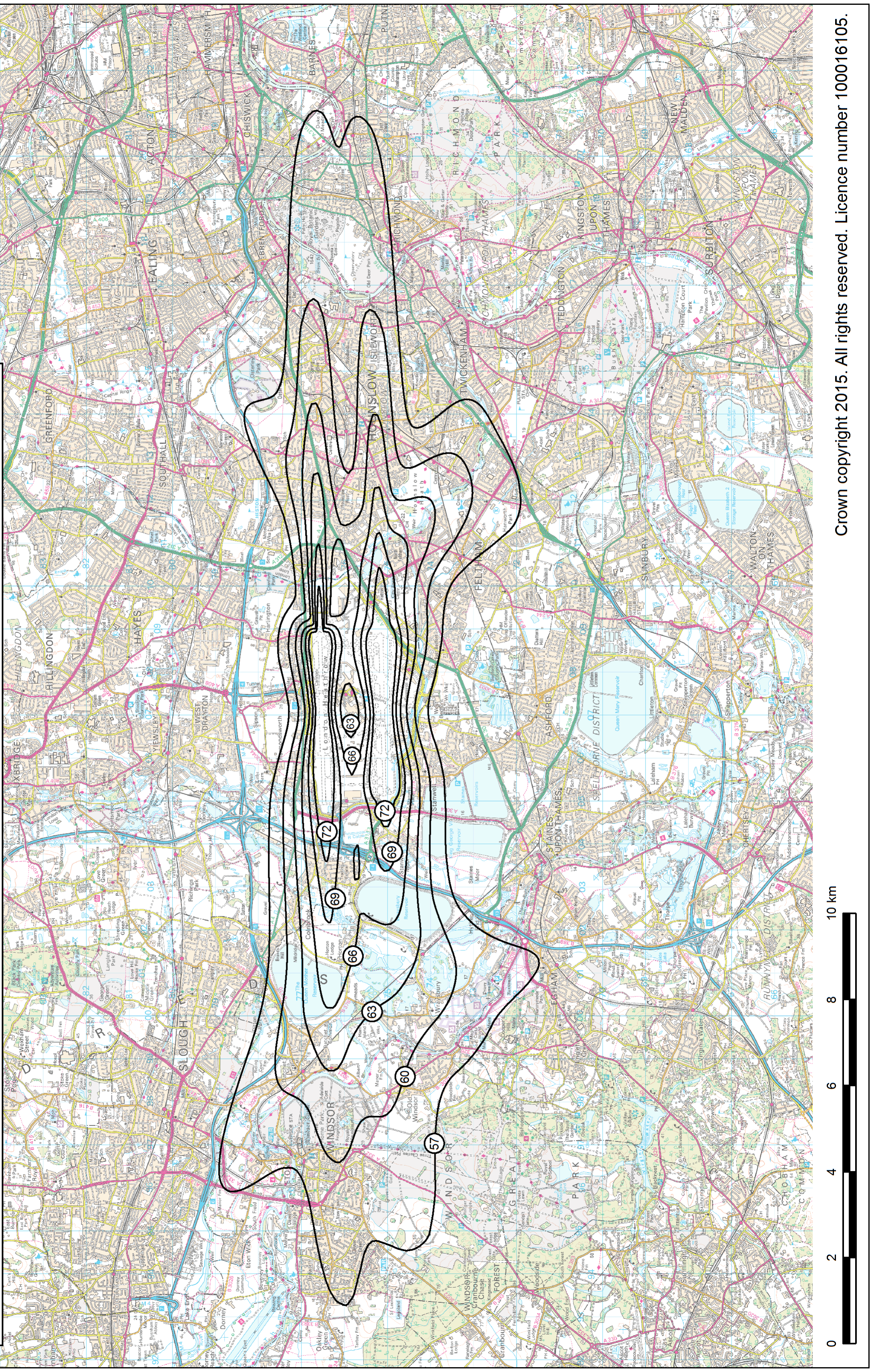
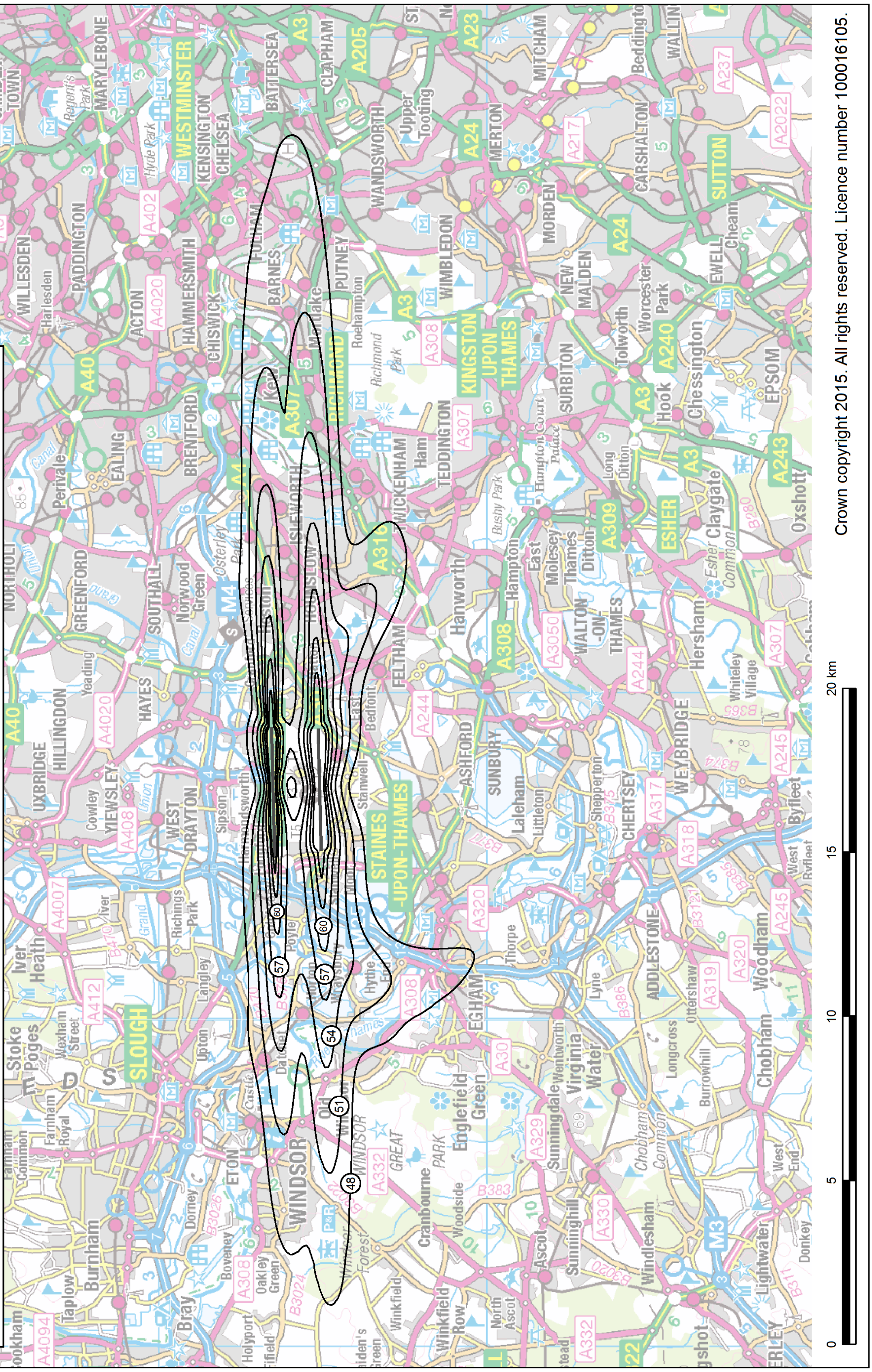


Figure 11b Heathrow 2014 night actual modal split (66% W / 34% E) Leq contours



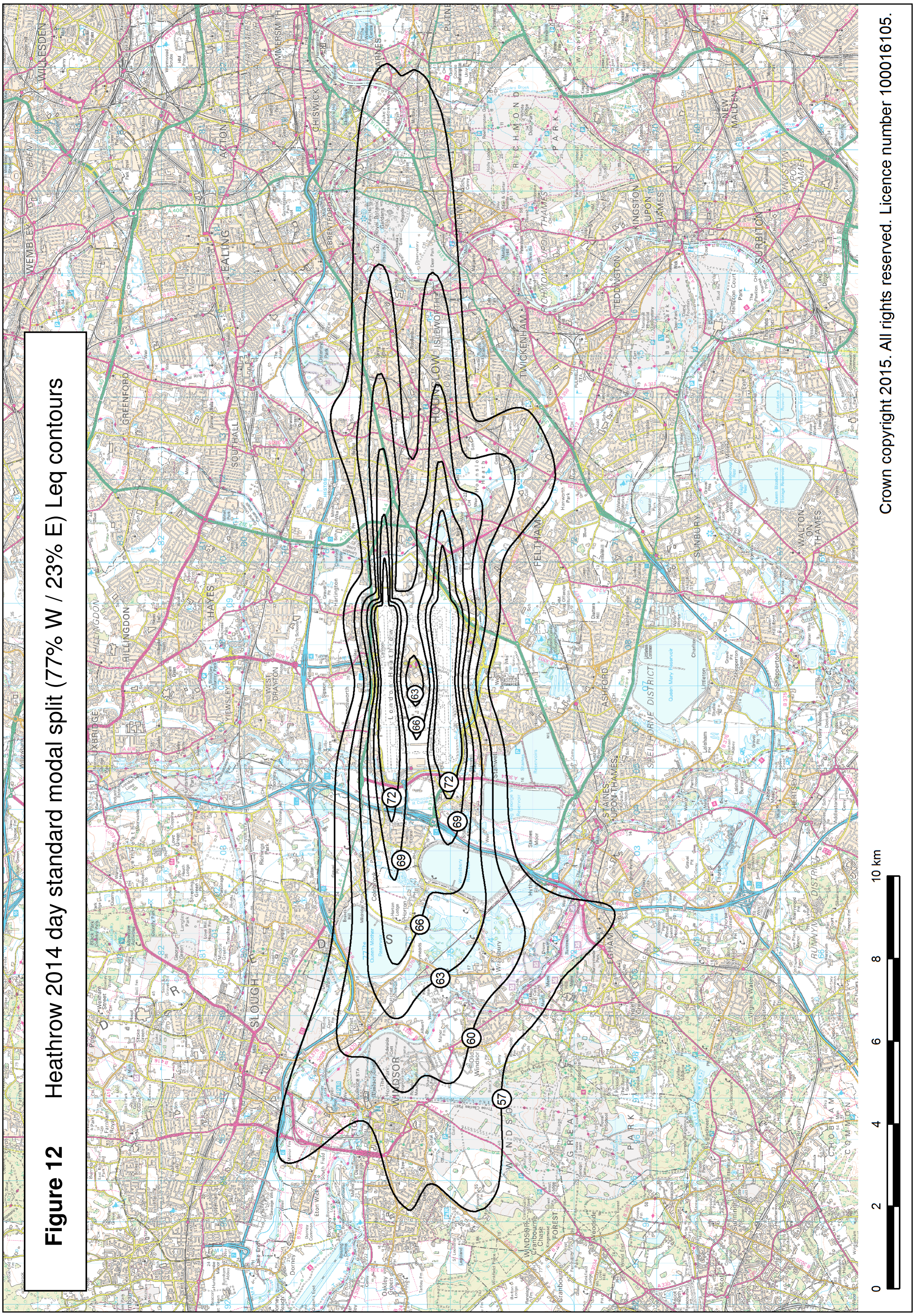


Figure 12 Heathrow 2014 day standard modal split (77% W / 23% E) Leq contours

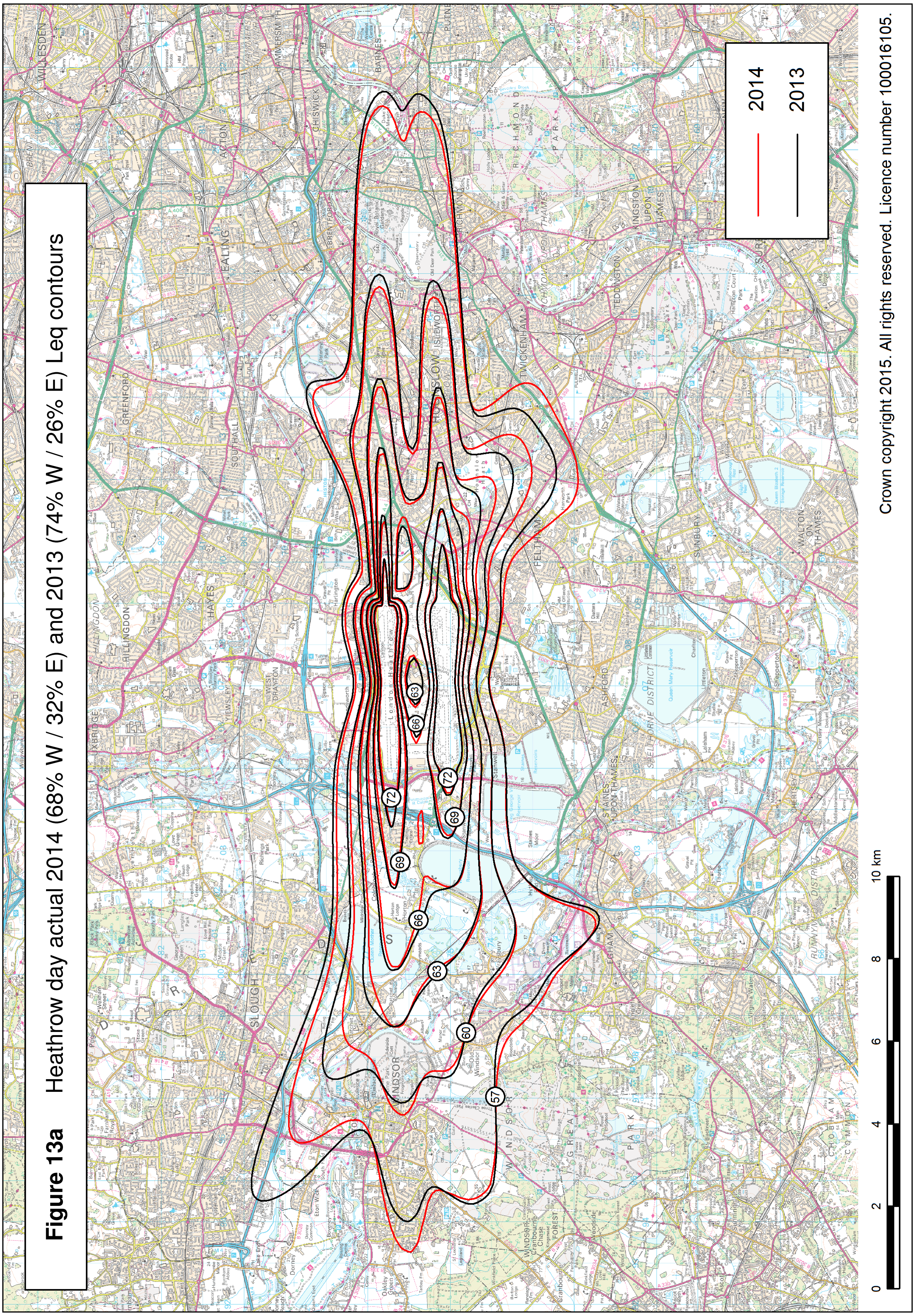


Figure 13a Heathrow day actual 2014 (68% W / 32% E) and 2013 (74% W / 26% E) Leq contours

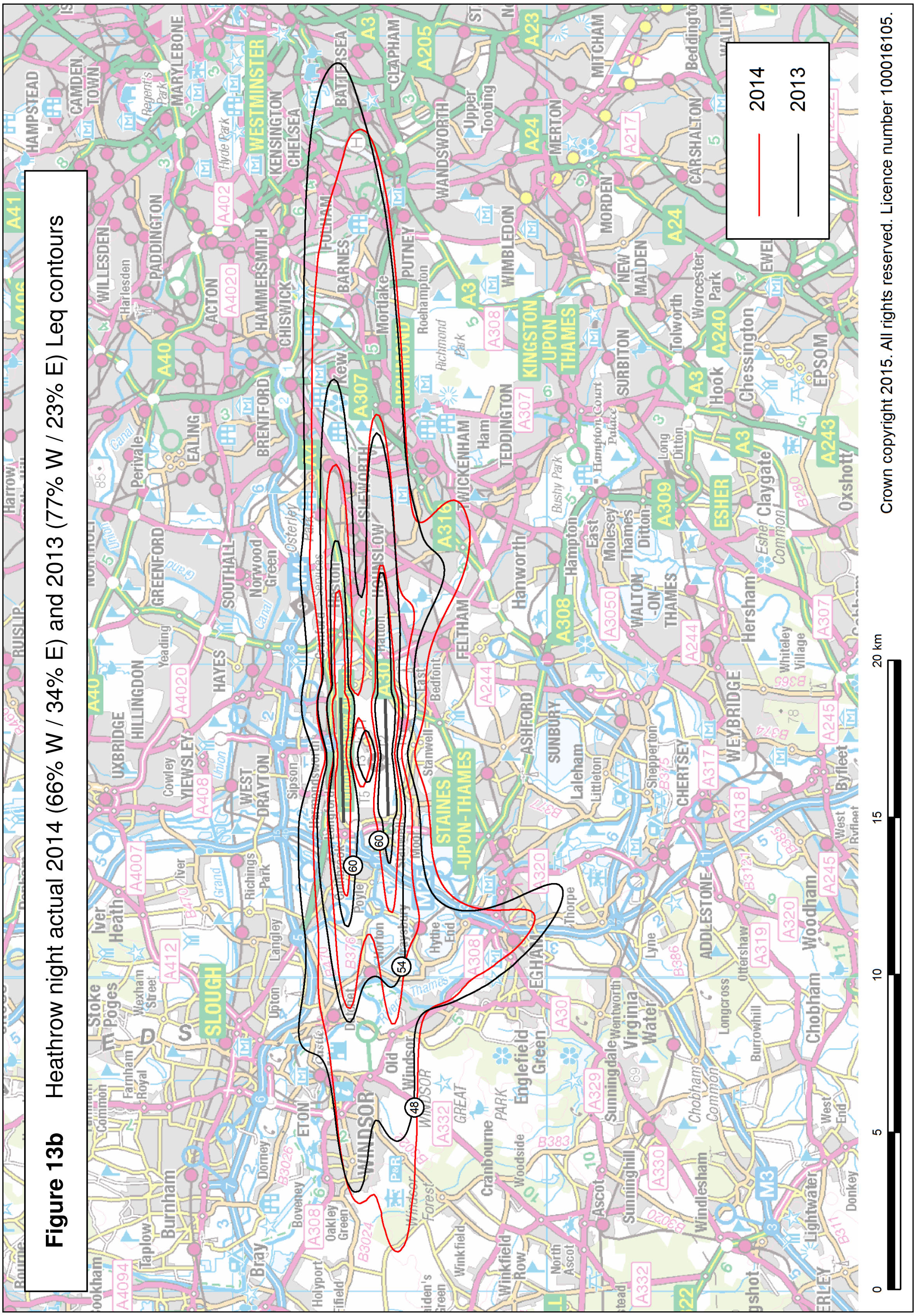


Figure 13b Heathrow night actual 2014 (66% W / 34% E) and 2013 (77% W / 23% E) Leq contours

Figure 14 Heathrow day standard 2014 (77% W / 23% E) and 2013 (77% W / 23% E) Leq contours

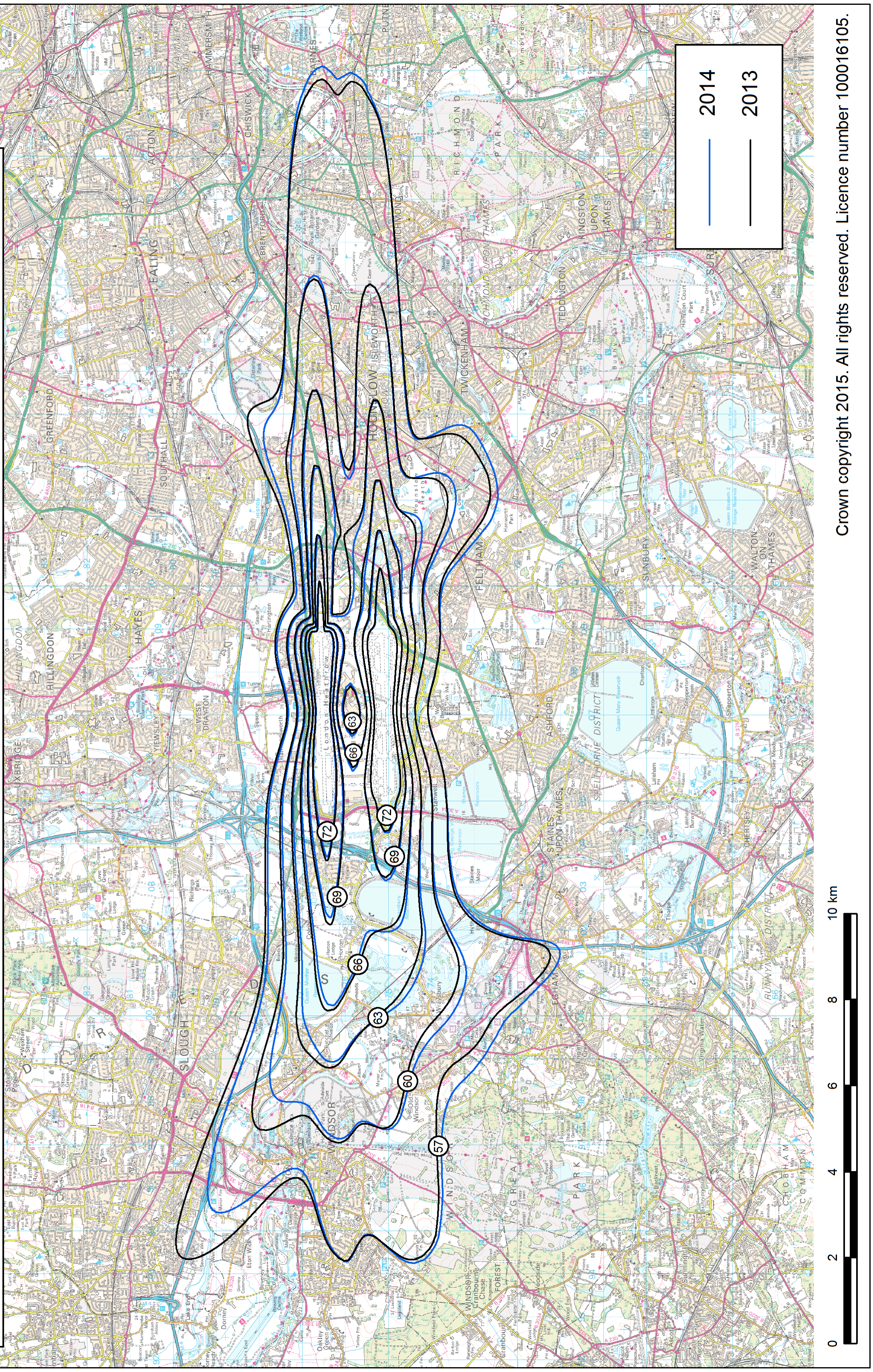


Figure 15 Heathrow annual traffic and summer day Leq noise contour area/population trend 1988-2014