Heathrow Community Noise and Track-keeping Report: Brockley

Heathrow Community Noise and Track-keeping reports

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. The Airport has agreed with local stakeholders that flight tracks and (where possible) noise levels affecting local communities would be examined through a series of 3-4 month studies.

Brockley Noise and Track-keeping report

This document describes the aircraft tracks and noise levels of departing and arriving aircraft in the Brockley area for a 92-day period from the 8 February 2015 to the 10 May 2015 .

Noise levels were collected using a temporary noise monitor placed directly under the approach path for runway 27L at Tyrwhitt Road, Brockley (51°27'54.8"N 0°01'25.5"W, 95ft elevation). Aircraft tracks were extracted from Heathrow's noise and track-keeping system (ANOMs) and their concentration/height investigated by drawing a 4 nautical mile (nm) 'gate' centred on the noise monitor, perpendicular to Heathrow's final approach paths. The approximate positions of the noise monitor and 'gate' are shown in Figure 1.

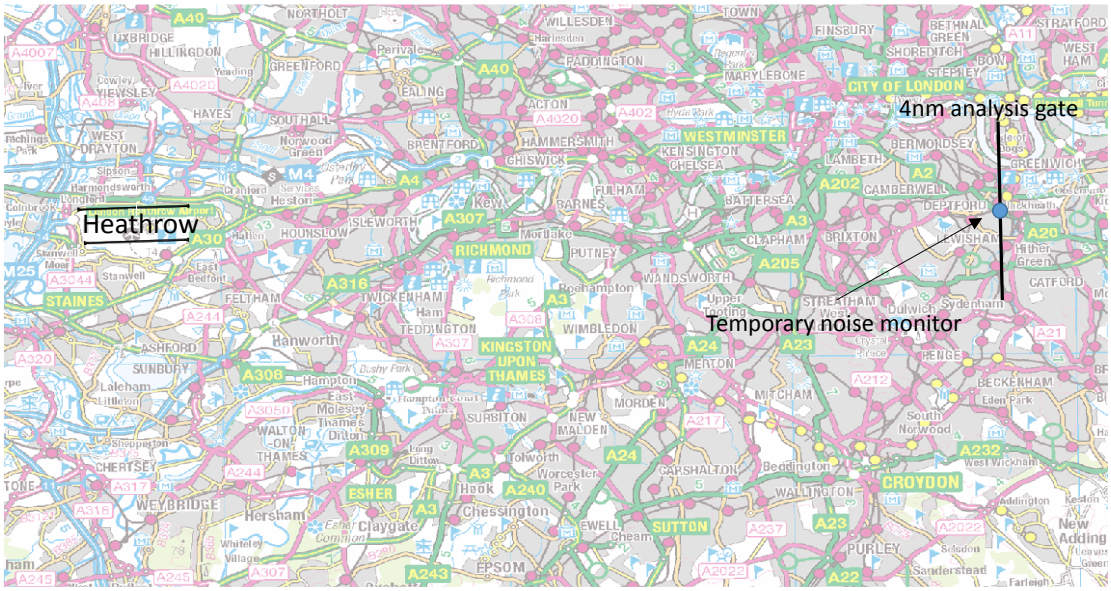

Figure 1: Location of the temporary noise monitor (blue dot) and 'gate'

Heathrow operations during the monitoring period

During the monitoring period, 119,395 air traffic movements were handled by Heathrow without any major disruption to normal operations. In addition, no trials took place that would have altered the flight paths of arriving or departing aircraft.

Heathrow airport operates in either a 'westerly' or 'easterly' direction depending on prevailing weather conditions (for more information see page 14). During the monitoring period, westerly operations prevailed for 64% of the time - below the 20-year average of 71% - with easterly operations being in place the remaining 36% of the time.

Summary:

- There were no major disruptions or trials that would have altered the flight paths of arriving or departing aircraft during the monitoring period.
- Westerly operations were in place 64% of the time, with easterly operations being in place the remaining 36% of the time.

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Sample aircraft tracks during the monitoring period

The images on pages 3 and 4 show the tracks of aircraft during a single day of operations for each of Heathrow's four modes of operation.

Easterly arrivals: Figure 2 shows a sample day of easterly arrival operations. During easterly operations arriving aircraft make their final approach over Berkshire. Prior to doing so, most aircraft will use one of Heathrow's four holding stacks. Although one of these stacks, Biggin, is located to the south of the temporary noise monitor, during the 92-day monitoring period only two easterly arrivals flew through the 'gate'.

Easterly departures: Aircraft departing from Heathrow follow pre-defined routes, referred to as Standard Instrument Departure (SID) routes, usually assigned according to the destination of the aircraft. The tracks of departing aircraft can be seen grouped around these routes in the sample day of easterly departure operations (i.e. when aircraft take-off towards London) in Figure 3. Each departure route also has a 1.5 kilometre Noise Preferential Route (NPR) either side of the route centreline within which aircraft must remain up to an altitude of 4,000 feet. On reaching 4,000 feet, ATC can instruct pilots to leave the departure route (and by definition the NPR too) and fly a more direct heading to their destination (for more information see page 13).
The departure route passing closest to Brockley is the easterly Detling route. Figure 3 shows that the majority of departing aircraft that initially follow this route after taking off from Heathrow pass to the south of the 'gate'. During the monitoring period 374 easterly departures flew through the southern end of the 'gate'.

Westerly arrivals: During westerly operations arriving aircraft make their final approach over London. In the vicinity of the temporary noise monitor aircraft are either flying on or turning on to the final approach paths for runways 27L and 27R prior to landing at Heathrow (see the sample day of aircraft tracks in Figure 4). Consequently the areas close to the temporary noise monitor are heavily overflown during westerly arrival operations. During the monitoring period approximately 55% of westerly arrivals landing at Heathrow passed through the 'gate', although this figure varied on a daily basis – for the day shown in Figure 4, 72% percent of Heathrow arrivals passed through the 'gate'.

Westerly departures: The temporary noise monitor was located some distance from Heathrow's westerly departure routes (Figure 5). During the monitoring period only a single westerly departure passed through the 'gate'. This aircraft was above 4,000 feet and would have been directed to leave its departure route by ATC.

Summary:

- The area in the vicinity of the temporary noise monitor is primarily overflown by arriving aircraft making their final approach to Heathrow over London (referred to as 'westerly arrivals').
- The area to the south of the noise monitor is also overflown by some departing aircraft that have taken off from Heathrow towards London (referred to as 'easterly departures') and initially followed the easterly Detling departure route.

Sample aircraft tracks during the monitoring period

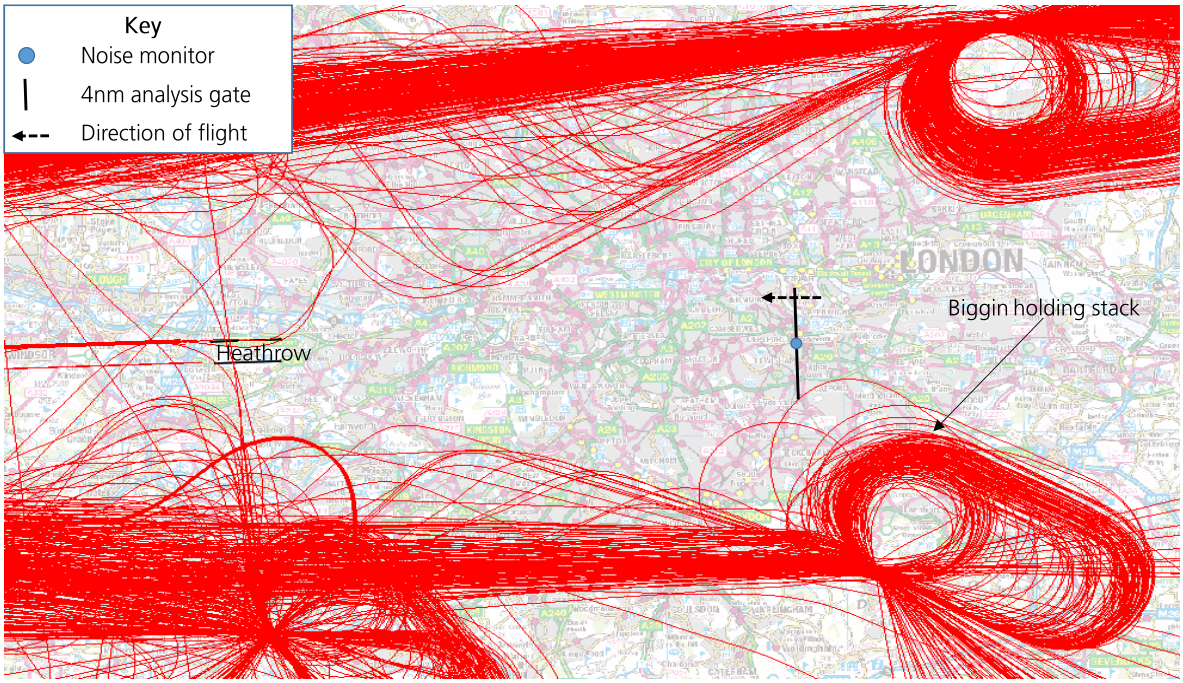

Figure 2: Sample day of arriving aircraft tracks during easterly operations (16 March 2015)

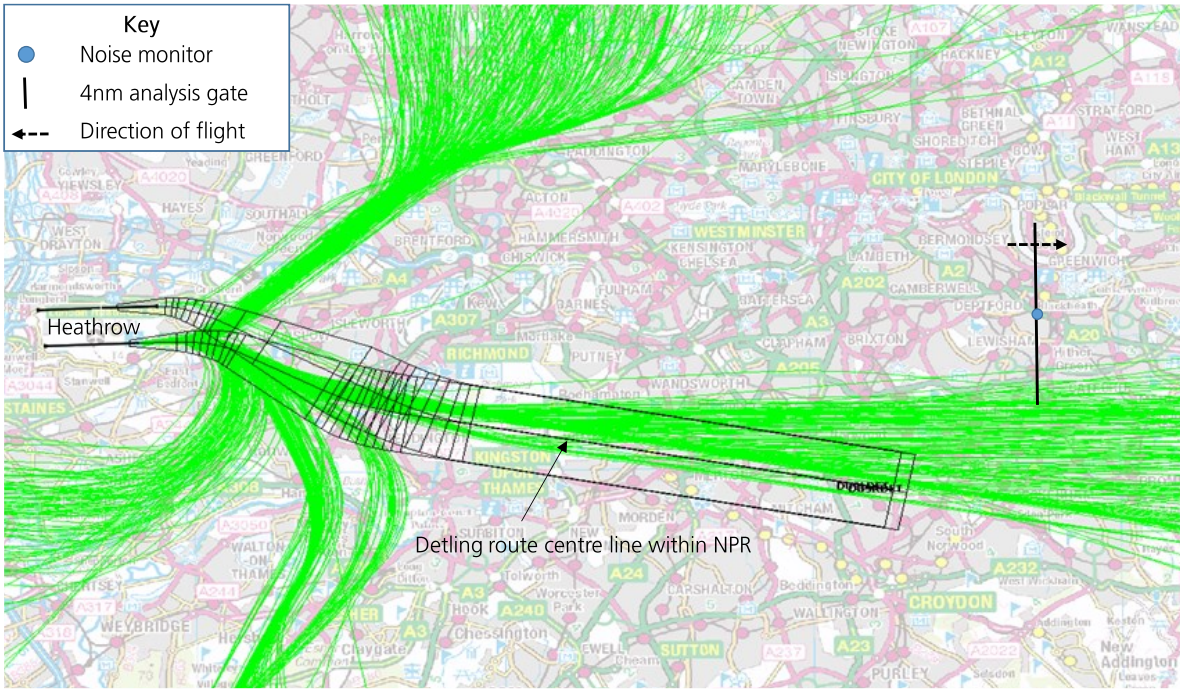

Figure 3: Sample day of departing aircraft tracks during easterly operations (16 March 2015)

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Sample aircraft tracks during the monitoring period

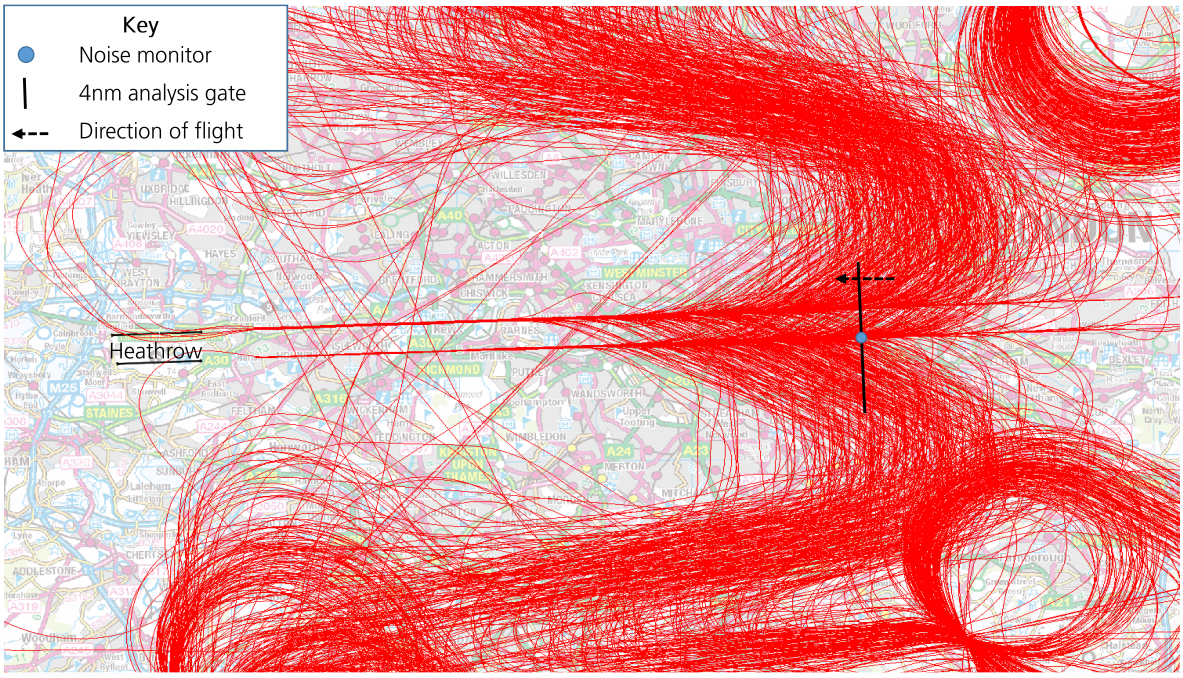

Figure 4: Sample day of arriving aircraft tracks during westerly operations (31 March 2015)

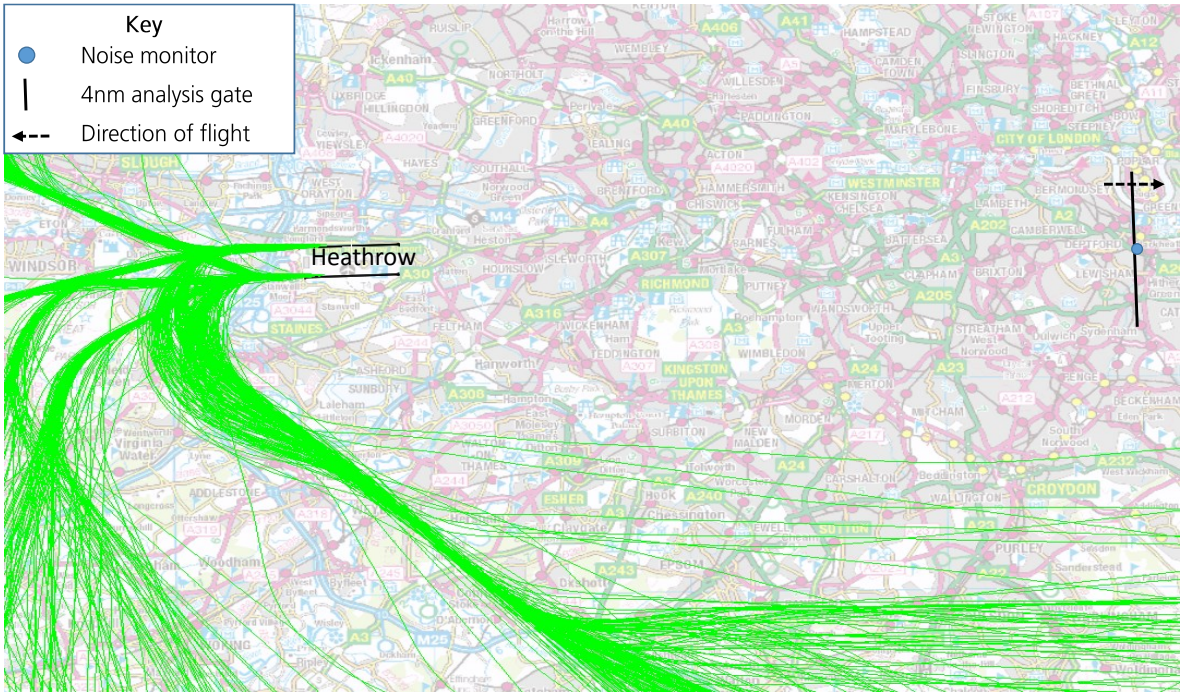

Figure 5: Sample day of departing aircraft tracks during westerly operations (31 March 2015)

Daily flight movements in the vicinity of the noise monitor

Introduction

The previous pages show that the area in the vicinity of the noise monitor is primarily overflown during westerly arrival operations, and to a lesser degree easterly departure operations. The figures below show the daily number of aircraft passing through the 4nm 'gate' for these two modes of operation. Also shown are the total number of daily westerly arrivals and easterly departures at Heathrow.

Westerly operations

The vast majority (98%) of aircraft passing through the 'gate' during the monitoring period were westerly arrivals. Figure 6 shows that although over half of all westerly arrivals to Heathrow passed through the 'gate', the proportion varied on a daily basis. Also noticeable is that throughout the monitoring period there were days with very few or no westerly arrivals passing through the gate. On these days easterly operations took place due to prevailing weather conditions. Excluding these days of easterly operations, the average number of arrivals passing through the gate was 379 per day. Only one westerly departure passed through the gate during the monitoring period.

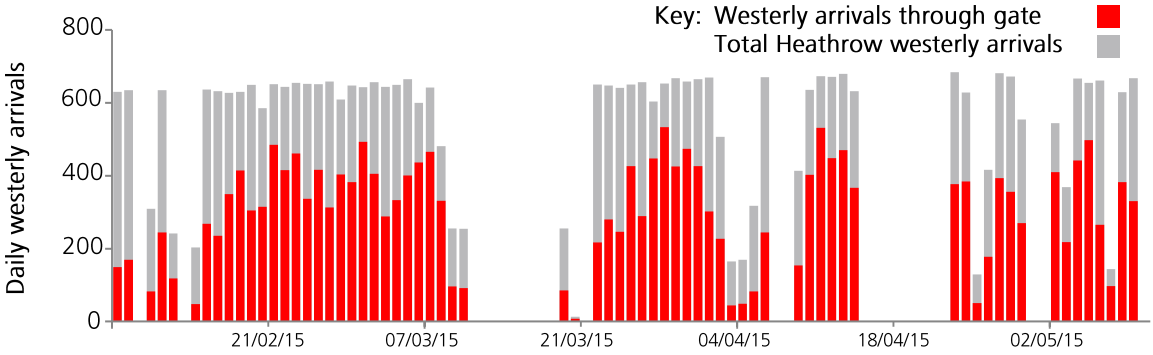

Figure 6: Daily arrivals passing through the 'gate' and total daily Heathrow arrivals (westerly operations only)

Easterly operations

As per the previous section, during the monitoring period 374 easterly departures and 2 easterly arrivals flew through the 'gate' during the monitoring period. This equated to an average of 11 flights per day when full days of easterly operations took place.

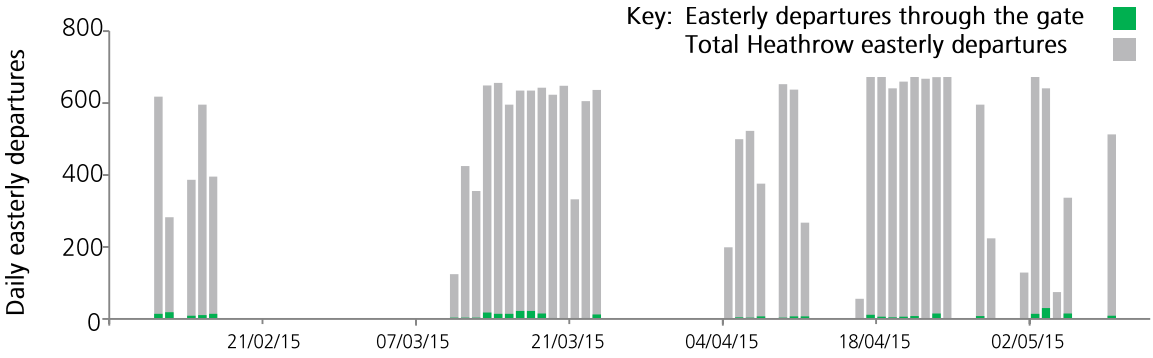

Figure 7: Daily departures passing through the 'gate' and total daily Heathrow departures (easterly operations only)

Summary:

- 98% of overflight in the vicinity of the noise temporary noise monitor were arriving aircraft approaching Heathrow over London.
- During full days of westerly operations an average of 379 arrivals per day passed through the 'gate'. This equates to over half of all westerly arrivals landing at Heathrow.

Heights and lateral concentration of aircraft tracks

Introduction

This section presents the heights and lateral concentrations of aircraft passing through the 'gate' during westerly arrival and easterly departure operations.

Westerly arrival operations

Figure 9a on the next page shows the concentrations of aircraft tracks through the 'gate' for the entire monitoring period — each red dot represents the position and height of an aircraft passing through the gate. During westerly operations arriving aircraft tracks are distributed across the entire width of the 'gate' and, as per earlier pages, this reflects aircraft either flying on or turning on to Heathrow's final approach paths. Two main concentrations are visible, one of which is directly over the noise monitor and the other approximately 0.8nm to the north. These represent aircraft that are already established on the final approach paths for runways 27L and 27R (page 14 explains how the use of these runways is alternated though the day).

The left-hand image of Figure 8 shows the heights of westerly arrivals as they passed through the gate. More than 98% of these were at heights between 3,800 and 6,000 feet. 0.9% of aircraft were below 3,800 feet, with a total of 18 aircraft being between 2,890 and 3,000 feet.

Easterly departure operations

Figure 9c on the next page shows departing aircraft during easterly operations passing through the southern end of the 'gate'. As per earlier, this reflects the main flow of aircraft that had initially followed the easterly Detling departure route being located to the south of the 'gate'.

The right-hand image of Figure 8 shows the heights of easterly departures as they passed through the gate. All departing aircraft were above 5,400 feet.

Summary:

- Westerly arrivals overfly the entire area in the vicinity of the noise monitor, typically above 3,800 feet, as they are either flying or turning onto Heathrow's final approach paths. These flights are most concentrated on the final approach paths for runways 27L and 27R.
- Easterly departures fly to the south of the noise monitor. Those passing through the gate during the monitoring period were all above 5,400 feet.

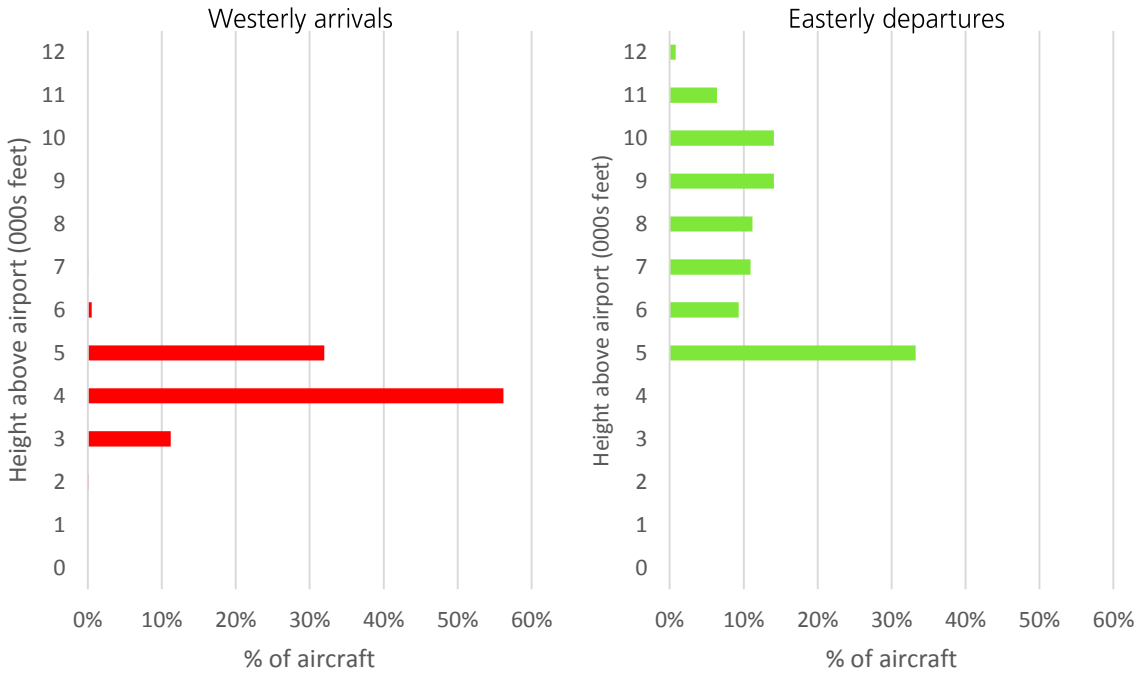

Figure 8: Heights of aircraft as they passed through the 'gate' - westerly arrivals (left) and easterly departures (right)

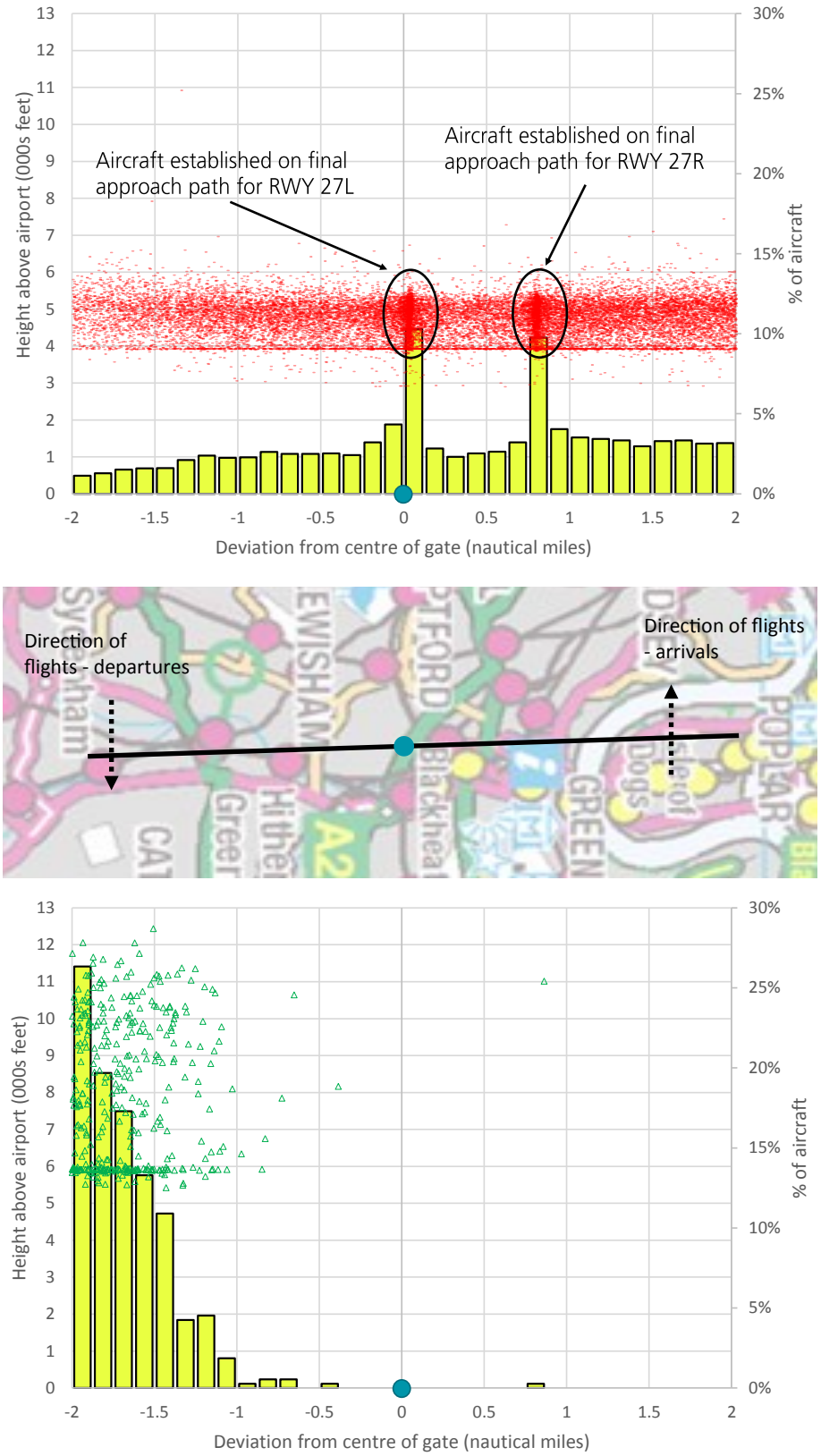

Figure 9: Heights and lateral concentrations of aircraft relative to the temporary noise monitor
9a (top): Westerly arrivals
9b (middle): Location of the analysis gate
9c (bottom): Easterly departures

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 10 demonstrates the average background noise level (L90, dBA) recorded by the Brockley monitor over a 24 hour period (black line). Figure 10 also shows the background noise level when separated by mode of operation, easterly or westerly; shown in two shades of orange (i.e. when the prevailing wind direction during those periods would generally contain an easterly or westerly component respectively). As can be seen, noise levels are generally comparable for each mode of operation although slightly higher background noise levels were recorded over the 24 hour period during periods of easterly operation. An easterly wind would mean the site was downwind of Lewisham town centre and the A20 main road.

The overall trend in Figure 10 is largely in line with expected results; during the night-time period of 23:00-05:00 hours the average background noise level was less than 40 dBA, rising to approximately 45 dBA for the rest of the day until 19:00 hours. This broadly coincides with the daytime increase in overall road traffic levels. The graph also illustrates the large variation in hourly background noise level at the monitoring site; typically up to 5 dBA or more during daytime hours between the quietest and the noisiest days, and 15 dBA or more at night.

The overall noisiest day was Tuesday 31 March 2015; a day with a strong westerly to north-westerly wind, placing the site downwind of Brockley railway station and the Brighton Main Line. The quietest day was Friday 6 March 2015; a day with a light to moderate southerly to south-westerly wind, placing the site upwind of the nearby A20 main road. Although hourly background noise levels during the night were significantly lower than average, it should be noted that even on this 'quiet' day the background level remained relatively high during daytime hours (e.g. up to 45 dBA between 08:00 and 18:00 hours).

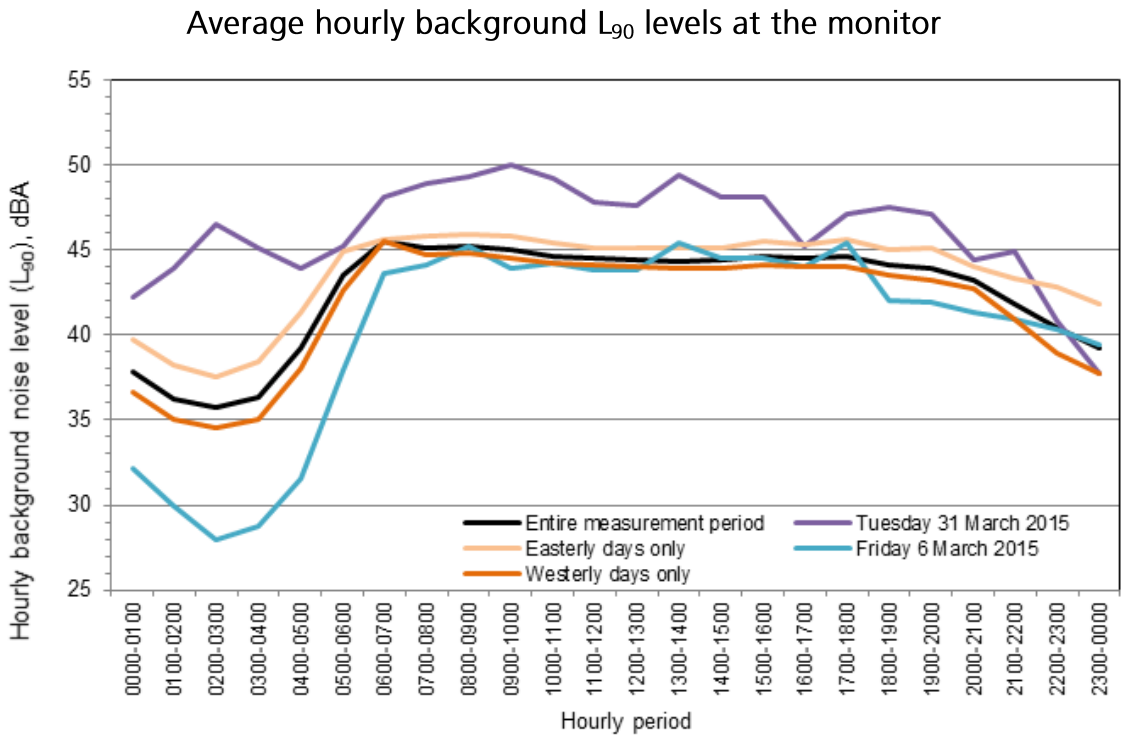

Figure 10. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Tuesday 31 March 2015 (noisiest day) and Friday 6 March 2015 (quietest day)

Noise — significant aircraft noise events

The noise monitors are set up to record noise events above a pre-determined threshold level (i.e. aircraft generated noise above background - fully defined on page 13). This means that not every aircraft passing through the Brockley analysis gate generates a noise event. During the monitoring period a total of 10,945 aircraft noise events were recorded.

Since the noise monitor was positioned relatively close to the final approach paths for runways 27L and 27R and well away from the Standard Instrument Departure (SID) routes, arrivals account for nearly all of the noise events recorded at the monitor. Figure 11 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 16% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines). Accounting for rejected events, 5,447 noise events were generated by westerly arrivals on runway 27L, 3,737 noise events by westerly arrivals on runway 27R, and 7 noise events by departures on runway 09R which initially followed the easterly Detling departure route.

Arrivals (99.9% of all noise events)			Departures (0.1% of all noise events)	
27L	27R	Total	09R	Total
5,447	3,737	9,184	7	7

Figure 11. Aircraft noise events by operation and runway following filtering for bad weather

Figure 12 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 13 shows the average (mean) departure and arrival L_{Max} values recorded at the Brockley monitor for each aircraft type.

For arrivals (and excluding the result for the A310, for which there were only three recorded noise events), the noisiest aircraft on average was the A300, followed by the B747, A380, A330 and A340. Whilst the B747 would normally be expected to be noisier than the A300 on approach, further analysis of aircraft heights on arrival indicates that A300 aircraft were, on average, approximately 600 feet lower when passing over the noise monitor compared to the B747 (4,100 feet vs. 4,700 feet). On average, the quietest aircraft type measured on arrival at the Brockley site was the B787.

Although average departure noise levels are also shown in Figure 13 (for the A319, A320, A380, B777 and the 'Others' category of aircraft), the sample sizes are too small for any meaningful analysis to be made.

The overall distribution of noise (L_{Max}) for arrivals and departures is shown in Figure 14. Figure 15 indicates the trend in the noise distribution 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 departures are too small for any meaningful analysis to be made. The graphs for arrivals however indicate that the overall spread of the measured noise levels is generally 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 for the first three weeks of deployment and later lowered to 57 dBA for the remainder of the monitoring period, 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 13 .

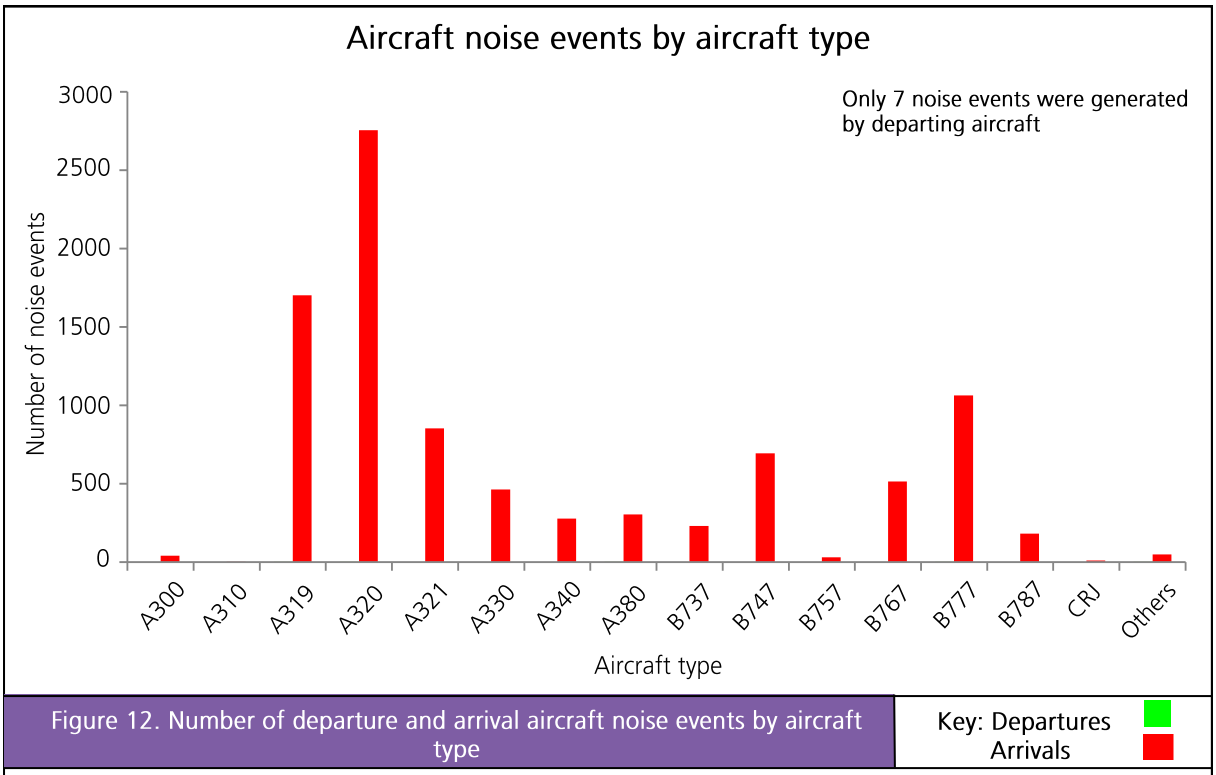

Figure 12. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures
Arrivals

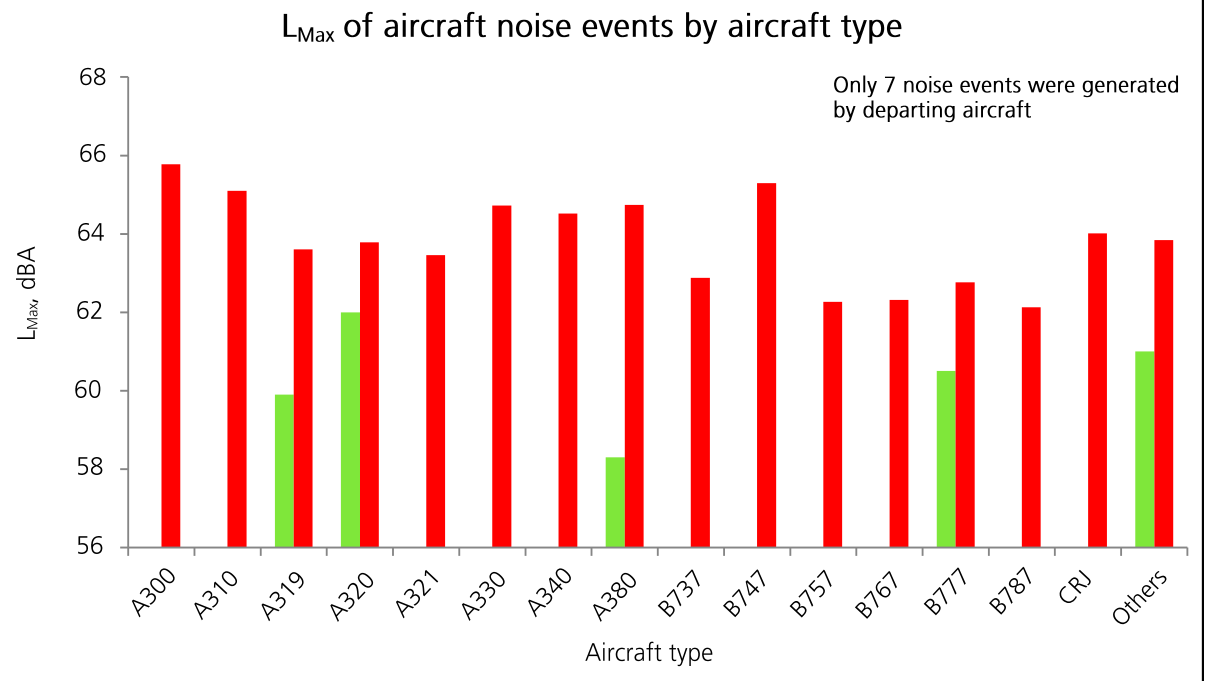

Figure 13. Average (mean) L_{Max} by aircraft type for departures and arrivals

Key: Departures
Arrivals

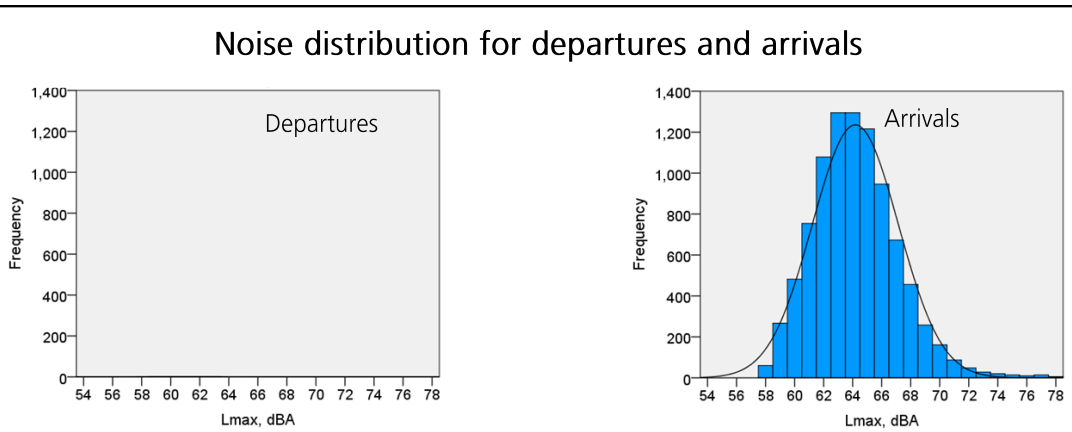

Figure 14. Above left: L_{Max} frequency distribution of departure noise levels
Above right: L_{Max} frequency distribution of arrival noise levels

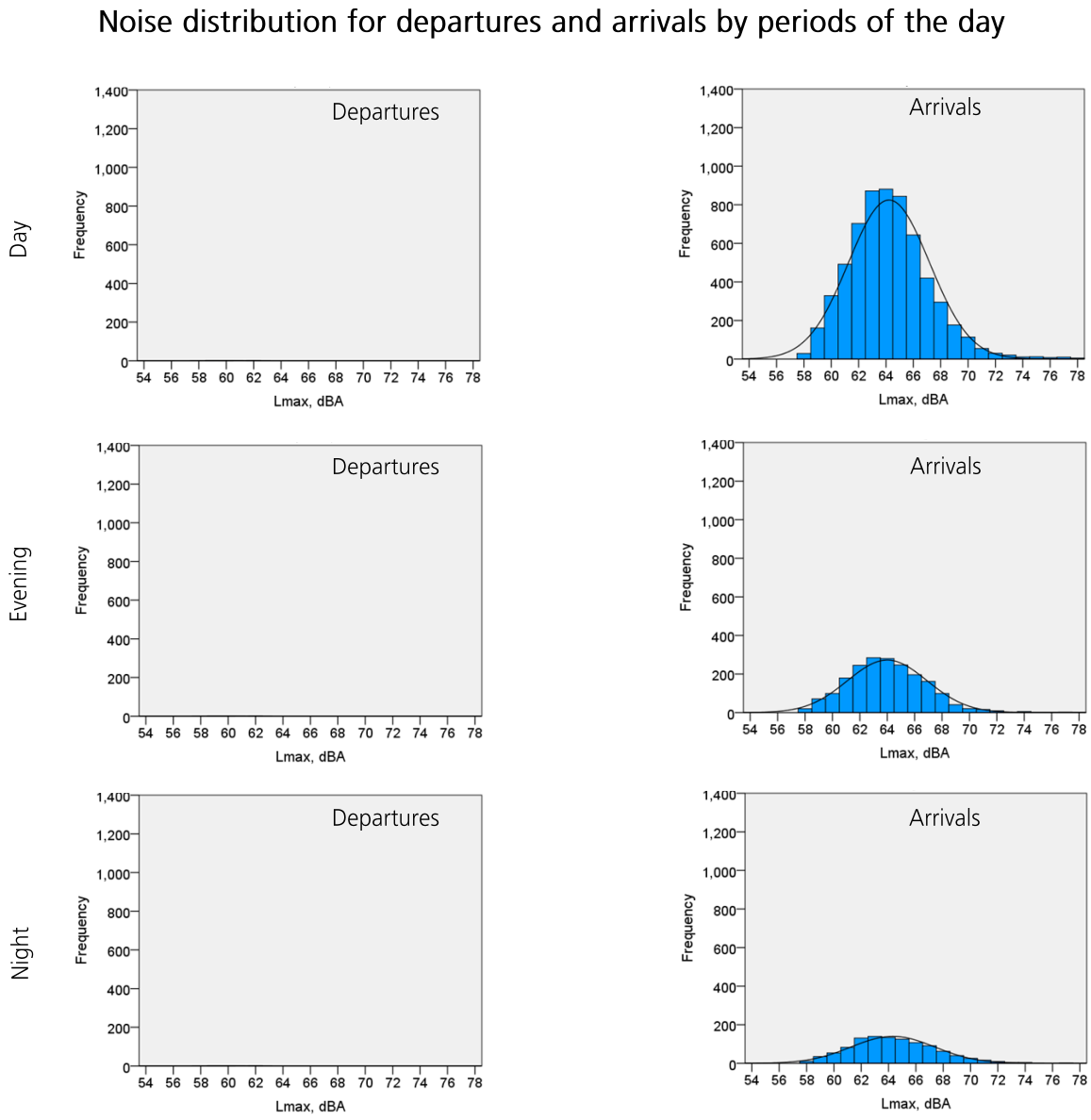

Figure 15. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max} (Day — 12 hour period 07:00-19:00), L_{Max} (Evening — 4 hour period 19:00-23:00) and L_{Max} (Night — 8 hour period 23:00-07:00)

Summary

Background

This report describes the overflight and noise measured in the vicinity of a temporary noise monitor located at Tyrwhitt Road, Brockley over a 92-day period from the 8 February to 10 May 2015. During this period 21,453 aircraft passed through a 4nm 'gate' centred on the noise monitor — an average of 233 per day.

Heathrow operates in either a westerly or easterly direction, primarily due to prevailing wind conditions. During the monitoring period westerly operations prevailed for 64% of the time, below the 71% historical average.

Flight movements

The area in the vicinity of the temporary noise monitor is primarily overflown by aircraft making their final approach to Heathrow over London (referred to as 'westerly arrivals'). These aircraft are most concentrated on the final approach paths, but as aircraft are also turning onto the final approach the entire area in the vicinity of the temporary noise monitor is overflown. During full days of westerly operations an average of 379 westerly arrivals passed through the 4nm 'gate' centred on the noise monitor — over half of the westerly arrivals landing at Heathrow.

The area to the south of the noise monitor is also overflown by some departing aircraft that have taken off from Heathrow towards London (referred to as 'easterly departures') and initially followed the easterly Detling departure route. Compared to arriving aircraft, these are relatively few in number as the main flow of aircraft on this route is further to the south. During full days of easterly operations an average of 11 easterly departures passed through the 4nm 'gate' centred on the noise monitor.

Aircraft noise

During the monitoring period a temporary noise monitor was placed at Tyrwhitt Road, Brockley. As the monitor was located close to the final approach paths for runways 27L and 27R, and well away from Heathrow's departures routes, 99.9% of noise events generated were caused by arriving aircraft. Medium-sized aircraft (e.g. the A320 family) dominated the overall number of arrival noise events due to the relatively high numbers of these types operating at Heathrow.

The noisiest arriving aircraft on average was the A300, followed by the B747, A380, A330 and A340. Whilst the B747 would normally be expected to be noisier than the A300 on approach, A300 aircraft were, on average, approximately 600 feet lower when passing over the noise monitor compared to the B747. On average, the quietest arriving aircraft type was the B787.

Results of the monitoring period

The results of the monitoring period represent a snapshot of the track and noise impact. The results generated are broadly in line with what might be expected in the future at the Tyrwhitt Road monitoring site. However, given the positioning of the noise temporary monitor directly under the 27L approach path, different noise levels would be expected if monitors were placed at other locations in the Brockley area.

Additional information

References

- Heathrow airspace trials: http://www.heathrow.com/noise/future-plans/modernising-uk-airspace/heathrow's-airspace-trials
- Department for Transport — Heathrow Noise Contours: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/458527/lhr_2014_report_final.pdf

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. For the measurement of aircraft noise, it is usual practice to measure L_{Max} using the sound level meter's slow (S) response setting.
- L_{90} is the noise level exceeded for 90% of the measurement period and is used to quantify the background level of noise.

Details of the temporary noise monitor used for this study

The sound monitor used for this study was a Larson Davies LD 870 sound monitor placed directly under the approach path for runway 27L at Tyrwhitt Road, Brockley (51°27'54.8"N 0° 01'25.5"W, 95ft elevation)

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 Brockley monitor was set with a threshold of 57 dBA, meaning that noise events below 57 dBA L_{Max} were not recorded by the monitor (for the first three weeks of deployment the threshold was set at 60 dBA). 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 where the background noise level can vary on occasion (for example, due to road traffic or railway noise), it can be 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. Setting the threshold at 57 dBA appeared to be low enough in this instance to capture almost the entire distribution of arrival L_{Max} levels during each time period.

Approximately 16% 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).

Standard Instrument Departure (SID) routes and Noise Preferential Routes (NPRs)

Aircraft taking off from Heathrow follow pre-defined routes, known as SIDs, usually based upon the destination of the aircraft. There are sets of SIDs for both easterly and westerly operations.

Because all aircraft perform differently, or may be affected by weather conditions which can cause them to drift left or right, there will be some variation as to where different aircraft will fly relative to the SID. For this reason there are also corridors, known as Noise Preferential Routes (NPRs), which extend 1.5 kilometres either side of the route centreline. As long as aircraft remain within the NPR up to an altitude of 4,000 feet they are considered to be on track.

Air Traffic Control (ATC) is responsible for the routing of aircraft once airborne. When they have reached 4,000 feet, ATC can instruct the pilots to leave the SID (and by definition the NPR too) and fly a more direct heading to their destination, although aircraft can continue to follow the SID until its end (and 6,000 feet). Additionally, ATC can direct aircraft off the SID at an altitude below 4,000 feet if this is required for safe separation from other aircraft or for other safety reasons such as weather avoidance. This is known as vectoring.

Operational background

Heathrow airport operates in either a 'westerly' or 'easterly' direction as shown in Figure 16. 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 used force when the wind is in an easterly direction, are in force for the remaining 29% of the time. 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 in a westerly direction. This preference does not operate at night.

Runway alternation

During westerly operations 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. This runway alternation pattern changes by week; in alternation pattern 1 (week commencing 13 January in 2014) the designated arrivals runway is 27R between 06:00-15:00 (Figure 16; 'Westerly operations - 1') and 27L between 15:00 and the last departure of the day (Figure 16; 'Westerly operations - 2'). In alternation pattern 2 this order is reversed. After the last departure of the day a 4 week night-time alternation pattern will be utilised and this includes easterly operations should the weather conditions allow.

There is no runway alternation during the day on easterly operations due to the legacy of the Cranford Agreement, which prohibited departures from 09L, other than in limited circumstances. Therefore, during easterly operations, the majority of departures use the southern runway, 09R, and the majority of arrivals tend to use the northern runway, 09L.

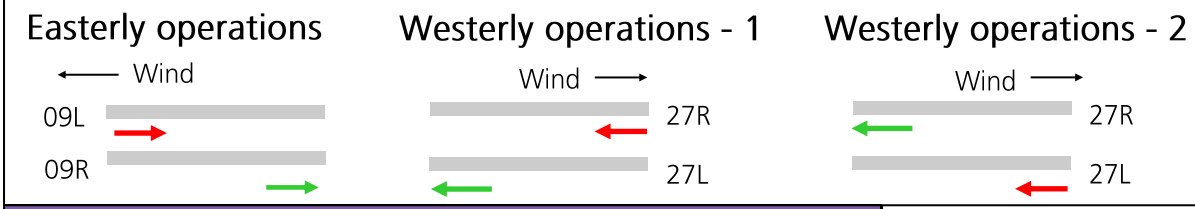

Figure 16. Illustration of the direction of easterly and westerly operations

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