Heathrow Community Noise and Track-keeping Report: Chertsey

This document reports on an 98-day period of continuous noise monitoring from 9 June 2011 to 14 September 2011 using a Larson Davies LD 870 sound monitor placed at the 'Chertsey' site (positioned at 51° 24′ 45.50" N, 0° 30′ 40.97" W, 46 feet elevation). All timings are local.

Background

Heathrow Airport is committed to limiting the impacts of noise on communities around the airport and publishes a Noise Action Plan in accordance with National and European Regulations. An objective of the plan is to better understand local noise concerns and priorities by establishing a Community Noise and Track Monitoring Programme. As part of this Programme, the Airport has agreed with local stakeholders represented on the Noise and Track Keeping Working Group (NTKWG), that flight tracks and (where possible) noise levels affecting local communities would be examined through a series of 3-4 month studies. The studies are organised so that the noise and flight tracks are analysed over the monitoring period based on a 'grid' of local communities, defined and agreed with NTKWG and shown below in Figure 1. The impact on the community within the grid square is then reported at the end of the monitoring period.

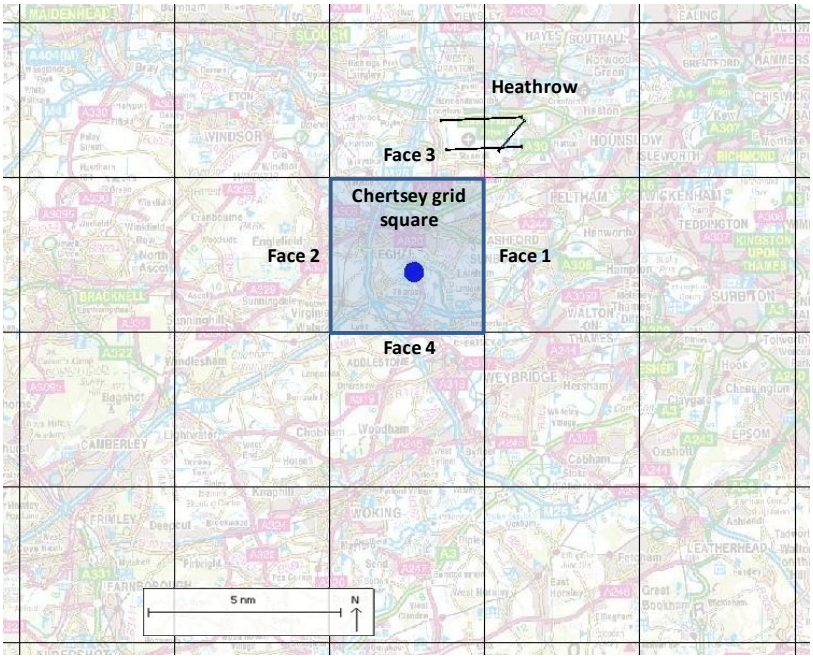


Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot in the centre of the blue shaded grid (the Chertsey community grid square area)

This report describes the noise levels and aircraft tracks affecting the Chertsey grid square, shown above. Noise levels were recorded by a temporary noise monitor situated at Chertsey Lane, its position is indicated by the blue dot. The noise monitor was positioned under the westerly Dover (DVR) and easterly Compton (CPT) Noise Preferential Routes (NPRs) . The grid is also overflown by some departures that follow the westerly Midhurst (MID) NPR. Some arrivals overfly the grid during easterly operations, mainly those that have left the Ockham or Biggin holding stack to the south of the airport start their approach to land at Heathrow. Relatively few arrivals overfly the grid during periods of westerly operations. Flight movements of air traffic through the grid square were derived from the Airport's noise and track-keeping system. Explanations of technical terms and names used in this report can be found on page 9.

Flight movements

Operational background: Heathrow airport operates in either a 'westerly' or 'easterly' direction as shown in Figure 2 on page 2. Westerly operations are typically operated when the wind comes from the west and, as a long term annual average over 20 years, are in force for 71% of the time. Easterly operations, typically in force when the wind is in an easterly direction, are used for the remaining approximate 29%. Shorter term fluctuations between westerly and easterly operations can vary considerably from this approximate long-term 70:30 split. During the daytime a westerly preference is operated. This means that during periods of light easterly winds the airport operates on westerly operations. This preference does not operate at night. During westerly operations landing runway alternation is applied. This provides for one runway to be used for arrivals from 06:00 until 15:00 and the other runway to be used for arrivals from 15:00 until after the last departure of the day, after which landing aircraft use the first runway again until 06:00. Although between 0600-0700 both runways maybe, and typically are, used for landings. The runway alternation pattern alternates by week; in alternation pattern 1 (week commencing 2 January in 2012) the arrivals runway is designated 27R between 06:00-15:00 (Figure 2; 'Westerly operations— 1') and 27L between 1500 and the last departure of the day (Figure 2; 'Westerly operations— 2'). In alternation pattern 2 this order is reversed.

Although the Cranford Agreement, which prohibited departures from 09L other than in limited circumstances has ended, there is no runway alternation during the day on easterly operations as the necessary taxiway infrastructure is not in place. On easterly operations, therefore, the majority of departures use the southern runway, 09R, and arrivals tend to use the northern runway, 09L.

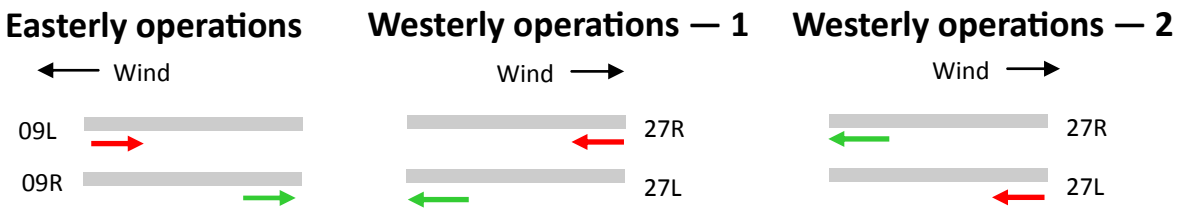


Figure 2. Illustration of the direction of easterly and westerly operations **Key: Departures** → **Arrivals** →

Operations during the monitoring period: During the monitoring period Heathrow operated normally (i.e. there were no periods where the airport was closed or operated significantly reduced numbers of movements for reasons such as adverse weather or industrial action). Westerly operations prevailed for 83% of the time - higher than the long term average. Over the period, there were 55,008 westerly arrivals and 54,970 westerly departures. Easterly operations were in place for the remaining 17% of the time - lower than the long term average with a total of 11,075 easterly arrivals and 11,032 easterly departures, mainly using runway 09R.

Flight path information is derived from radar data using a flight monitor processing programme. A public version of this flight tracking software, 'WebTrak', is available on Heathrow airport's noise website. To track flights affecting the Chertsey grid square during the monitoring period, a series of monitoring 'gates' were set up on the faces of the grid square as shown in Figure 1. The traffic count for aircraft passing through these 'faces' is given in Figure 3 (note that this table is cumulative as both arrivals and departures enter and exit the grid square — counts of daily movements through the grid square are given in Figure 6).

	Easterly				Westerly			
	Face 1 (E)	Face 2 (W)	Face 3 (N)	Face 4 (S)	Face 1 (E)	Face 2 (W)	Face 3 (N)	Face 4 (S)
Arrivals	295	267	0	416	0	0	0	0
Departures	976	762	0	297	462	4,429	16,861	13,260

Figure 3. Arrival and departure traffic through the faces of the grid square during the monitoring period (Face 1 – East, Face 2 – West, Face 3 – North, Face 4 – South)

Arrival flight paths: Compared to departures relatively few arrivals flew through the Chertsey grid during the monitoring period. The Chertsey grid is located north-west of the Ockham holding stack which is used for both easterly and westerly operations. On easterly operations the flight paths of the vast majority of arriving aircraft that have left the Ockham stack to land at Heathrow are to the south of the Chertsey grid (i.e. they do not overfly the grid). However, some arrivals do overfly the grid, most leaving the Ockham stack and making their way to Heathrow's easterly runways (09L and 09R). The lowest level of the stack is 7,000 feet and many aircraft have left the stack well in excess of this and so penetrate the grid at altitudes above 7,000 feet. On westerly operations arrivals leave the Ockham stack and fly east (i.e. they do not overfly the Chertsey grid), some do overfly the grid but these are relatively few in number and typically at heights of at least 8,500 feet.

Departure flight paths: Aircraft departing Heathrow fly pre-defined routes, usually based upon the destination of the aircraft. On westerly operations the Chertsey grid square is overflown by departing aircraft following the westerly Dover NPR, while the top left hand corner of the grid is also overflown by some departures following the Midhurst NPR. The distribution of departing aircraft flight paths through the grid for westerly operations, as well as their vertical distribution through the northern face (Face 3), for the majority of August 2011 are illustrated in Figure 4 overleaf. Aircraft following the Dover NPR entered at the north-west quadrant of the grid square and exited at the south-east quadrant. Departing flights entering the grid (Face 3) during the monitoring period were above 1,000 feet, with over 80% being between 2,000 feet and 3,999 feet . This reflects aircraft climbing after taking off from Heathrow while at the same time staying below the lower levels of the Ockham stack.

On easterly operations the grid is overflown by departing aircraft following the easterly Compton NPR. Departing aircraft flight paths through the grid for easterly operations, and their vertical distributions through the northern face (Face 1), for the majority of August 2011 are illustrated in Figure 5 overleaf. Departing aircraft generally entered the south-east quadrant the grid and exited at the south-west quadrant. Departing flights entering the grid (Face 1) during the monitoring period were above 1,000 feet with over 80% being between 3,000 feet and 4,999 feet. Compared to westerly operations, a larger proportion of easterly departures were higher on entering the grid as they had flown more track miles from Heathrow.

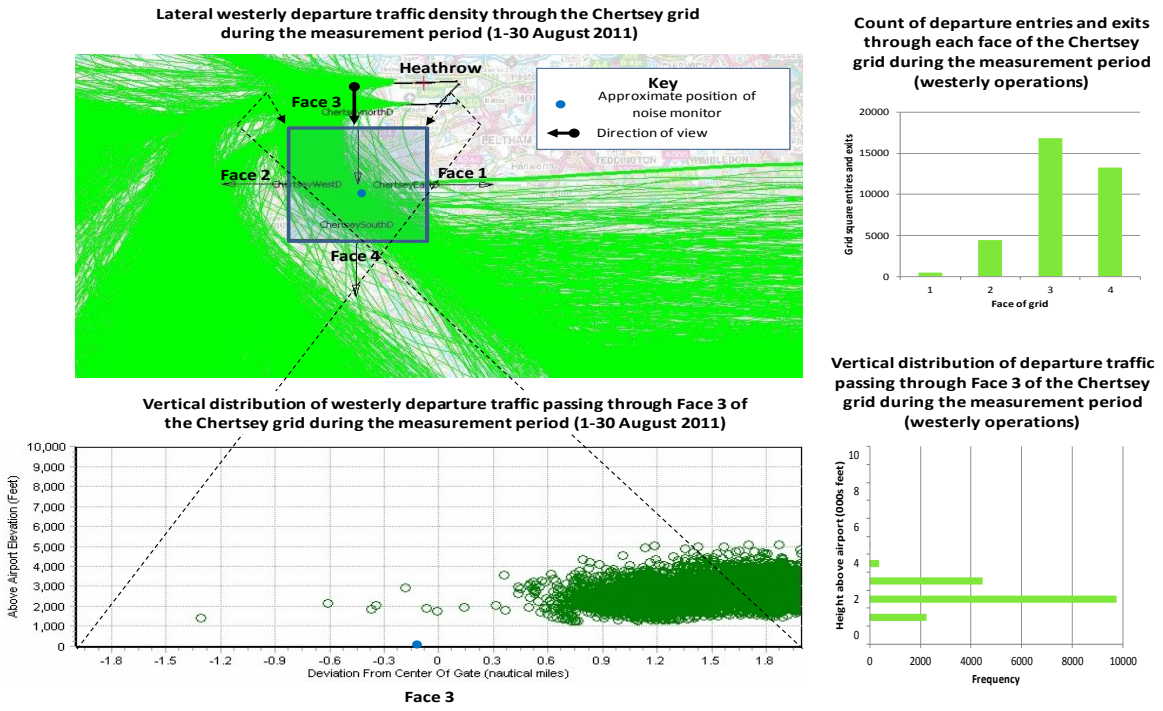


Figure 4. The lateral and vertical distribution of departing air traffic passing through the Chertsey grid square during the monitoring period (westerly operations)

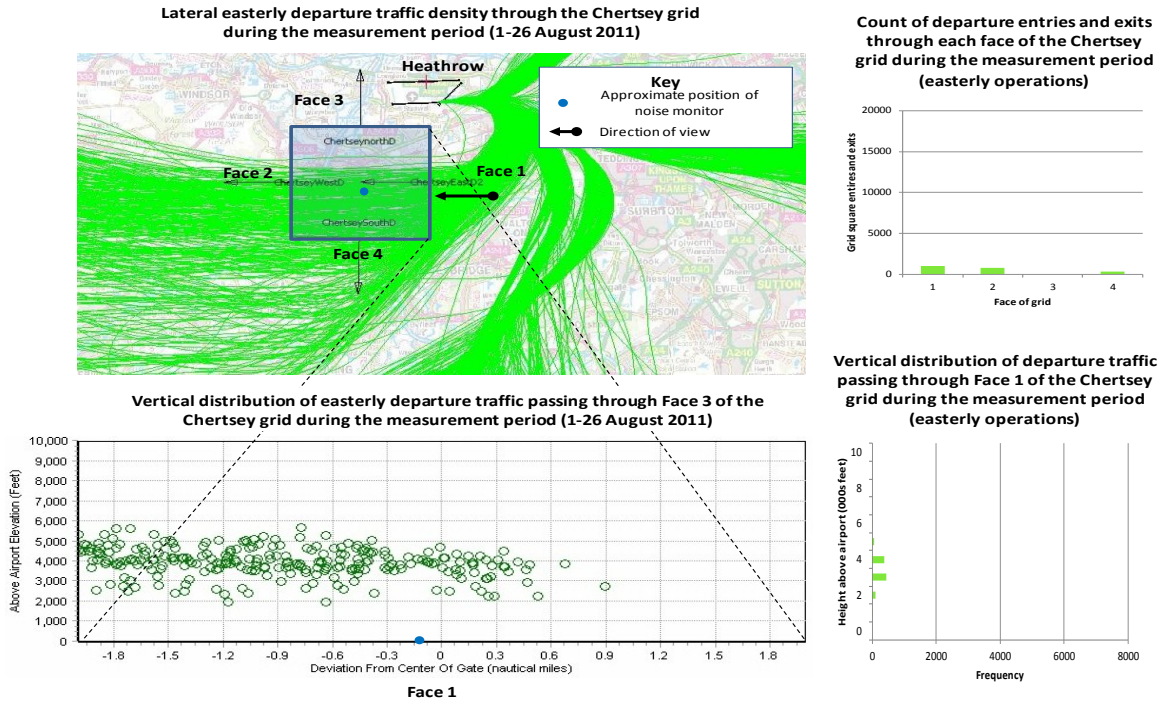
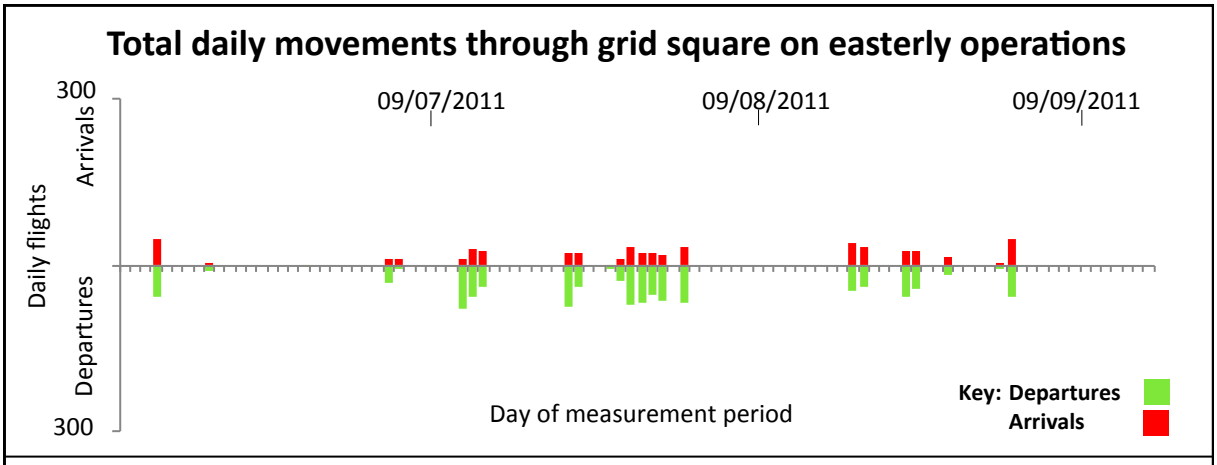
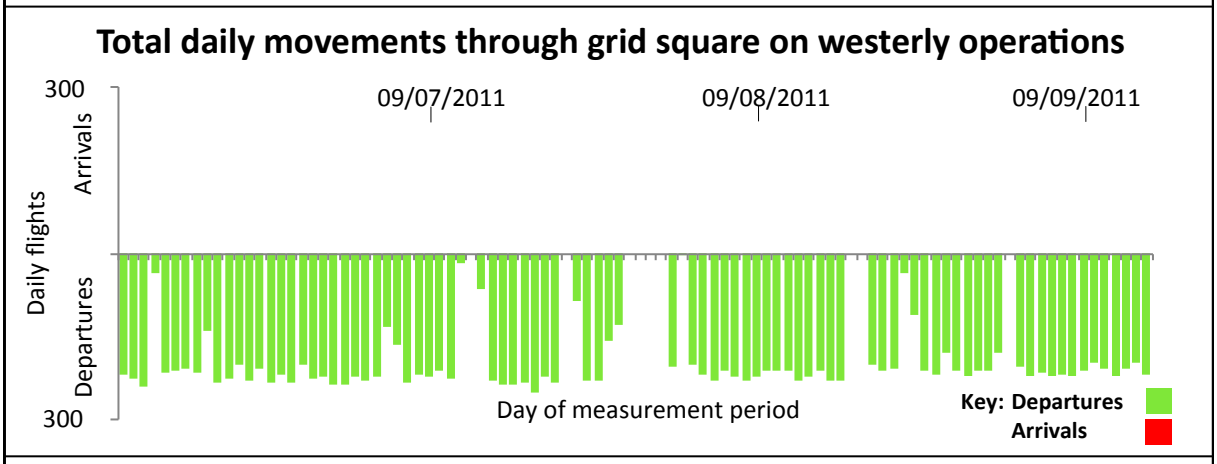
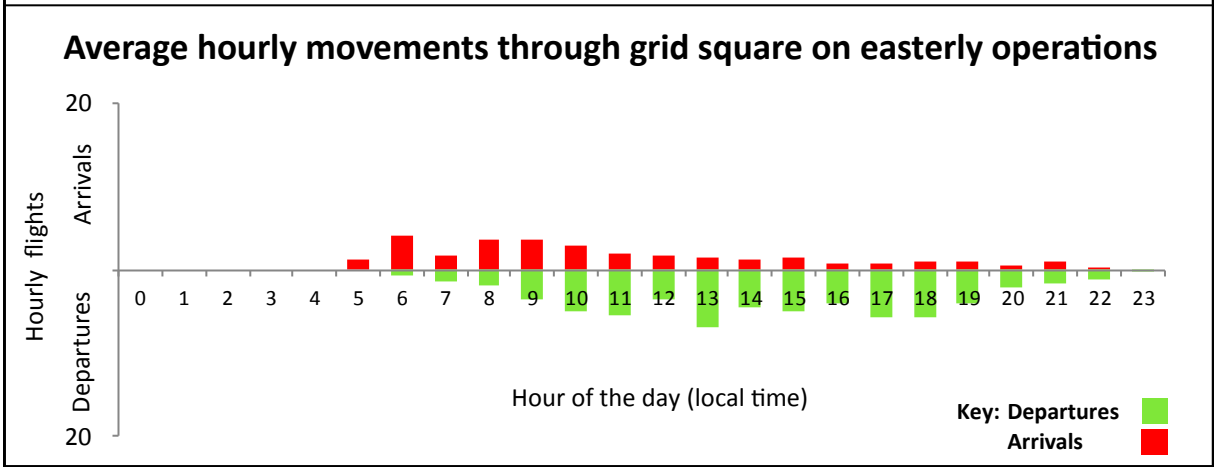


Figure 5. The lateral and vertical distribution of departing air traffic passing through the Chertsey grid square during the monitoring period (easterly operations)

Figure 6 overleaf shows the proportion of traffic that passes through the grid square by direction of runway operation and hour. During the monitoring period over 90% of aircraft overflying the grid had taken-off from Heathrow's westerly runways (westerly departures). For these departures it is noticeable that average hourly movements through the grid before 15:00 local were higher for alternation pattern 1 (when 27L was the designated departure runway from 06:00 to 1500 local) than alternation pattern 2 (when 27R was the dominant departure runway from 06:00 to 1500 local), and the opposite was true after 15:00 local. This is because (some) aircraft following the westerly Midhurst NPR only pass through the top left-hand corner of the Chertsey grid if they depart from runway 27L. Fewer departures pass through the grid on days of easterly operations due to the comparatively lower traffic load on the easterly Compton NPR.







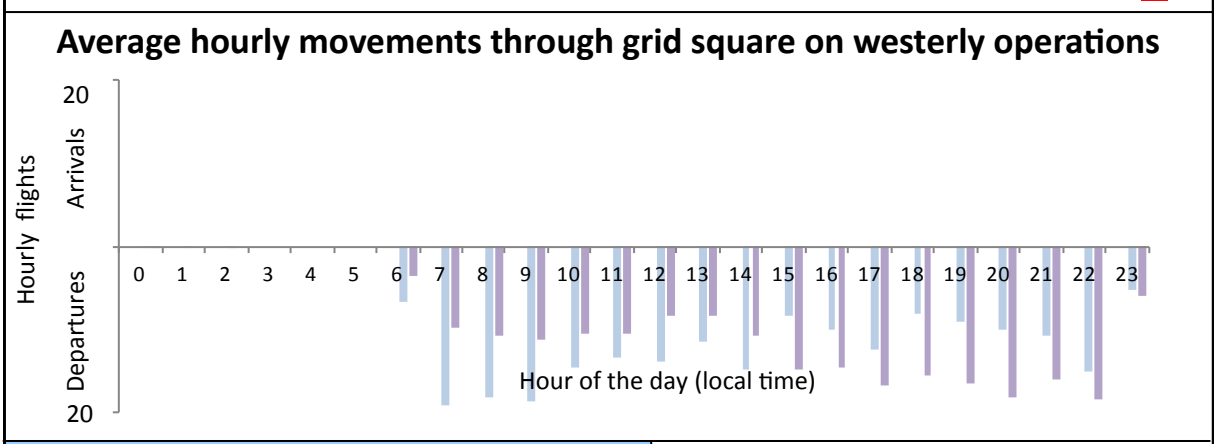


Figure 6. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square

Key: Alternation pattern 1: Arrivals Departures
Alternation pattern 2: Arrivals Departures

Noise — background noise

The ambient noise recorded by the monitor is generated by both aircraft and other background noise sources, including local road traffic, distant motorways and railway lines. In rural areas, the ambient level can be affected by noise sources such as farm machinery and bird song. In windy conditions, the noise generated by trees, crops and long grass can also affect the measured noise level.

Figure 7 demonstrates the average background noise level (L_{90}, dBA) recorded by the Chertsey Lane monitor over a 24 hour period (black line). Figure 7 also shows the background noise level when separated by mode of operation, easterly or westerly; shown in two shades of orange. As can be seen, daytime background noise levels are comparable for each mode of operation, although slightly higher background noise levels at night were recorded during periods of westerly operation (a westerly wind would mean that the site was downwind of the M25 motorway).

The overall trend in Figure 7 is largely in line with expected results; during the night-time period of 00:00-04:00 hours the average background noise level was 40 dBA or less, rising to over 45 dBA after 06:00 hours for the rest of the day until 22:00-23:00 hours. This broadly coincides with the main period of Heathrow operations and the daytime increase in overall road traffic levels. The graph also illustrates the large variation in hourly background noise level at the monitoring site; up to 10 dBA or more between the quietest and noisiest days. The overall noisiest day was Sunday 12 June; a day with a moderate southerly wind, placing the site downwind of the M3 motorway. The quietest day was Tuesday 26 July; a day with a light northerly wind, placing the site upwind of the M3.

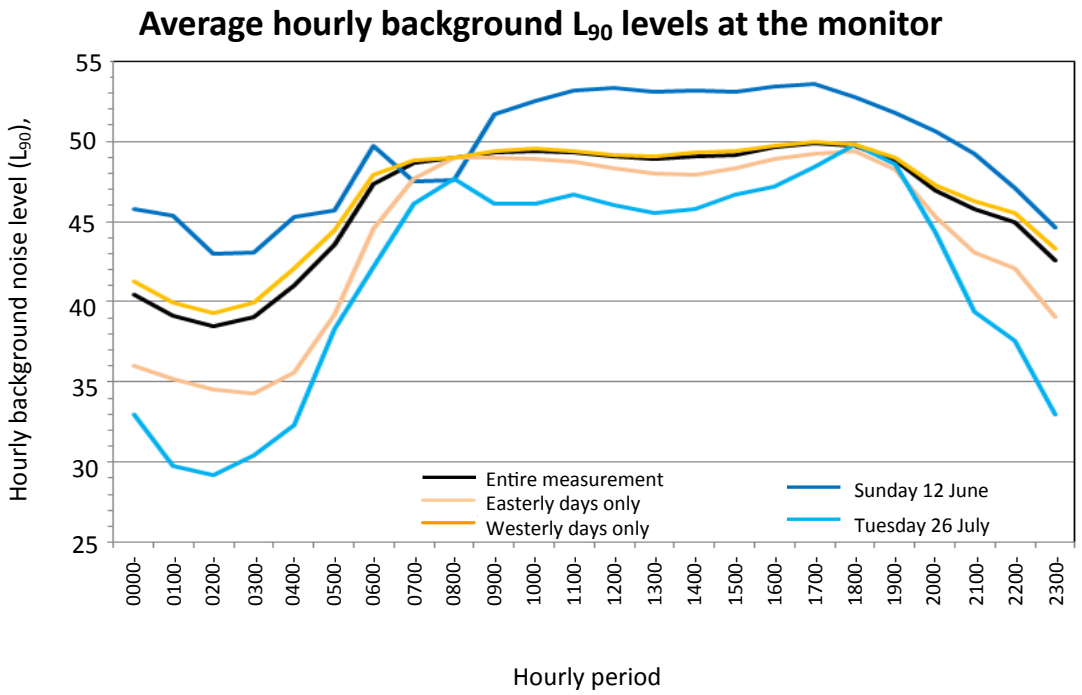


Figure 7. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Sunday 12 June (noisiest day) and Tuesday 26 July (quietest day)

Noise — significant aircraft noise events

The noise and track keeping monitors are set up to record noise events above a pre-determined threshold level (i.e. aircraft generated noise above background - fully defined at the end of this report). This means that not every aircraft passing through the Chertsey Lane grid square generates a noise event. During the monitoring period a total of 12,087 aircraft noise events were recorded.

As the noise monitor was positioned under the westerly Dover and easterly Compton NPRs, departures account for nearly all of the noise events recorded at the site (99.9%). Although not analysed separately for this study, it should also be noted that the average measured noise levels for westerly departures were slightly higher than for easterly departures. This was due to the monitor being located at a shorter track distance from the start-of-roll position on the westerly runways 27L/R compared with the easterly runways 09L/R.

Figure 8 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 13% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines). Accounting for rejected events, 10,005 departure noise events were generated by westerly departures and 455 noise events by easterly departures (10,460 in total). As explained above, only a very small number of arrival noise events were recorded at the Chertsey Lane site (11 in total).

Figure 9 indicates that medium-sized aircraft (e.g. the A320 family) dominate the overall number of aircraft noise events due to the relatively high numbers of these types operating at Heathrow. Figure 10 shows the average (mean) departure and arrival L_{Max} values recorded at the Chertsey Lane monitor for each aircraft type. Note that no arrival measurements were recorded for the A300, A310, A380, B737, B767, CRJ, MD80 and 'other' aircraft. In addition, six of the eight remaining aircraft types only registered one arrival noise event at the monitor. The sample sizes for arrivals are therefore too small for any meaningful analysis to be made. For departures (and excluding the result for the MD80, for which there was only one recorded noise event), the noisiest aircraft on average was the B747, followed by the A380, A340 and A330.

The overall distribution of noise for arrivals and departures is shown in Figure 11. Figure 12 indicates the trend in the noise distribution (L_{Max}) for arrivals and departures by time period (day, evening and night). Although shown for completeness, it should again be noted that the data samples for arrivals are too small for any meaningful analysis to be made. The graphs for departures however indicate that the overall spread of the measured noise levels is consistent during each period of the day but that there are much lower numbers of noise events during evening and night due to the lower traffic levels. In this instance the monitor threshold was set at 60 dBA, which appeared to be low enough to capture almost the entire distribution of L_{Max} levels during each time period. The use of this threshold is explained further on page 9.

Departures (99.9% of total noise events)					Arrivals (0.1% of total noise events)				
09L	09R	27L	27R	Total	09L	09R	27L	27R	Total
1 (0.0%)	454 (4.3%)	5,205 (49.7%)	4,800 (45.8%)	10,460 (99.9%)	4 (0.0%)	0 (0.0%)	6 (0.1%)	1 (0.0%)	11 (0.1%)

Figure 8. Aircraft noise events by operation and runway following filtering for bad weather

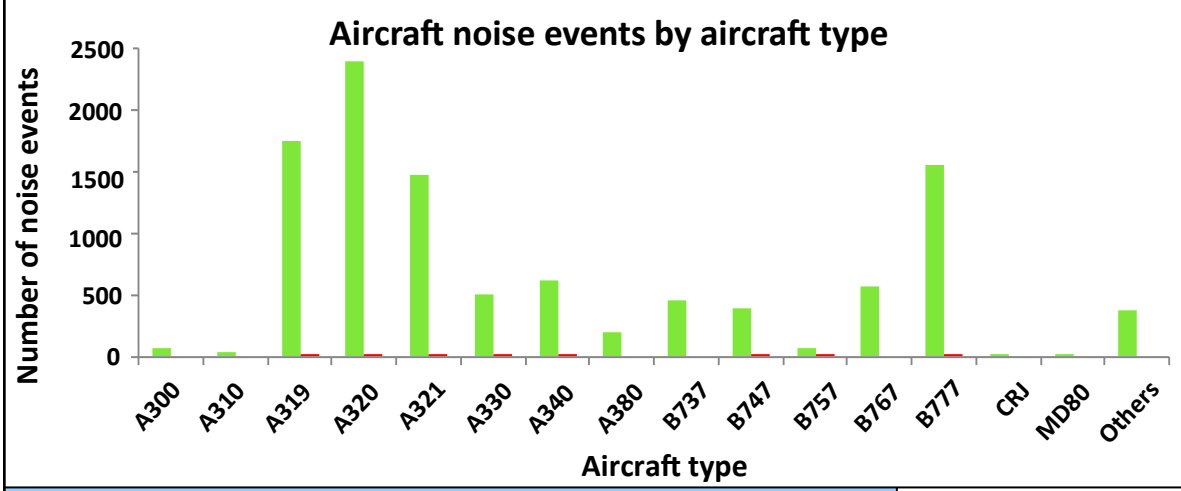


Figure 9. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures, Arrivals

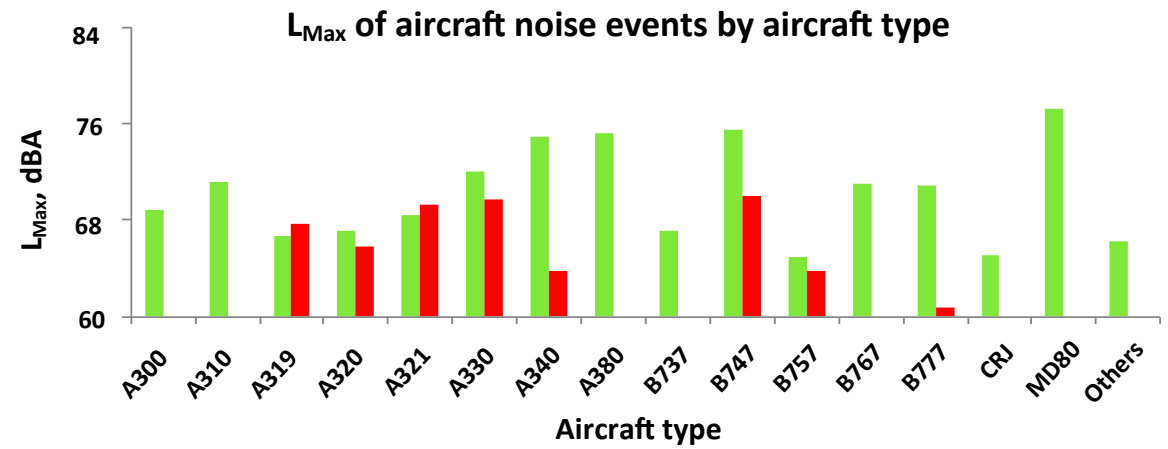


Figure 10. Mean average L_{Max} by aircraft type for departures and arrivals

Key: Departures, Arrivals

Noise distribution for departures and arrivals

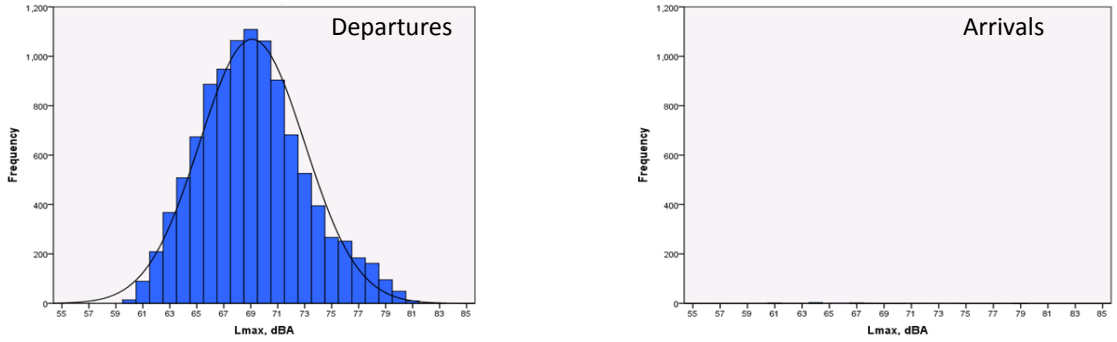


Figure 11. Above left: L_{Max} frequency distribution of departure noise levels; Above right: L_{Max} frequency distribution of arrival noise levels (frequency scale 0-1200)

Noise distribution for departures and arrivals by periods of the day

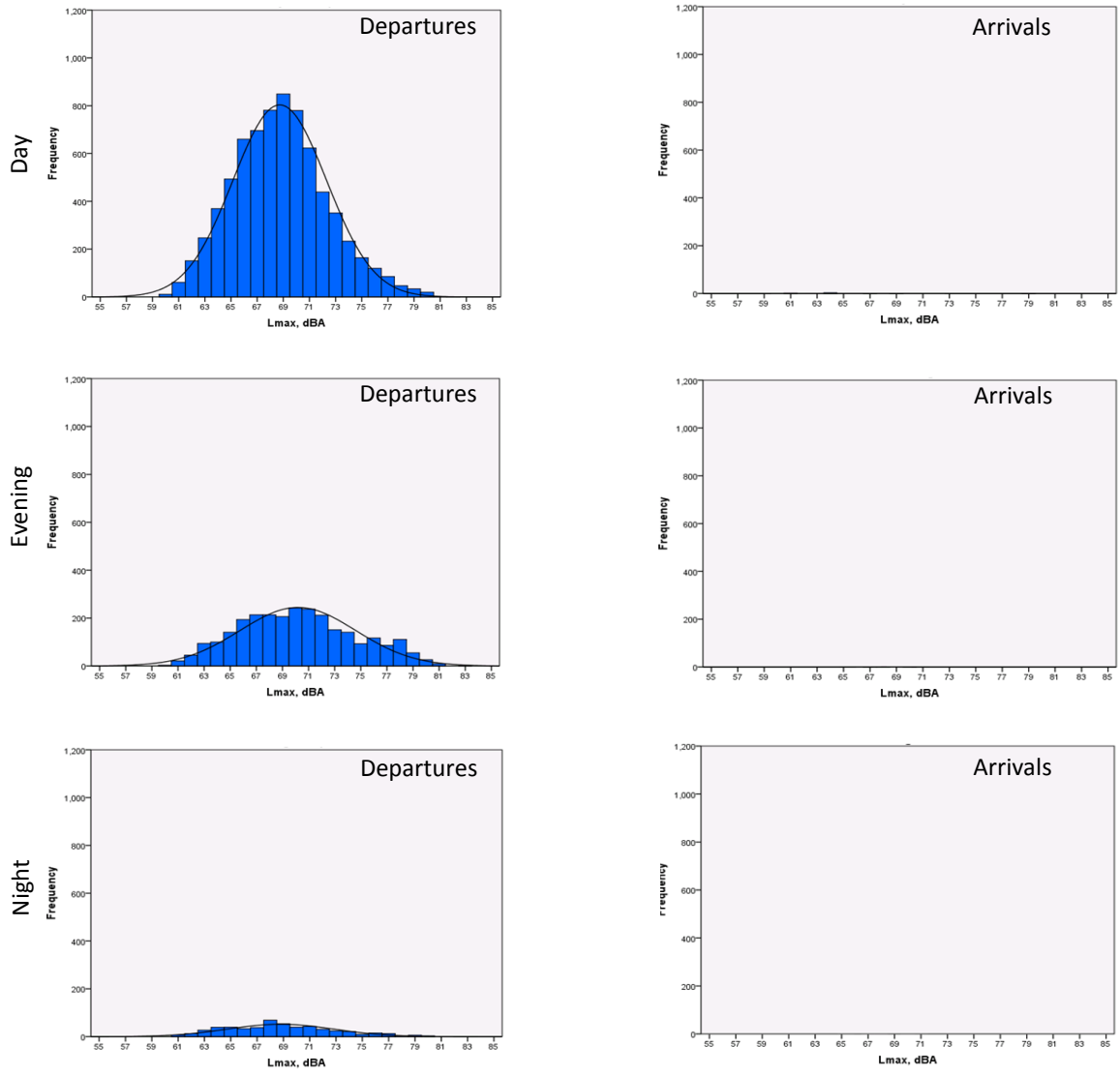


Figure 12. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max}(Day — 12 hour period 07:00-19:00), L_{Max}(Evening — 4 hour period 19:00-23:00) and L_{Max}(Night — 8 hour period 23:00-07:00)

Conclusions

This report describes the over-flight and noise impact measured for the Chertsey grid square over a 98 day period from 9 June to 14 September 2011. During the monitoring period the Chertsey grid square was overflown by 19,432 Heathrow arrivals and departures. Compared to the long-term average for Heathrow Airport, the measurement period experienced a higher proportion of westerly operations overall.

During the monitoring period over 90% of aircraft overflying the Chertsey grid had taken-off from Heathrow's westerly runways (westerly departures). These departures were following the westerly Dover NPR, additionally, when runway 27L was the designated departure runway, the top left hand corner of the grid was also overflown by some departures following the Midhurst NPR. Departing aircraft entered at the north-west quadrant of the grid square above 1,000 feet, with over 80% being between 2,000 feet and 3,999 feet, and exited at the south-east quadrant. This reflects aircraft climbing after taking off from Heathrow while at the same time staying below the lower levels of the Ockham stack. Although some westerly arrivals do overfly the grid, these are relatively few in number and typically at heights of at least 8,500 feet.

On days of easterly operations the Chertsey grid was primarily overflown by departing aircraft following the easterly Compton NPR. They generally entered the south-east quadrant the grid above 1,000 feet, with over 80% being between 3,000 feet and 4,999 feet, and exited the south-west quadrant (i.e. departures generally flew east to west through the lower half of the grid). Compared to westerly operations, a larger proportion of easterly departures were higher on entering the grid as they will have flown more track miles from Heathrow. The grid was also overflown by some arrivals on days of easterly operations. These will have mainly left the Ockham stack, located to the south-east of the Chertsey grid, and penetrate the grid above 7,000 feet. However, the majority of arrivals that have left the Ockham stack do not enter the Chertsey grid.

Average daytime background noise levels are comparable for days of easterly and westerly operations, although slightly higher background noise levels at night were recorded during periods of westerly operation (a westerly wind would mean that the site was downwind of the M25 motorway). Nearly all of the noise events recorded at the monitor (99.9%) were for departing aircraft as opposed to arrivals as opposed to arriving aircraft (rather than background noise). This is unsurprising as the noise monitor was positioned under the westerly Dover and easterly Compton NPRs and the majority of aircraft flying through the grid were departures, typically below 5,000 feet while arrivals were typically above 7,000 feet.

The majority of significant aircraft noise events at the Chertsey sit are generated by medium-sized aircraft (e.g. the A320 family); this reflects the traffic mix at Heathrow. Overall there were very few noise events for arrivals, with only two aircraft types registering more than one noise event during the monitoring period, making sample sizes too small for any meaningful analysis to be made. For departing aircraft the noisiest aircraft on average were wide-boded aircraft such as the B747, followed by the A340, A380 and A330 (this excludes the result for the MD80, for which there was only one recorded noise event).

The noise distributions measured at the monitoring site for departures indicate that the overall spread of the measured noise levels is consistent during each period of the day but that there are much lower numbers of noise events during evening and night due to the lower traffic levels.

The results of the Chertsey monitoring period represent a snapshot of the track and noise impact. As part of this program we expect to return to the grid square in the future to conduct a further 3-4 month community noise study.

Additional information

References

- Heathrow Airport, Draft Noise Action Plan 2010-2015, (June 2010) www.heathrowairport.com/noise/
- Department for Transport — Heathrow Noise Contours http://www.dft.gov.uk/pgr/aviation/
- Operational Freedoms at Heathrow www.heathrow.com/noise/
- South East Airports Task Force http://www.dft.gov.uk/publications/

Stacks and NPRs

- Further information on arrival stacks, routes and Noise Preferential Routes can be found on the noise factsheets page of the Heathrow airport website (www.heathrow.com/noise/).

Explanation of terms used:

- Noise can be defined as unwanted sound. Sound in air can be considered as the propagation of energy through the air in the form of oscillatory changes in pressure. The size of the pressure changes in acoustic waves is quantified on a logarithmic decibel (dB) scale, firstly because the range of audible sound pressures is very great and secondly because the loudness function of the human auditory system is approximately logarithmic. The dynamic range of the auditory system is generally taken to be 0 dB to 140 dB. The additional noise from two sources producing the same sound pressure level, will lead to an increase of 3 dB. A 3 dB noise change is generally considered to be just noticeable, a 5 dB change is generally considered to be clearly discernible and a 10 dB change is generally accepted as leading to the subjective impression of a doubling or halving of loudness. 'A-weighting' accounts for the acoustic sensitivity of the human ear to a range of sound levels. Its application to dB produces the 'dBA' scale.
- The L_{Max} value is the maximum value that the A-weighted sound pressure level reaches during a given measurement period of time.
- L_{90} is the noise level exceeded for 90% of the measurement period and is used to quantify the background level of noise.

Noise monitoring details:

- To ensure that as far as possible only genuine aircraft 'noise events' are measured (i.e. noise peaks caused by aircraft movement), the noise monitors are set up to record noise events above a pre-determined threshold level. The Chertsey monitor was set with a threshold of 60 dBA, meaning that noise events below 60 dBA L_{Max} were not recorded by the monitor. The choice of threshold level is often a compromise between (i) losing a proportion of quieter aircraft events and (ii) recording a large number of spurious non-aircraft events. At locations such as Chertsey, where the background noise level is frequently varying (for example, due to the M25 and M3 motorwaysor local road traffic), it becomes difficult to select an appropriate threshold level that is low enough to capture a suitable number of lower-level aircraft noise events, but high enough to ensure that extraneous noise is not recorded.
- Approximately 13 percent of all measurements were rejected due to unacceptable weather conditions, i.e. wind speeds greater than 10 m/s or during periods of precipitation (in accordance with recommended international guidance on aircraft noise monitoring).

Influence of wind on the measured noise level:

- Over long distances, the wind can have a varying influence on the measured noise level. Downwind of a noise source the noise level can, in general, increase by a few decibels depending on wind speed. Likewise, when measuring upwind of a noise source the noise level can decrease by several decibels, again depending on wind speed and distance.

Report prepared by Helios, CAA & BAA. For further information please visit the Heathrow noise website www.heathrowairport.com/noise; alternatively please contact the Heathrow noise action line (on 0800 344 844) or BAA's Flight Evaluation Unit directly (Second Floor Meridian, The Compass Centre, Nelson Road, Heathrow Airport, Hounslow, TW6 2GW, UK)