# Heathrow Community Noise and Track-keeping Report: Mogden

This document reports on an 92-day period of continuous noise monitoring from the 26 June 2012 to the 25 September 2012 using a Larson Davies LD 870 sound monitor placed at the Mogden sewage treatment works (positioned at 51° 27′ 50.45" N, 0° 20′ 26.85" W, 95 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 the 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.

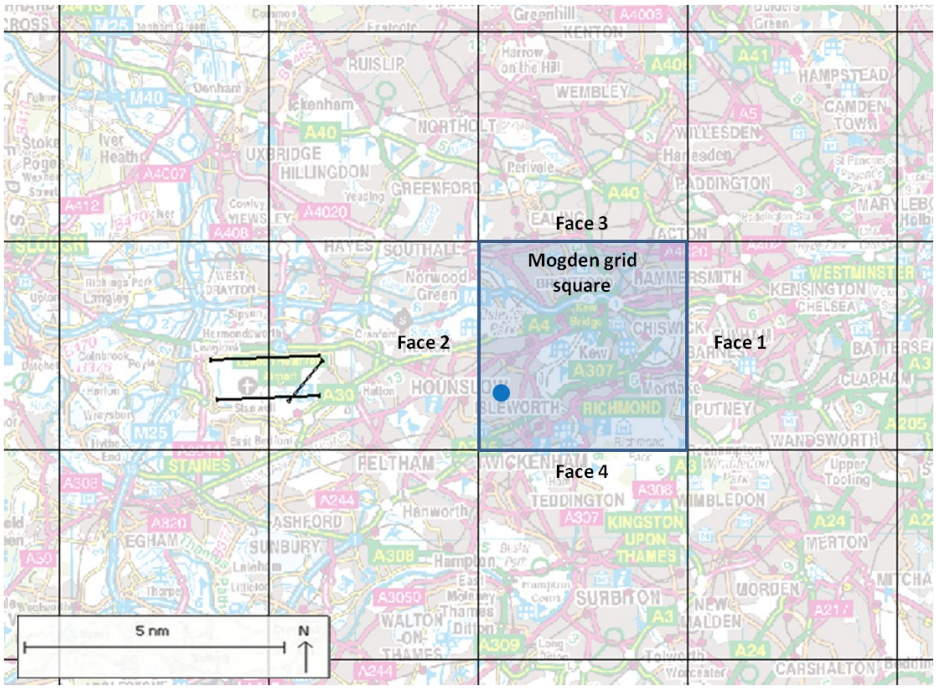


**Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot in the blue shaded grid (the Mogden community grid square area)**

This report describes the noise levels and aircraft tracks affecting the 'Mogden' grid square, shown above. Noise levels were recorded by a temporary noise monitor situated at the Mogden sewage treatment works (position indicated by blue dot). The noise monitor site was located to the east of Heathrow's two runways, close to the extended centre line of runway 27L and between the 60 and 63 $L_{eq}$ noise contours (average 2011 contours, see references on page 9). Flight movements of air traffic through the grid square were derived from the Airport's noise and track-keeping system. Explanations of technical terms 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 operated 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 there is a preference for westerly operations. This means that during periods of light easterly winds the airport operates in a westerly direction. This preference does not operate at night.

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, after which landing aircraft use the first runway again until 06:00. The runway alternation pattern changes by week; in alternation pattern 1 (week commencing 2 January in 2012) the

designated arrivals runway is 27R between 06:00-15:00 (Figure 2; 'Westerly operations - 1') and 27L between 15:00 and the last departure of the day (Figure 2; 'Westerly operations - 2'). In alternation pattern 2 this order is reversed.

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. On easterly operations, therefore, the majority of departures use the southern runway, 09R, and the majority of arrivals tend to use the northern runway, 09L.

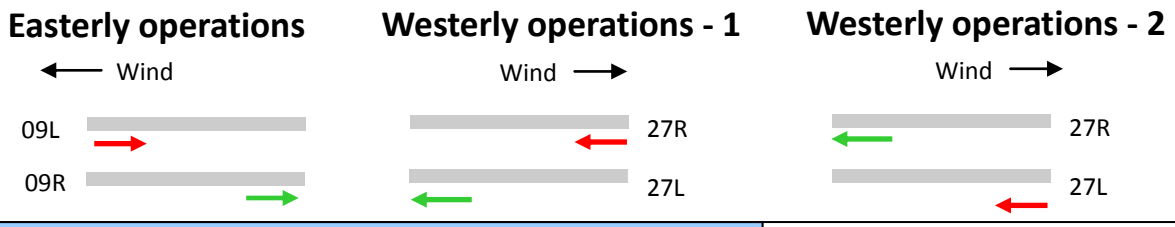


**Figure 2. Illustration of the direction of easterly and westerly operations** | **Key: Departures → Arrivals →**

**Operations during the monitoring period:** During the monitoring period Heathrow operated normally, handling a total of 122,430 air traffic movements (arrivals and departures) without interruption (e.g. airport closure due to meteorological activity or industrial action). Three significant events took place during the monitoring period (Farnborough Airshow, the Olympics and the Paralympics) however none of these caused any significant disruption or changes to the daily flying schedule. Additionally, during the monitoring period a number of aircraft operated out of alternation for safety reasons, for example due to fires on the designated approach path. During the monitoring period, westerly operations prevailed for 88% of the time - higher than the long term average - with a total of 53,986 westerly arrivals and 54,055 westerly departures taking place. Easterly operations were in place for the remaining 12% of the time and these accounted for 7,233 arrivals and 7,156 departures during the monitoring period.

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 Mogden 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 and will count an aircraft each time it enters and exits the grid).

| | Easterly | | | | Westerly | | | |
|---|---|---|---|---|---|---|---|---|
| | Face 1 (E) | Face 2 (W) | Face 3 (N) | Face 4 (S) | Face 1 (E) | Face 2 (W) | Face 3 (N) | Face4 (S) |
| Arrivals | 7 | 12 | 8 | 10 | 54,162 | 54,526 | 351 | 525 |
| Departures | 27 | 3,598 | 2,614 | 940 | 1 | 0 | 0 | 1 |

**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:** During westerly operations the Mogden grid is primarily overflown by arrivals landing on the southern and northern runways, 27L and 27R respectively. Figure 4 overleaf shows the lateral distribution of arriving flight paths through the grid and the vertical distribution through Face 2. The images show that landing aircraft are concentrated laterally and vertically as they enter (Face 1) and exit (Face 2) the grid. This is because the aircraft are established on the Instrument Landing System (ILS) for final approach. Landing aircraft typically enter the grid above 2,000 feet and exit it between 900 feet and 1,100 feet. A small proportion of westerly arrivals also overfly the grid, generally at heights above 6,000 feet, prior to commencing their approach. Similarly during easterly operations a very small proportion of arrivals also overfly the grid prior to commencing their approach.

**Departure flight paths:** The Mogden grid is only usually overflown by departing aircraft during easterly operations. Figure 5 overleaf shows the lateral distribution of departing flight paths through the grid and the vertical distribution through Face 2. Aircraft departing on the Brookmans Park and Buzad Standard Instrument Departure (SID) routes overfly the north-west corner of the grid, whereas aircraft primarily departing on the Dover SID overfly the southern half of the grid. Approximately 90% of departures enter the grid between 2,000 and 4,000 feet, and over 95% of departures exit the grid between 2,000 and 5,000 feet. During the monitoring period a single westerly departure overflew the grid above 8,000 feet.

**Go-arounds and calibration flights:** In addition to arriving and departing aircraft, the Mogden grid square also experiences noise generated by aborted landings or 'go-arounds' on easterly operations. During the monitoring period no easterly go-arounds overflew the grid. Also there were no calibration flights during the monitoring period.

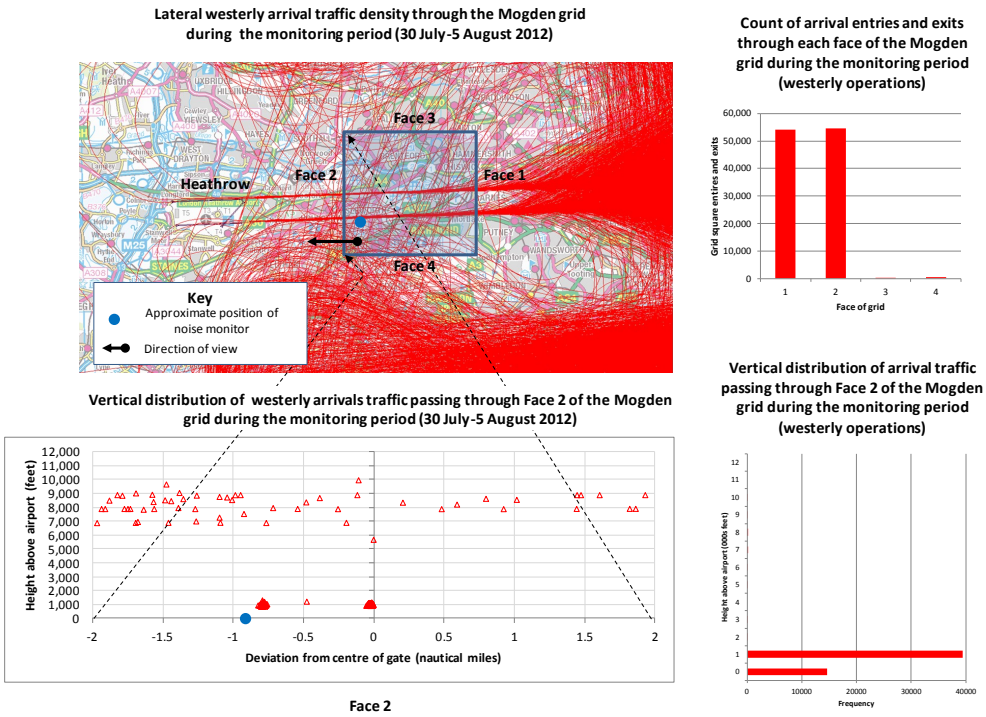


**Figure 4. Lateral and vertical distribution of arriving air traffic passing through the Mogden grid during the monitoring period (westerly operations) - representative sample**

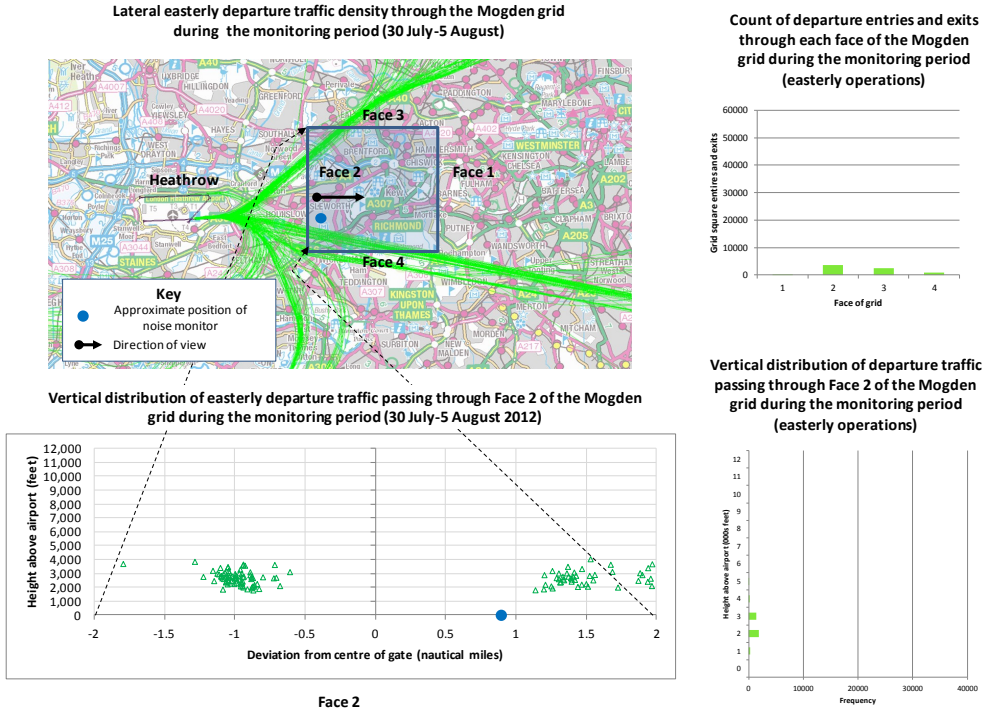


**Figure 5. Lateral and vertical distribution of departing air traffic passing through the Mogden grid during the monitoring period (easterly operations) - representative sample**

Figure 6 overleaf shows the proportion of aircraft that passed through the grid by direction of runway operation and hour. During the monitoring period the grid was overflown throughout the main hours of operation by arrivals on days of westerly operations and departures on days of easterly operations. Being under Heathrow's final approach paths, all arrivals landing on the westerly runways overfly the grid. During the monitoring period approximately 9% of arriving aircraft operated out of alternation; this was partly due to the 'Operational Freedoms' trial which is discussed further in the additional information section. However, over 20% of the aircraft operating out of alternation did so for safety reasons, for example due to fires on the designated approach path. Fewer aircraft overflew the grid on days of easterly operations as not all of Heathrow's departure routes pass through the grid.

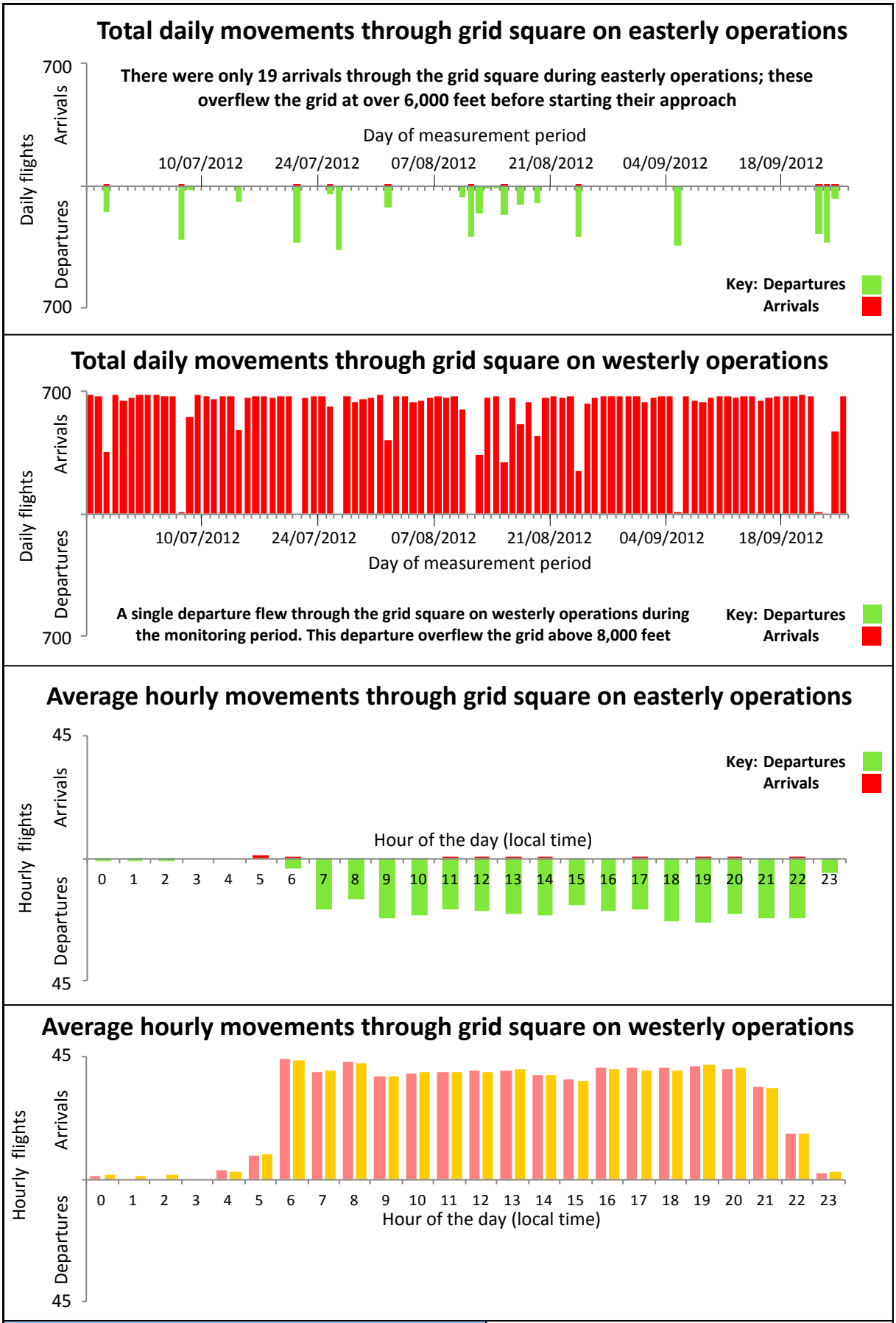


**Figure 6. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square**

**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 Mogden 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. Although Figure 7 indicates that slightly lower average background noise levels were recorded during periods of easterly operation (when the wind is in an easterly direction), the differences are small in absolute terms (i.e. typically less than 2 or 3 dB).

The overall trend in Figure 7 is largely in line with expected results, with slightly lower background noise levels at the Mogden site during the night-time than during the day. Between 00:00-06:00 hours the average background noise level was less than 48 dBA, rising to just over 50 dBA after 08:00 hours for the rest of the day until 17:00 hours. This broadly coincides with the daytime increase in overall road traffic levels. However, the relatively small variation in average background noise level between day and night (of 2 to 3 dB) is somewhat less than would typically be expected in an urban environment, and may be explained by constant (24 hour) noise from the sewage treatment works.

The graph also illustrates the large overall variation in hourly background noise level at the monitoring site; up to 8 or 9 dBA between the quietest and noisiest days. The overall noisiest day was Friday 29 June; a day with a moderate southerly wind, placing the noise monitor site downwind of the A316. The quietest day was Saturday 28 July; a day with a light northerly wind, placing the noise monitor upwind of the A316, and also upwind of much of the sewage treatment works.

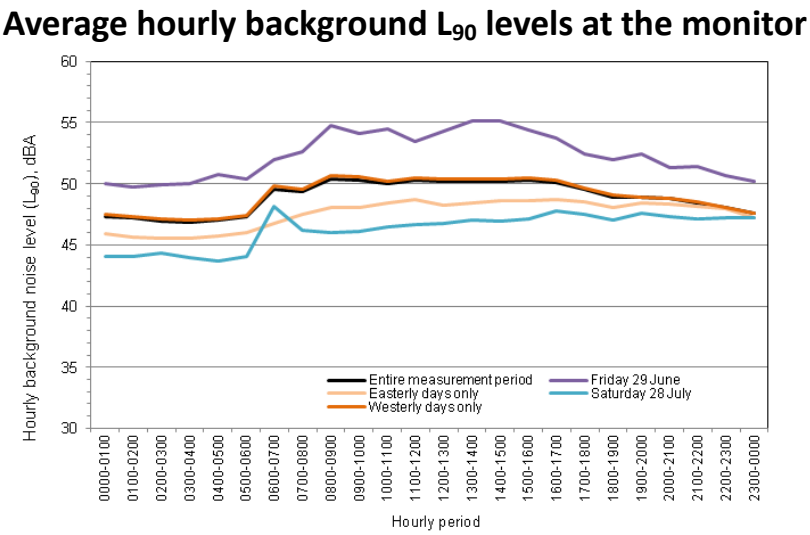


**Figure 7. Hourly background $L_{90}$ levels at the monitor averaged over 24 hour period; including Friday 29 June (noisiest day) and Saturday 28 July (quietest day)**

## 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 Mogden grid square generates a noise event. During the monitoring period a total of 28,697 aircraft noise events were recorded.

As the noise monitor was positioned close to the extended centreline of runway 27L, westerly arrivals account for nearly all of the noise events recorded at the site (approximately 97%). Figure 8 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 10% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines). Accounting for rejected events, 24,564 noise events were generated by westerly arrivals on runway 27L and 513 noise events by arrivals on runway 27R. Thus, a total of 25,077 arrival noise events were recorded at the Mogden monitor after filtering for bad weather.

As indicated above, only a very small number of departure noise events were recorded at the Mogden site. This is unsurprising since the monitor was located well outside any of the departure Noise Preferential Routes (NPRs), the lateral limits within which aircraft should remain when departing on a given SID, After filtering for bad weather 726 noise events were generated by easterly departures, nearly all of which were from runway 09R.

Figure 9 indicates that medium-sized aircraft (e.g. the A320 family) and the wide-bodied B777 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 Mogden monitor for each aircraft type. For arrivals, the noisiest aircraft on average was the B747, followed by the A340, B767, and A380. For departures, the noisiest aircraft on average was the B747, followed by the A300 and B777.

The overall distribution of noise ($L_{Max}$) for arrivals and departures is shown in Figure 11. Figure 12 indicates the trend in the noise distribution for arrivals and departures by time period (day, evening and night). In this instance the monitor threshold was set at 60 dBA, which appeared to be low enough to capture the entire distribution of $L_{Max}$ levels for arrivals during each time period. In addition, the majority of the lower-level $L_{Max}$ events shown in Figures 11 and 12 for arrivals (e.g. events below 65 dBA) are from arrivals on Runway 27R, which are significantly quieter than arrivals on Runway 27L due to their relative distance from the Mogden noise monitor. Although shown for completeness, it should be noted that the data samples for departures are generally too small for any meaningful analysis to be made.

The graphs for arrivals indicate that lower numbers of noise events were recorded during the evening and night periods compared to the daytime, which is as expected and due to the lower traffic levels during those periods. The results also indicate that the overall spread of the measured noise levels is generally consistent during the daytime and evening periods, although the night time distribution appears to be shifted slightly to the right of the chart, indicating slightly higher noise levels overall. This can be explained by the greater proportion of movements from larger wide-bodied aircraft such as the B747, B777 and B767 at night.

| Departures (2.8% of total noise events) | | | | | Arrivals (97.2% of total noise events) | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 09L | 09R | 27L | 27R | Total | 09L | 09R | 27L | 27R | Total |
| 4 | 722 | 0 | 0 | 726 | 0 | 0 | 24,564 | 513 | 25,077 |

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

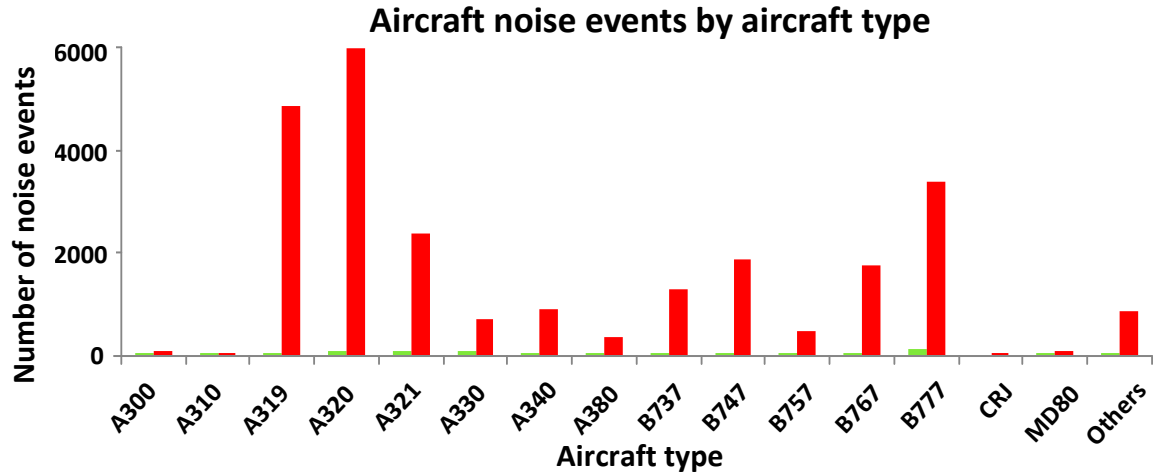


**Figure 9. Number of departure and arrival aircraft noise events by aircraft type**

Key: Departures
Arrivals

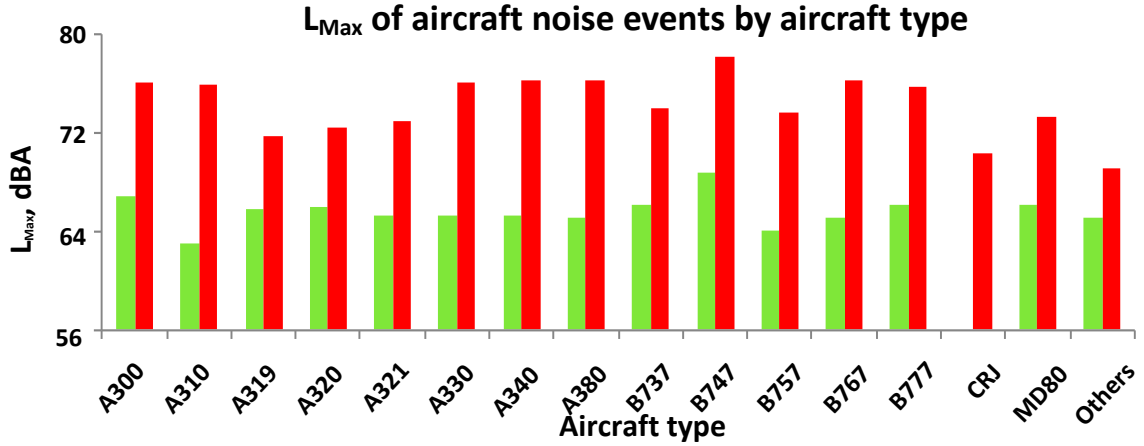


**Figure 10. Mean average $L_{Max}$ by aircraft type for departures and arrivals**

Key: Departures
Arrivals

## Noise distribution for departures and arrivals

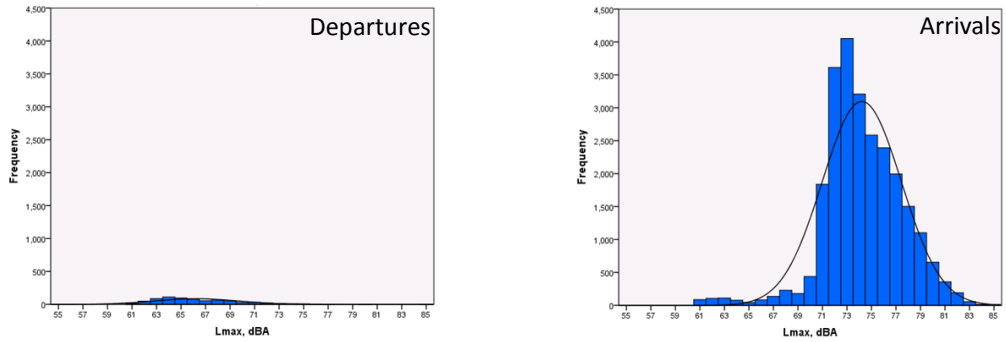


**Figure 11. Above left: $L_{Max}$ frequency distribution of departure noise levels**
**Above right: $L_{Max}$ frequency distribution of arrival noise levels**

## Noise distribution for departures and arrivals by periods of the day

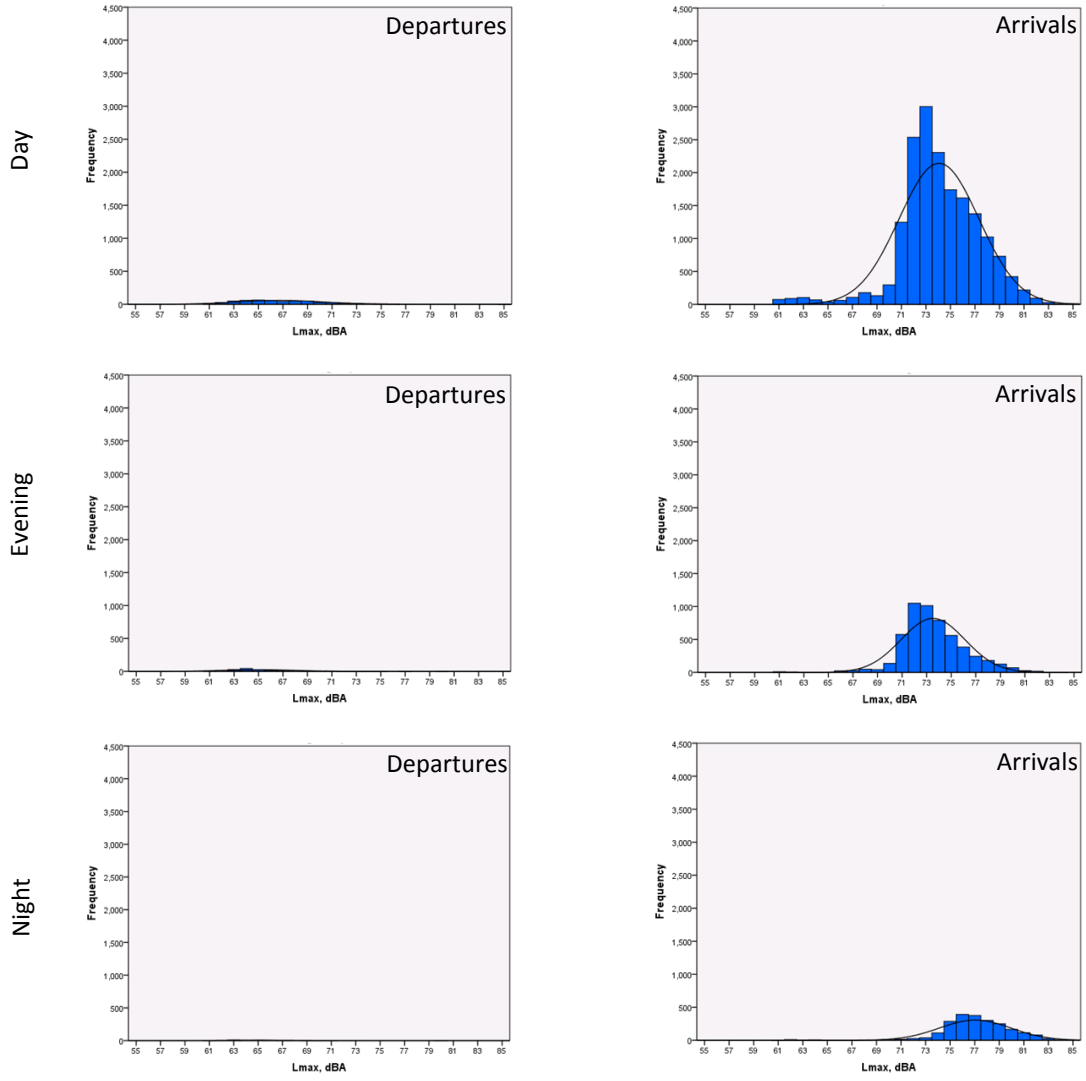


**Figure 12. $L_{Max}$ distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of $L_{Max}$(Day — 12 hour period 07:00-19:00), $L_{Max}$(Evening — 4 hour period 19:00-23:00) and $L_{Max}$(Night — 8 hour period 23:00-07:00)**

## Conclusions

This report describes the overflight and noise experience measured for the Mogden grid square over a 92-day period from the 26 June to 25 September 2012. During the monitoring period the Mogden grid square was overflown by 57,622 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 westerly operations the Mogden grid is overflown by arriving aircraft throughout the main hours of operation. Being close to touchdown, the flight paths of these aircraft are concentrated laterally and vertically in two streams, one for Runway 27L and the other for Runway 27R. Landing aircraft typically enter the grid above 2,000 feet and exit between 900 feet and 1,100 feet. During the monitoring period approximately 9% of arriving aircraft operated out of alternation; this was partly due to the 'Operational Freedoms' trial. However, over 20% of the aircraft operating out of alternation did so for safety reasons, for example due to fires on the designated approach path.

During easterly operations the Mogden grid is oveflown by departing aircraft throughout the main hours of operation. The north-west corner of the grid is usually overflown by aircraft departing on the Brookmans Park and Buzad Standard Instrument Departure (SID) routes, whereas aircraft primarily departing on the Dover SID overfly the southern half of the grid. Departing aircraft will typically overfly the grid between 2,000 and 5,000 feet.

On days of easterly operations the Mogden site experiences slightly less background noise than on days of westerly operations. Changes in background noise levels throughout the day broadly reflect road traffic levels, there is however a relatively small variation in average background noise level between day and night which may be explained by constant (24 hour) noise from the sewage treatment works.

As the noise monitor was positioned close to the extended centreline of runway 27L, westerly arrivals account for nearly all of the noise events recorded at the site (approximately 97%). Only a very small number of departure noise events were recorded on easterly operations which is unsurprising since the monitor was located well outside any of the departure Noise Preferential Routes (NPRs).

The majority of significant aircraft noise events generated were by medium-sized aircraft (e.g. the A320 family), which reflects the traffic mix at Heathrow. For arrivals the noisiest aircraft on average was the B747, followed by the A340, B767, and A380. For the much smaller sample of departing aircraft the noisiest aircraft on average was the B747, followed by the A300 and B777. Lower numbers of noise events were recorded during the evening and night periods compared to the daytime, which is as expected and due to the lower traffic levels during those periods. The noise distributions measured at the monitoring site are generally consistent between the daytime and evening periods, with the night time distribution indicating slightly higher noise levels overall. This can be explained by the greater proportion of movements from larger wide-bodied aircraft such as the B747, B777 and B767 at night.

The results of the Mogden monitoring period represent a snapshot of the track and noise impact. The results generated for westerly operations are broadly what might be expected in the future. However, the impact of westerly operations may change with the further use of 'Operational Freedoms' at Heathrow, the use of which will depend on the outcome of the current trial and any subsequent public consultation (please see reference section for more information).

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, Noise Action Plan 2010-2015 http://www.heathrowairport.com/noise
- Department for Transport — Heathrow Noise Contours https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3933/heathrow-2011-report.pdf
- Operational Freedoms at Heathrow http://www.heathrowairport.com/noise
- South East Airports Task Force http://assets.dft.gov.uk/publications/south-east-airports-taskforce-report/south-east-airports-taskforce-report.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.
- A trial of 'Operational Freedoms' started at Heathrow on 1 November 2011, to explore if the runways and the airspace around the airport can be used in a more efficient and flexible way. The trial is taking place in two phases, the first from 1 November 2011 to 29 February 2012, the second from 1 July 2012 to 28 February 2013. This trial is a recommendation of the Government's South East Airport Taskforce which was set up in 2010 to look at how to make London's airports 'better, not bigger'. The trial will look at whether new procedures can be used to bring benefits to the local community through less late-running flights; to passengers, by providing a more punctual service; and to the environment, by reducing aircraft stacking times and reducing emissions. This trial will not result in an increase in the number of flights operating into or out of Heathrow.

Noise monitoring details:

- To ensure that as far as possible only genuine aircraft noise 'events' are measured (i.e. noise peaks caused by an aircraft movement), the noise monitors are set up to record noise events above a pre-determined threshold level. The Mogden 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 Mogden, where the background noise level is frequently varying (for example, due to 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. However setting the threshold at 60 dBA appeared to be low enough to capture the entire distribution of relevant $L_{Max}$ levels during each time period.
- Approximately 10% 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).

Report prepared for Heathrow Airport by Helios and the CAA. 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 Heathrow Flight Performance directly (Second Floor Meridian, The Compass Centre, Nelson Road, Heathrow Airport, Hounslow, TW6 2GW, UK).