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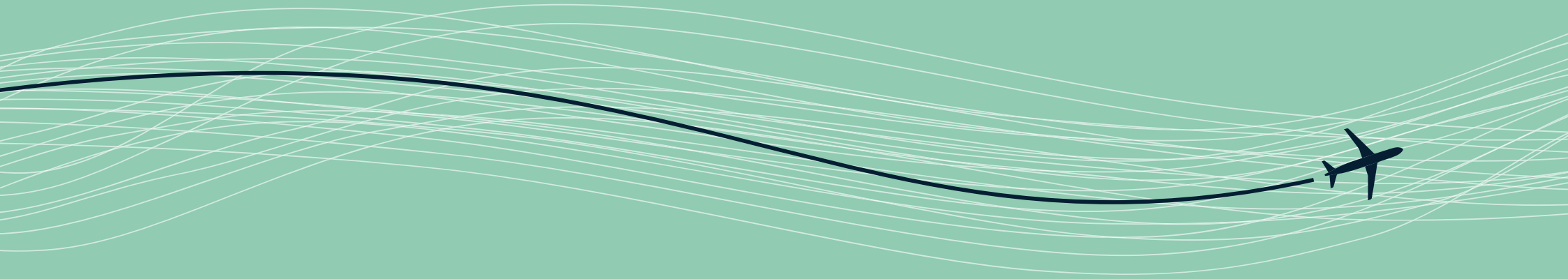
Noise Monitoring Breaston 2022



MAG
East Midlands
Airport

Noise Monitoring Breaston 2022

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Executive Summary

East Midlands Airport has carried out noise monitoring at one location in Breaston, in addition to the noise monitoring at its five permanent noise monitors. The monitoring was undertaken over 92 days, between 15th June and 14th September 2022. Large periods of data are unavailable due to power outages at the monitoring position.

This report sets out details and results of the Breaston noise monitoring, as well as an analysis of the noise (and weather) data for primary (decision-making) and secondary (explanatory) aviation noise metrics.

The runway split during the monitoring period was 27 % on runway 09 and 73 % on runway 27. This is comparable with the average split occurring over 2020 and 2021 of 25 % / 75 % (09 / 27).

During the monitoring period, noise levels associated with 252 movements were captured. These were split in to 140 departures, 73 overflights, 7 arrivals and 11 ‘touch and go’s.

Purely as a result of aircraft, noise level during the day and night have been calculated to be 35 dB $L_{Aeq,16hour}$ (7 am to 11 pm) and 42 dB $L_{Aeq,8hour}$ (11 pm to 7 am) at the monitoring location.

Due to the small number of aircraft captured during the monitoring period, it is not possible to analyse some trends, such as frequency of individual aircraft levels, as the results would not necessarily be reflective of typical operations at the airport.

Contents

1.0 Glossary

Acoustic Aviation Terms

Annoyance
The principal health effect relating to daytime (7am to 11pm) aircraft noise, where someone is to some extent bothered, annoyed or disturbed.

Sleep disturbance
The health effect relating to night-time (11pm to 7am) aircraft noise, usually taken to be where someone experiences an awakening.

Summer 92-day period
16th June to 15th September inclusive, representing the busiest period of activity at UK airports.

Shoulder periods
The time period either immediately before (6am to 7am) or after (11pm to 11:30pm) the daytime.

Noise contour
A line around an airport where all points on the line have the same noise level, representing a particular metric.

ANOMS
The Airport Noise and Operations Monitoring System. ANOMS collects data from the airport's noise monitors and radar systems to correlate noise levels and physical locations for individual flights. Weather and flight data are also collected.

NPR
Noise Preferential Routings are established departure routings that aircraft must follow, unless extenuating circumstances apply (such as being instructed otherwise by Air Traffic Control for safety reasons or due to inclement weather).

Touch and Go
An aircraft

Touch and Go
A manoeuvre where an aircraft lands on the runway and then takes back off again in one motion. It is typically undertaken in training but can also be used during an aborted landing.

Noise Metrics and Indices

***L*Aeq,T**
The hypothetical steady sound, containing (or equivalent to) the same sound energy as the actual fluctuating sound over the chosen measurement period, *T*.

***L*Aeq,16hour**
The equivalent sound level over a 16-hour day (7am to 11pm) calculated using the average movements over the daytime summer 92-day period. The metric recognised by the UK government for making evidence-based decisions, due to it correlating best with annoyance.

***L*Aeq,8hour**
The equivalent sound level over an 8-hour night (11pm to 7am) calculated using the average movements over the night-time summer 92-day period.

***L*day**
The equivalent sound level over a 12-hour day (7am to 7pm) calculated using the annual average daytime movements.

***L*evening**
The equivalent sound level over a 4-hour evening (7pm to 11pm) calculated using the annual average evening movements.

***L*night**
The equivalent sound level over an 8-hour night (11pm to 7am) calculated using the annual average night-time movements.

***L*DEN**
The logarithmic time weighted average of L_{day}, $L_{evening}$ and L_{night}, applying a 5 dB penalty to the evening and 10 dB penalty to the night-time.

Number Above (Nx)
The number of aircraft events generating noise levels above *x* dB $L_{Amax,s}$ (typically 65 or 70 dB during the day and 60 dB at night). A useful communication metric as it correlates well to annoyance.

Sound Exposure Level (SEL)
The equivalent sound level if all the noise energy of an aircraft event is condensed into a one second period. It takes into account both noise level and duration of an event.

$L_{Amax,s}$
Simply the highest measured noise level during an aircraft event, with the sound monitoring equipment taking a measurement every 1 second (known as a slow response). All references to L_{Amax} in this report refer to $L_{Amax,s}$, unless otherwise stated.

Other Referenced Terms

CAA
The UK Civil Aviation Authority.

ERCD
The Environmental Research and Consultancy Department of the CAA.

ERCD Report 0904
Metrics for Aircraft Noise, published by CAA, 2009.

CAP1506
Survey of Noise Attitudes (SoNA), published by CAA, 2021.

ANIS1982
A previous study comparable to that in CAP1506, and is useful for showing how UK noise attitudes have changed over time.

CAP2161
Survey of Noise Attitudes: Aircraft noise and sleep disturbance, published by CAA, 2021.

CAP1767
An investigation into the influence of background ambient noise levels on attitudes to aircraft noise, published by CAA, 2019.

Noise Action Plan
East Midlands Airport Noise Action Plan 2019-2023.

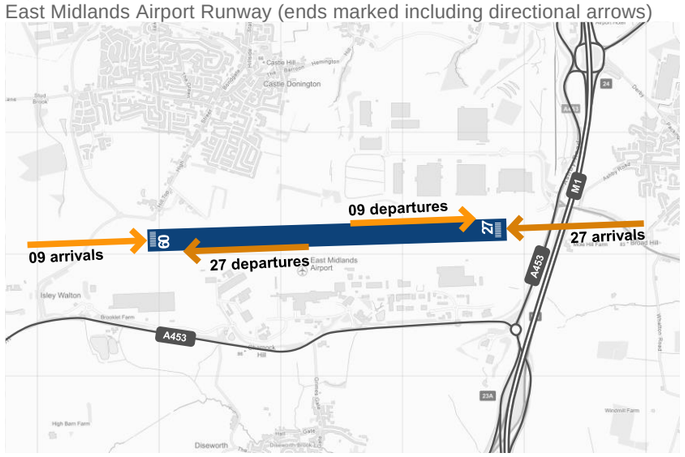
2.0 East Midlands Airport

2.1 East Midlands Airport and the surrounding areas are shown in **Figure 1**. The airport has one runway, facing in an east / west direction.

2.2 There are six main paths that departing aircraft will follow, two to the west and four to the east. These are known as Noise Preferential Routings (NPRs). East Midlands six NPRs and their names can be seen in **Figure 1**.

2.3 The two runway ends are named ‘09’ and ‘27’. These ends indicate the direction of travel for arriving and departing aircraft, as can be seen in **Figure 2**.

Figure 2
East Midlands Airport Runway (ends marked including directional arrows)



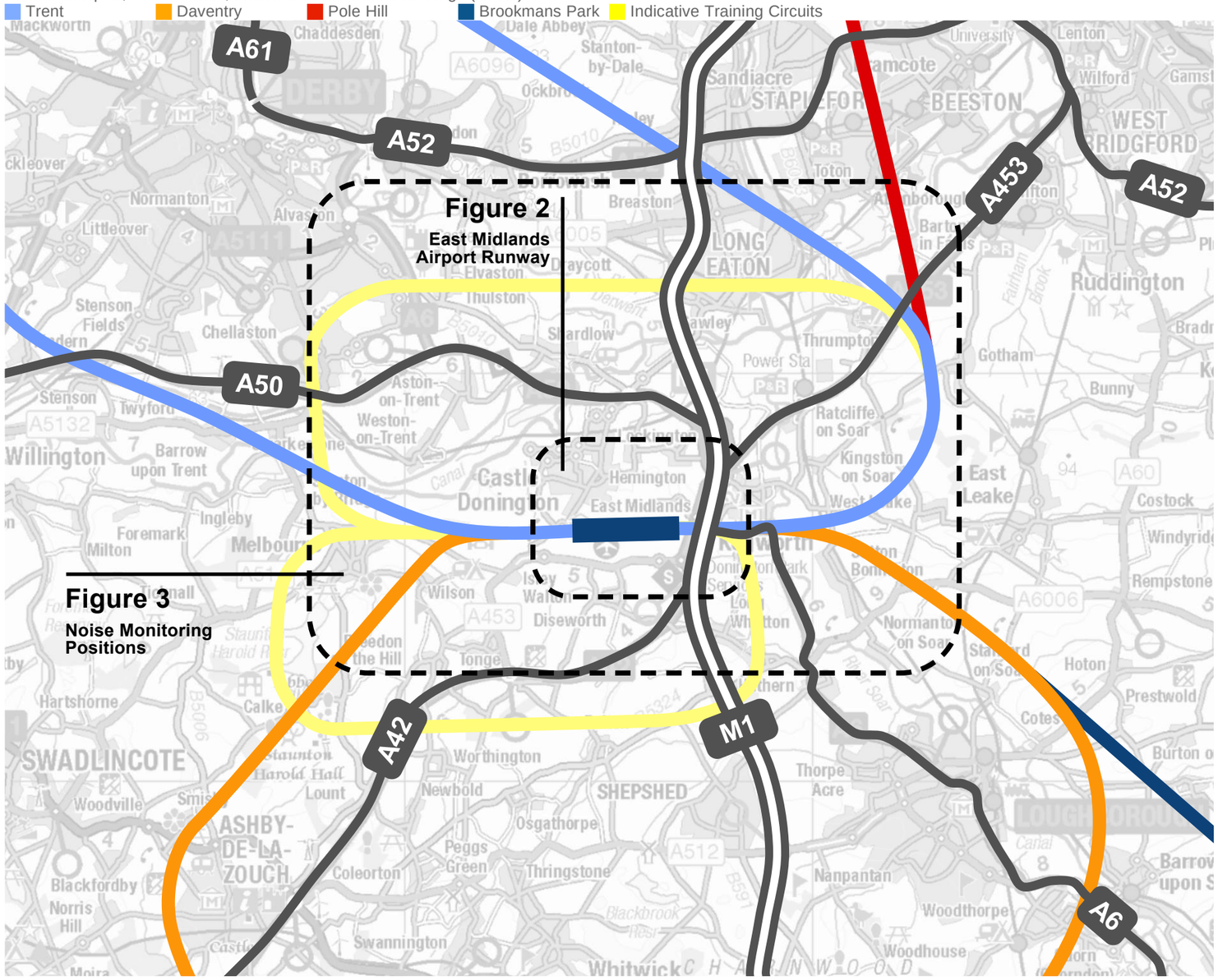
2.4 Aircraft typically take off in a westerly direction, and arrive from the east; this is due to the prevailing wind conditions. Over 2020 and 2021, this split has been 75% departing to the west and 25 % to the east, as set out on the Airport’s website[1]. As this split is purely due to wind direction, it is not expected to have been affected by the pandemic.

2.5 In practice, aircraft arriving at East Midlands Airport can be taken to arrive in the same line as the runway direction.

2.6 East Midlands Airport is used by some airlines based there as a training centre. Aircraft can be flown in ‘circuits’ around the airport, to allow pilots to train on things like departure and arrival procedures. The circuits shown on Figure 1 are strictly indicative.

[1] https://www.eastmidlandsairport.com/community/living-near-the-airport/ (accessed November 2022).

Figure 1
Stansted Airport, its surrounds, and Noise Preferential Routings (NPRs)
Trent Daventry Pole Hill Brookmans Park Indicative Training Circuits



2.7 There are five permanent noise monitors installed around East Midlands Airport, with two at each end of the runway and one to the north of the Airport. These monitoring locations can be seen in **Figure 3,** right.

2.8 These figures also show how the permanent noise monitors are located relative to East Midlands Airport's NPRs. Noise data from these permanent monitors can be seen in near-real-time at https://webtrak.emsbk.com/ema2.

2.9 Position M111, the location of which is shown on **Figure 3**, is the temporary position on which this report focuses. The location is approximately 7 km from the airport's northern perimeter, within a residential garden off Wilsthorpe Road.

2.10 Monitoring at Location M111 was undertaken between 15th June and 14th September 2022. The power supply to the monitor was disrupted on numerous occasions, sometimes for several minutes and sometimes for multiple days. These disruptions are set out in **Appendix B**.

2.11 Location M111 has captured departures on the Trent NPR using runway 09, which passes above the monitoring location.

2.12 Further information on the noise monitor and associated software are set out in **Appendix A**.

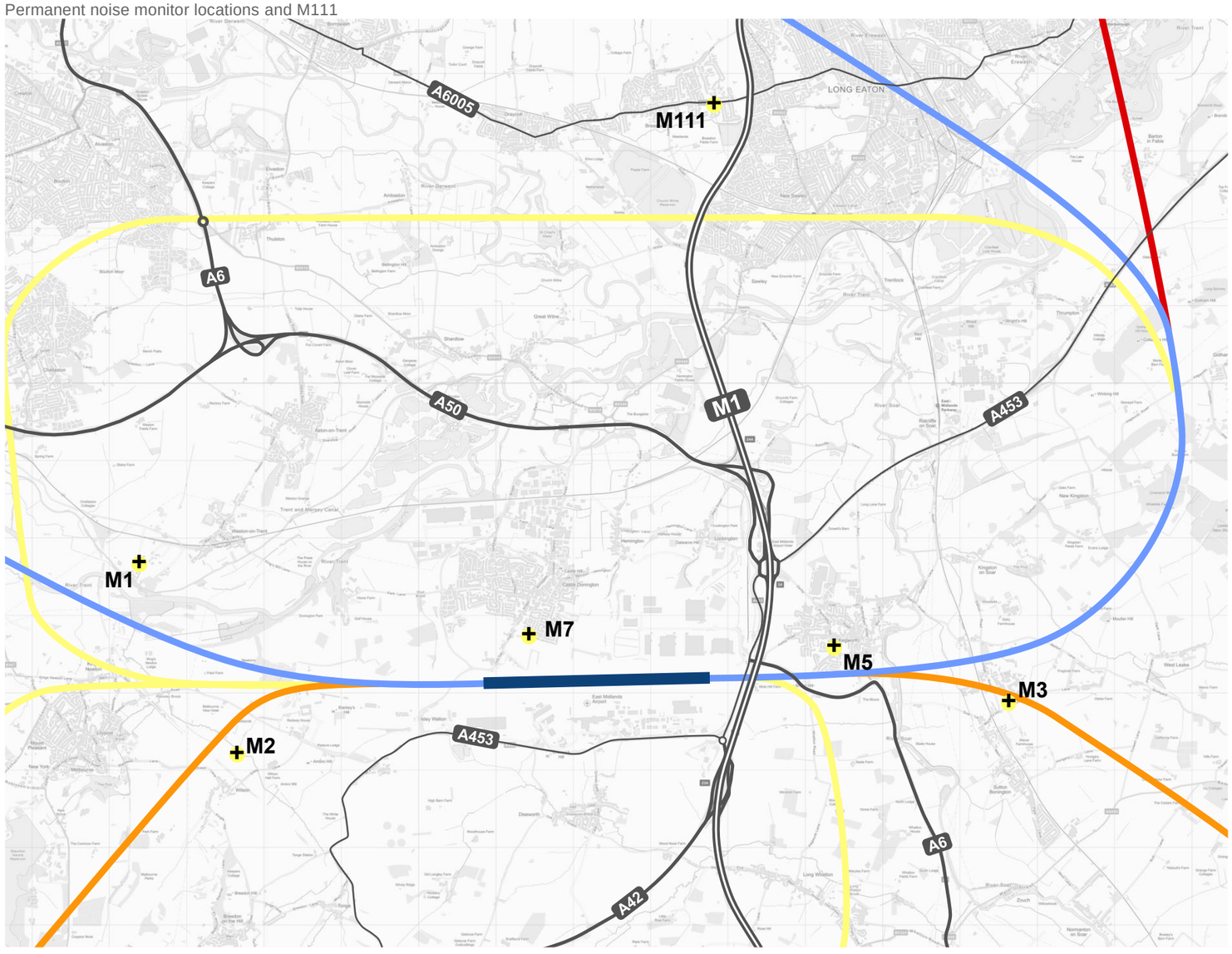
2.13 Noise data for the whole monitoring period are set out in **Appendix B**.

2.14 Weather conditions were acceptable for noise measurements for the vast majority of the monitoring period. The weather data during the monitoring period are also set out in **Appendix B**.

2.15 We note that the NPRs shown in Figures 1 and 3 are all to provide context only. They do not show the full width of each path, within which aircraft should remain within.

2.16 The provided gate data, as is set out in **Appendix A**, shows how correlated events flew relative to the NPRs.

Figure 3
Permanent noise monitor locations and M111



3.0 Movements During Monitoring

3.1 Monitoring at the Breaston location took place over 78 days, between 15th June and 14th September 2022, inclusive. During that time, a total of 18,295 movements operated from East Midlands Airport. How these movements are split is set out in **Table 1**.

3.2 A 'gate' located above the monitor captured 252 movements. How these movements are split is also set out in **Table 1**. More information on the gate, what it is and how it works is set out in **Appendix A**.

3.3 1.4 % of movements operating from East Midlands Airport were captured by the gate. The 99%, or so, not captured flew on routes that the gate did not cover, as only a small percentage of flights use the 09 Trent NPR, with departures on runway 09 also happening in the minority. Some aircraft may have overflown the monitor but not generated noise levels high enough to trigger the monitor.

3.4 As set out East Midlands Noise Action Plan (supplementary information) document, around 4 % of all aircraft used the Trent routing in 2016, so the number of aircraft captured in this exercise is in line with expectations.

3.5 As would also be expected for such a position, the majority of movements captured were departures (140), and then overflights (73). A small number of arrivals (7) and "touch and go" or training (11) movements were also captured.

3.6 From the total movement data, a runway split has been calculated. This shows during the monitoring period, runway 27 was in use 73 % of the time and runway 09 (departures potentially overflying the monitoring position) was in use 27 % of the time.

3.7 The long-term (2020 and 2021) split at East Midlands Airport is 75 % / 25 %, showing wind conditions during the monitoring period can be considered typical.

3.8 Given that only 140 departures were captured by the monitor over 78 days, it is not possible to identify from the monitor data alone days when East Midlands Airport was operating on an easterly or westerly direction.

3.9 There were 22 days when at least one departure was captured. Purely looking at these 22 days, the average number of departures per hour are set out in **Figure 4**.

Figure 4
Average movements per hour

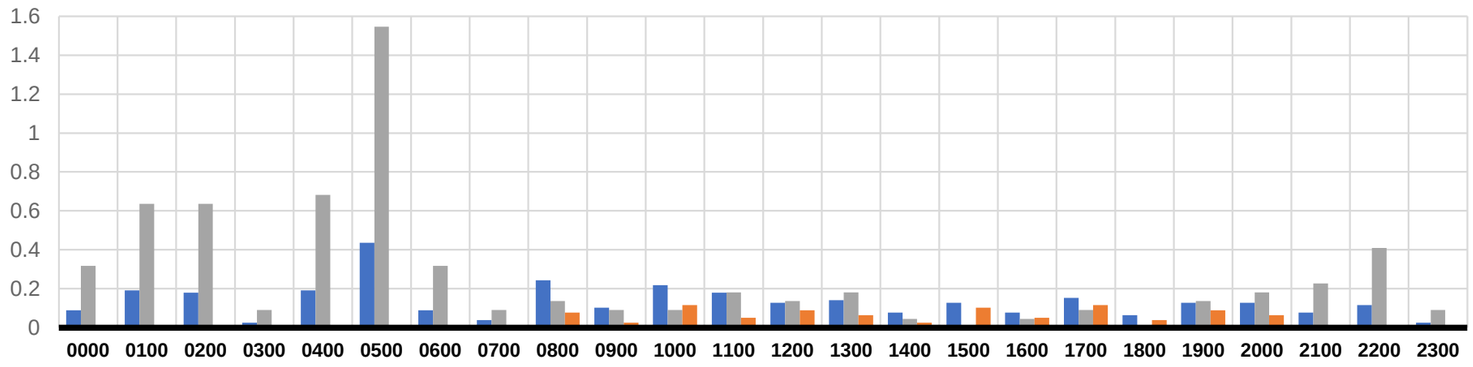


Table 1 Movements breakdown

Operation	Departures	Arrivals	Other	Total
Total movements				
East (09)	2,391	2,338	140	4,869
West (27)	6,411	6,467	548	13,426
Gate-captured movements	140	7	84	231

Table 2 Most common aircraft type movements captured

Aircraft Type	No. Movements Captured	% of movements
Boeing 767-300	26	10
Boeing 737-700 / 737-700ER	25	10
AgustaWestland AW109	23	9
Boeing 737-400	22	9
Boeing 737-800	16	6
Boeing 757-200	15	6
Boeing 777-200F	14	6
Boeing 767-200 / 767-200ER	13	5

3.10 It can be seen in **Figure 4** that when the Airport is operating on runway 09, departing aircraft can overfly this location during both the daytime and the night-time.

3.11 There was no clear pattern identified for overflights, other than only occurring during the daytime.

3.12 It is important to note the scale of **Figure 4**, illustrating how few aircraft are captured per hour or day.

3.13 The most common aircraft types captured are set out in **Table 2**.

3.14 The main known aircraft operators during the monitoring period were:

- Freight operators, including DHL, Fedex, and UPS (approximately 37 % of all movements);
- Ryanair (approximately 14 % of all movements).

3.15 As a large percentage of movements were overflights not associated with East Midlands, 28% of all movements cannot be linked to an operator.

4.0 Ambient Noise Analysis

Rationale

4.1 The CAA state that $L_{Aeq,16hour}$ is the metric to be used for evidence-based decisions, as it correlates best with annoyance in UK-based surveys on daytime noise attitudes. It is important to note that the $L_{Aeq,16hour}$ value to be used is the average resulting from all movements during a 92 day summer period between mid-June and mid-September. The latest survey was undertaken in 2014 and is set out in *CAP1506*.

4.2 As explained in *CAP1506*, even though some people have criticisms of $L_{Aeq,16hour}$ (such as '*an equivalent continuous level is not consistent with people's perception of aircraft noise as a number of discrete, noticeable events*'), it is important for metrics to correlate with the impact being described, which is what $L_{Aeq,16hour}$ does, and it does it better than any other metric.

4.3 This correlation is known as a dose-response function.

4.4 The expected impact of a noise level can be correlated between a noise level and % likelihood of a typical person being highly annoyed using Table 25 of *CAP1506*, reproduced in **Table 3**.

4.5 During the night-time, impact is correlated between noise level and sleep disturbance. The CAA states that $L_{Aeq,8hour}$ is the metric to use and is supported by their indicative findings in *CAP2161*.

4.6 As set out in *CAP2161*, $L_{Aeq,8hour}$ correlates best with mean disturbance during the night-time.

4.7 **Table 3** shows that the likelihood of annoyance and disturbance increase with noise level.

4.8 It is important to note that aircraft noise levels can be audible even when below the ambient noise climate, due to the potential for different frequency spectra.

4.9 The CAA undertook an investigation into any correlation between annoyance to aircraft noise and background ambient noise levels; this investigation is set out in document *CAP1767*.

4.10 The CAA found that there is only a weak link between such a relationship, and crucially any response is tied in with noise sensitivity and socio-economic status as well. It was not possible for the CAA to recommend a link between an individual's aircraft noise-annoyance response related to background ambient noise.

4.11 East Midlands Airport is also required to produce L_{day}, $L_{evening}$, L_{night} and L_{den} metrics every five years as part of the Environmental Guidelines (England) Regulations 2006. There is therefore benefit in calculating these metrics from the noise monitoring, but it is important to note that these metrics do not correlate as well with annoyance as $L_{Aeq,16hour}$.

4.12 The above studies were not able to differentiate the response of people living near airports depending on whether or not they have had enhanced glazing installed, either through an airport-supported scheme or otherwise.

Table 3 % highly annoyed as a function average summer day noise exposure, $L_{Aeq,16hour}$

Average summer day noise exposure, $L_{Aeq,16hour}$ (dB)	% highly annoyed	
	ANIS 1982	SoNA 2014
51	3	7
54	5	9
57	9	13
60	14	17
63	23	23
66	34	31
69	48	39

Table 4 Aviation noise metric results, dB

Metric	Measured Results	Without aircraft	Aircraft only
Whole Period			
$L_{Aeq,16hour}$	51	51	35
$L_{Aeq,8hour}$	48	48	42
L_{day}	52	52	35
$L_{evening}$	50	50	39
L_{night}	48	48	42
L_{DEN}	55	55	48

Results

4.13 While the monitoring period did cover the full 92-day summer period, there were large periods where there was power disruption and as such the monitoring results cannot be directly compared to the dose-response functions set out. The results set out in this section are therefore provided for context only and must be considered with a precautionary approach.

4.14 Noise levels associated with the movements set out in **Section 3** above have been analysed to produce values in various aviation metrics.

4.15 ANOMS can correlate noise events with aircraft movements and can therefore calculate contributions from overall noise levels with those specifically from aircraft. These contributions are set out in **Table 4**, calculated over the whole monitoring period (omitting several brief time periods, as detailed in **Appendix B**).

4.16 As 'aircraft only' noise levels are substantially below ambient noise levels, these values should be viewed as strictly indicative, rather than definitive.

4.17 If the monitoring period were to be taken as being representative of the summer 92-day period, during the daytime, well below 7 % of the community in the vicinity of the monitoring position would be expected to be highly annoyed by aircraft noise.

4.18 This is found using the lowest result of *CAP1506* and comparing $L_{Aeq,16hour}$ noise levels from aircraft only, calculated for all movements, noting that the noise level is lower than the range of *CAP1506*.

4.19 When considering 'aircraft only' noise levels against 'measured results', it can be seen that aircraft have little influence over the noise climate, as 'measured results' are significantly higher. This does not mean that aircraft are not audible, nor that the local community will not be subject to any annoyance or disturbance from aircraft noise. It does mean, however, that road traffic noise becomes dominant in this scenario.

5.0 Number Above Analysis

Rationale

5.1 Number Above contours are specifically stated in UK aviation policy as being helpful in explaining noise impacts around an airport.

5.2 The N70, N65 and N60 metrics relate to different noise impacts, and all three are set out within this section.

5.3 N70 was first used in Australia to relate to the number of times that speech interference would be expected throughout the day. For the equivalent effect to be relevant in the UK, a threshold greater than 70 dB L_{Amax} would be more appropriate.

5.4 However, the research set out in *CAP1506* clearly states that N65 (a lower L_{Amax} threshold than N70) correlates better with annoyance than N70. This trend suggests that any threshold greater than 70 dB L_{Amax} would not be beneficial.

5.5 As with the analysis in the section above, the trend was found to correlate most closely during the 92-day summer period, and so cannot strictly be applied to noise levels calculated from the monitoring period.

5.6 *CAP1506* states that $L_{Aeq,16hour}$ correlates best with annoyance, then N65 over the same summer period (excluding those surveyed who experienced less than 1 event). N70 corelates least well of all the metrics considered.

5.7 N60 relates to a similar effect to N65 and N70, except during the night-time period.

5.8 *CAP2161* states that $L_{Aeq,8hour}$ correlates best with night-time disturbance, then L_{night}, then N60.

Figure 5

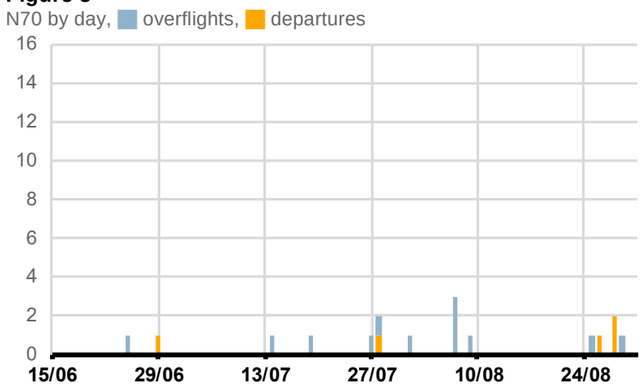


Figure 6

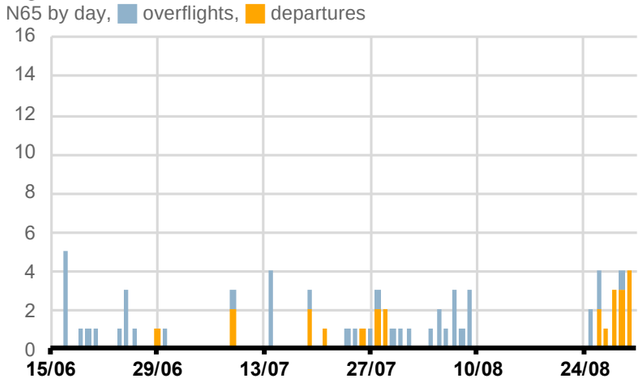
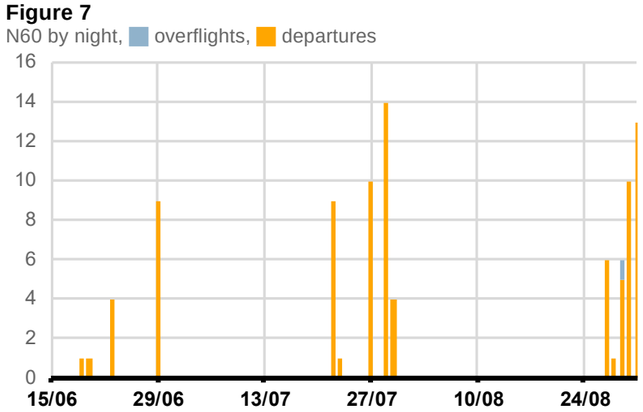


Figure 7



Results

5.9 Averaged over the 78-day period, the following number of events meeting the relevant threshold were captured:

- N70: 18 events;
- N65: 76 events;
- N60: 89 events.

5.10 **Table 5** below sets out the percentage of movements that triggered the relevant threshold to be counted in the Number Above metrics.

Table 5 Percentage movements within Number Above thresholds

Metric	Overflights	Departures	Total
N70	17 %	11 %	12 %
N65	60 %	53 %	49 %
N60	n/a	93 %	93 %

5.11 As set out in **Table 5**, nearly all night-time movements (93 %) generated a noise level of at least 60 dB L_{Amax} above the monitoring position. No overflights occurred during the night-time.

5.12 Half of all daytime movements (49 %) generated at least 65 dB L_{Amax} and few (12 %) of all daytime movements generated at least 70 dB L_{Amax}.

5.13 The trend for total movements matches that of departures. Overflights are more likely to generate noise levels above the relevant thresholds than departures.

5.14 Regardless of the noise level, it can be seen in **Figures 5**, **6** and **7** that the total numbers of aircraft flying are low, especially during the daytime.

6.0 Individual Event Analysis

Rationale

6.1 All of the metrics considered reflect the noise generated by multiple aircraft movements. There is also benefit in analysing noise levels corresponding to individual events.

6.2 Noise levels corresponding to an individual aircraft movement differ due to a wide range of factors, including aircraft type, weight, engine and weather. It is also important to account for the duration of the noise, for example an aircraft passing overhead quickly may be less disturbing than one passing more slowly.

6.3 The SEL (Sound Exposure Level) metric takes into account the overall noise of an aircraft movement. This includes the maximum noise generated during the movement; due to the logarithmic nature of noise levels, it is typical that the SEL is driven by the L_{Amax} of an aircraft event.

6.4 Not only does SEL account for both noise level and duration, but by summing multiple SELs, it is possible to calculate the L_{Aeq} over the time period in which they all occur. It is therefore a powerful metric for explaining aviation noise.

6.5 The L_{Amax} metric also has a part to play. It is the simplest measure of a noise event, providing only the highest noise level generated by an aircraft flyover. The L_{Amax} noise level cannot be correlated to annoyance, as no known dose-response function exists for aviation noise. It is, however, easy to understand and so is included within this section.

Figure 8
Average to maximum range in **OVERFLIGHTS SEL**

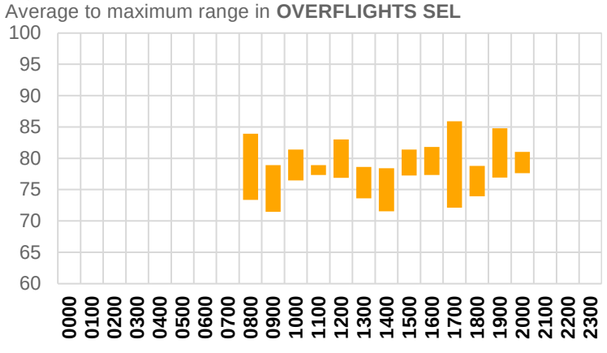


Figure 9
Average to maximum range in **DEPARTURES SEL**

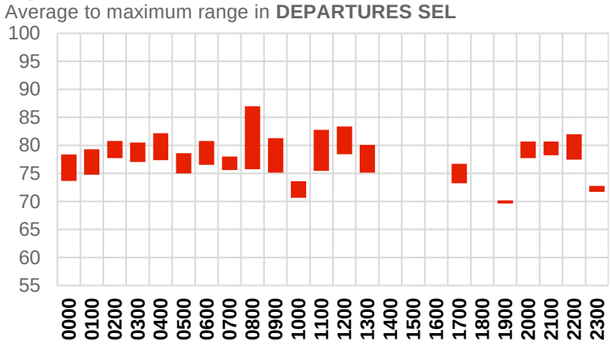


Figure 10
Average to maximum range in **OVERFLIGHTS L_{Amax}**

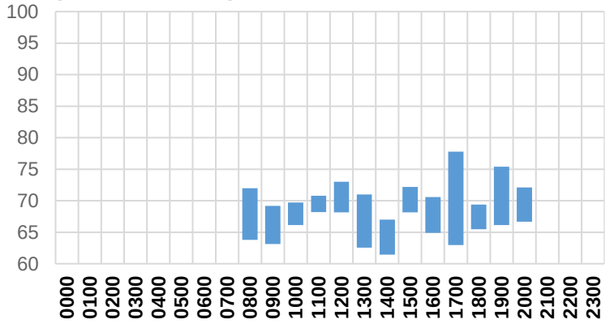
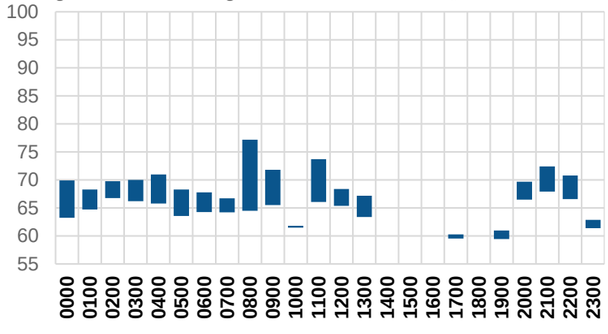


Figure 11
Average to maximum range in **DEPARTURES L_{Amax}**



Results

6.6 **Figures 8** and **9** show how the average and maximum SEL varies over the course of the day for departures and overflights. **Figures 10** and **11** show how the average and maximum L_{Amax} varies over the course of the day.

6.7 For overflights, it can be seen in **Figures 8** and **10** that there is some small variation in average SEL and L_{Amax} values throughout the day. Given that the number of movements captured overall is small, some variation could reasonably occur without being notable.

6.8 Values for overflights are daytime only, as no overflights occurred during the night-time.

6.9 For departures, it can be seen in **Figures 9** and **11** that there is greater variation in average SEL and L_{Amax} values throughout the day and night. These values are also subject to the same comment on small sample sizes.

6.10 During the night-time, where more aircraft departures were captured in each hour, it can be seen that there is less variation in values, as shown in **Figures 9** and **11**.

6.11 There are multiple hours in the afternoon where no departures were captured.

6.12 The single highest SEL and L_{Amax} noise events captured during the monitoring period are:

- Maximum SEL (overflight) measured: 86 dB; Sikorsky S76 helicopter.
- Maximum SEL (departure) measured: 87 dB; Boeing 747-800.
- Maximum L_{Amax} (overflight) measured: 78 dB; Sikorsky S76 helicopter.
- Maximum L_{Amax} (departure) measured: 77 dB; Boeing 747-800.

6.13 The highest SEL and L_{Amax} events both correlate to the same two events (the same helicopter generated the highest overflight noise levels, and same aircraft departure Both of the above events occurred during the daytime.

Appendix A

Noise Monitor and Gate Details

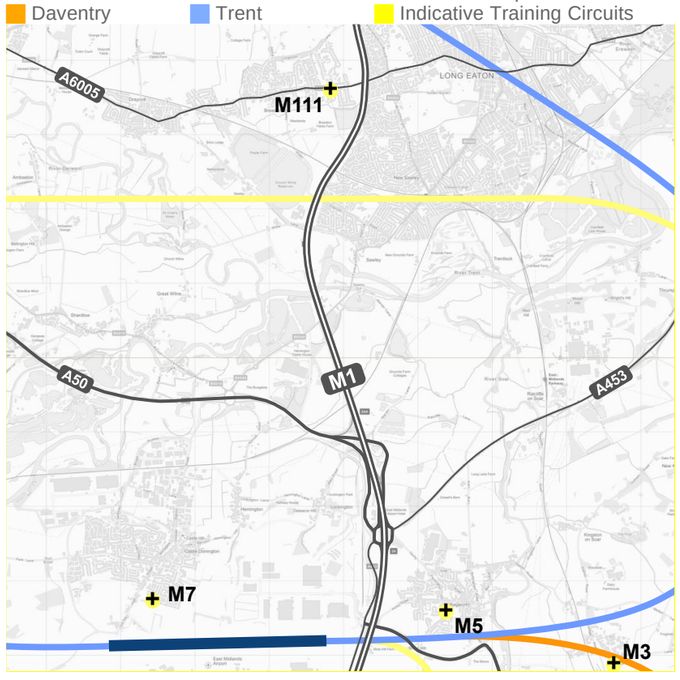
Monitoring Location M111

Noise monitoring has been undertaken at Location M111, which is located within a residential garden off Whilsthorpe Road, to the northeast of East Midlands Airport.

The monitoring location can be seen on **Figure A.1**.

The ambient noise climate is controlled by road traffic on Whilsthorpe Road.

Figure A.1
Noise monitor location M111 to north of East Midlands Airport
Daventry Trent Indicative Training Circuits



Monitoring was undertaken continuously between 15 June and 14 September, although the monitor was affected by power outages.

The equipment installed is a *Bruel and Kjaer* Sound Level Analyser (Type 3639 – A), which self-calibrates to ensure a suitable level of accuracy is maintained.

The microphone was positioned at 4.0 m above the local ground level, to minimise the measuring of noise reflecting off the ground. The microphone is located within a weatherproof windshield to protect it. The monitor setup can be seen in **Figure A.2**.

Figure A.2
Noise monitor in position

The Gate

The noise monitor is connected to East Midlands' ANOMS. When noise levels reached a trigger point, ANOMS correlates the noise event to an aircraft movement, assuming an aircraft movement is occurring above the position. The trigger level was set at 60 dB up to 1st August, after which it was lowered to 55 dB.

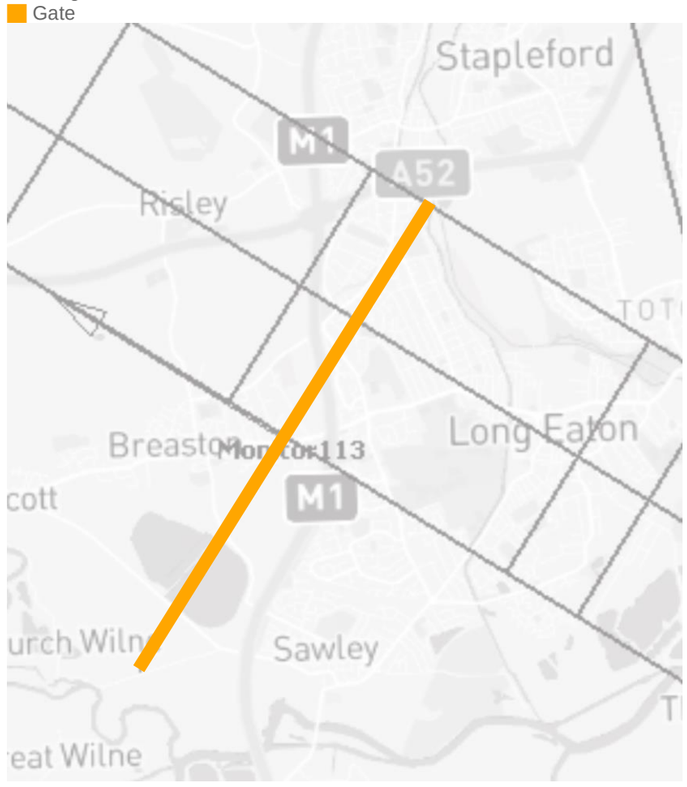
There could be some interference in the data, should noises close to the microphone be caused by something louder than an aircraft. To lower this risk, audio recording is made. To avoid an overly onerous, time-consuming process, only audio recordings of distinct outliers are further analysed (as noted in **Appendix B**).

Aircraft events are correlated against movements which passes through the 'gate'.

For Location M111, the 'gate' is located to capture movements departing on the Trent NPR from runway 09.

The gate is a virtual, rectangular shape stretching from ground level up to 8,000 feet above ground level and 2.6 nautical miles wide. The gate can be seen on **Figure A.3**.

Figure A.3
Virtual gates to correlate noise events with aircraft movements
Gate



The flightpaths of aircraft correlated to noise events can be seen in the below three figures, as well as the NPR routing in three dimensions.

Figure A.5
Departures on 09 Trent

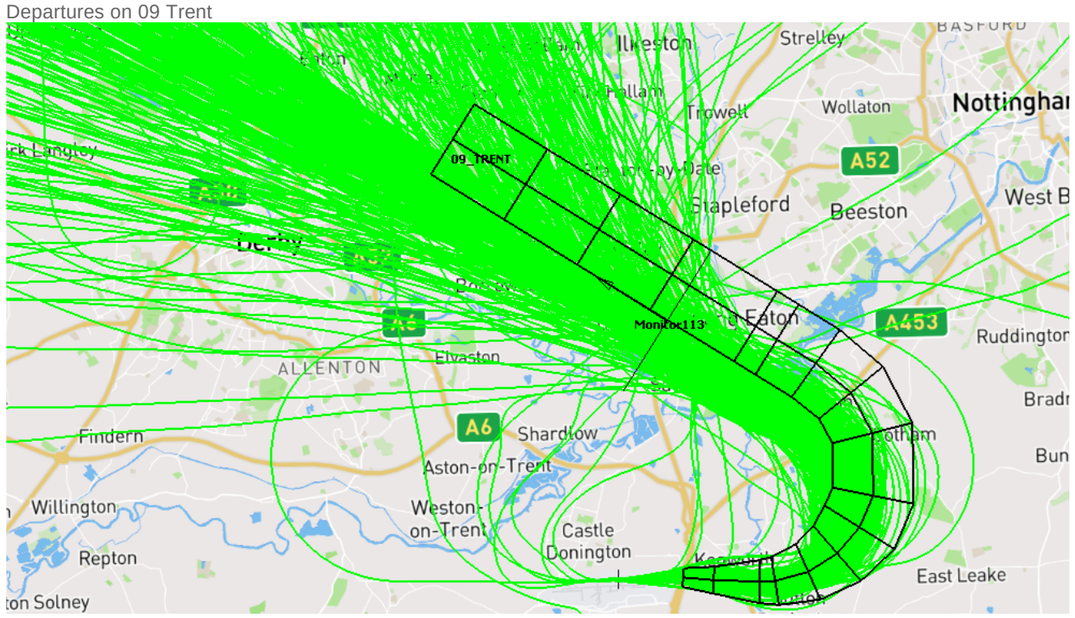


Figure A.6
Overflights

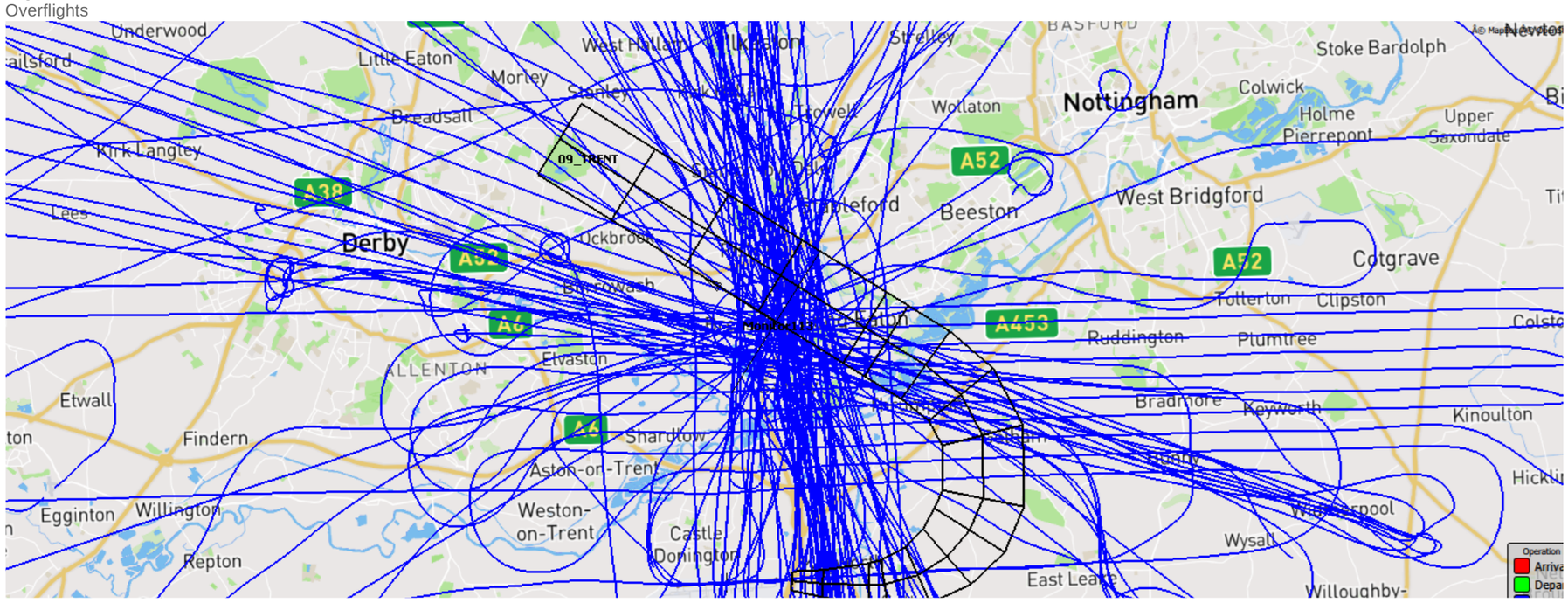
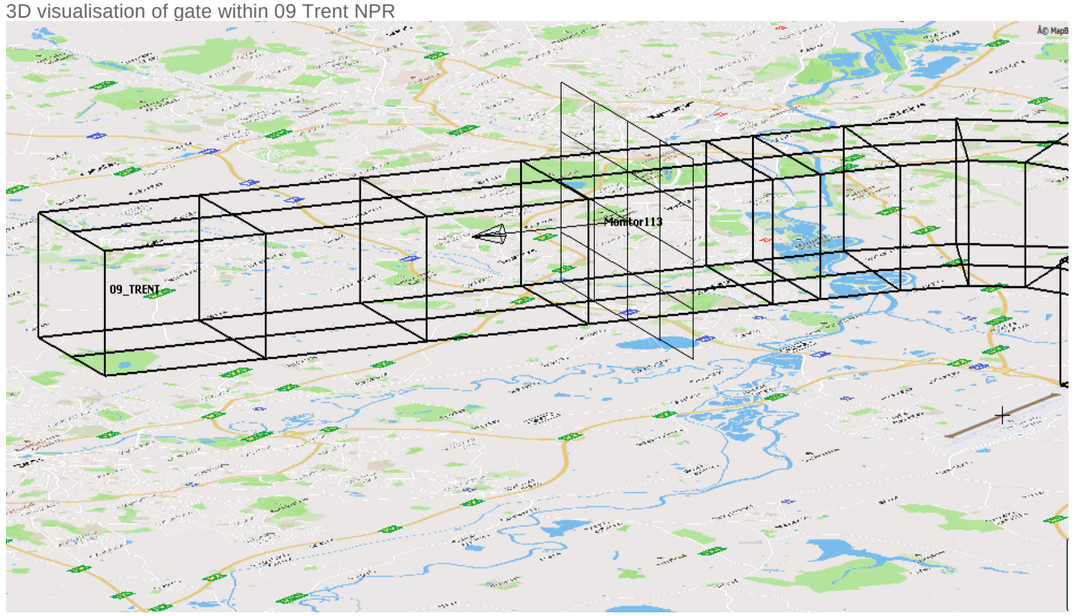


Figure A.7
3D visualisation of gate within 09 Trent NPR



Appendix B

Monitoring Results

Noise Data

Noise data collected by the monitoring position is presented in this appendix using the $L_{Aeq,1hour}$ metric. A 1-hour period shows how noise levels change hour by hour, allowing for greater inspection than longer period metrics.

Three values are presented, all of which are calculated by the monitoring equipment software. All are measured in dB $L_{Aeq,1hour}$ and are:

- Total noise level – all noise measured by the monitoring position uncorrected. Presented as continuous black line.
- Without aircraft noise level – total noise level minus any influence from correlated aircraft events. Representative of community noise levels if aircraft noise was not present. Presented as dashed grey line.
- Aircraft only noise level – the difference between total and community noise levels. Representative of noise purely from correlated aircraft events. Presented as continuous orange line.

The total and without aircraft noise levels match each other closely and are typically on top of each other on the graphs below due to the low levels of aircraft noise at the monitoring position.

Weather Data

Weather data has been provided alongside the noise data. East Midlands Airport has two weather monitors, with data provided being that from Weather Monitor 2, as this station measures rainfall.

Wind speed (knots), wind direction (degrees) and rainfall (inches) have been provided for the survey duration for every 15-minute period.

We have condensed this data down into 3-hourly periods, by averaging the wind speed and direction and summing the rain.

Correlated Event Data

Correlated aircraft events are those where an increase in noise level corresponds to a movement passing through the gate.

The data presented below shows the number of correlated events that have occurred in each hour of monitoring, split by arrivals and departures as well as the total.

Inclusion of these correlated events allows for the weather and noise data to be compared, when looking at which direction the runway is operating in, as well as how movements are split by hour and day.

Data Omitted from Analysis

Multiple periods of data have been omitted from noise analysis. These periods are set out in **Table 1.1** , alongside the reason why.

Table 1.1 Omitted data

Periods omitted	Reason
15/06/2022 12pm until 24/07/2022	No data
27/07/2022 9pm until 12am	Rain
16/06/2022 6pm until 7pm	Power disruption
16/08/2022 9pm until 12am	Rain
17/06/2022 1am until 2am	Power disruption
17/06/2022 6am until 7am	Power disruption
17/06/2022 3pm until 4pm	Power disruption
17/06/2022 5pm until 6pm	Power disruption
18/06/2022 8am until 9am	Power disruption
19/06/2022 6pm until 8pm	Power disruption
20/06/2022 4am until 5am	Power disruption
20/06/2022 7am until 10am	Power disruption
20/06/2022 1pm until 3pm	Power disruption
20/06/2022 6pm until 7pm	Power disruption
23/06/2022 9pm until 10pm	Power disruption
23/06/2022 8am until 9pm	Power disruption
24/06/2022 8am until 9am	Power disruption
24/06/2022 1pm until 2pm	Power disruption
24/06/2022 4pm until 5pm	Power disruption
29/06/2022 11am until 12am	Power disruption
29/06/2022 3pm until 7pm	Power disruption
2/07/2022 6am until 5pm	Power disruption
11/07/2022 10am until 11am	Power disruption
12/07/2022 12pm until 1pm	Power disruption
12/07/2022 4pm until 6pm	Power disruption
15/07/2022 4am until 8am	Power disruption
16/07/2022 12am until 1am	Power disruption
17/07/2022 8pm until 11pm	Power disruption
18/07/2022 5am until 8am	Power disruption
20/07/2022 12am until 1am	Power disruption
21/07/2022 7pm until 9pm	Power disruption
22/07/2022 6am until 23/07/2022 10pm	Power disruption
27/07/2022 5pm until 28/07/2022 5pm	Power disruption
28/07/2022 6pm until 29/07/2022 4am	Power disruption
31/07/2022 2am until 4am	Power disruption
31/07/2022 6am until 8am	Power disruption
31/07/2022 12pm until 5pm	Power disruption
31/07/2022 8pm until 10pm	Power disruption
1/08/2022 7am until 9am	Power disruption
1/08/2022 6pm until 2/08/2022 1am	Power disruption
3/08/2022 3pm until 6pm	Power disruption
9/08/2022 7pm until 10/08/2022 4pm	Power disruption
10/08/2022 6pm until 22/08/2022 1pm	Power disruption
22/08/2022 9pm until 11pm	Power disruption
26/08/2022 11pm until 12am	Power disruption
28/08/2022 4am until 7am	Power disruption
28/08/2022 11am until 14/09/2022	Power disruption

Data omitted due to weather is omitted from noise analyses. It is not necessary to omit the above weather-related periods from movement analyses, as the number of aircraft movements was not affected.

Data missing due to power disruption is omitted where no data has been collected and so cannot be used in any analyses.

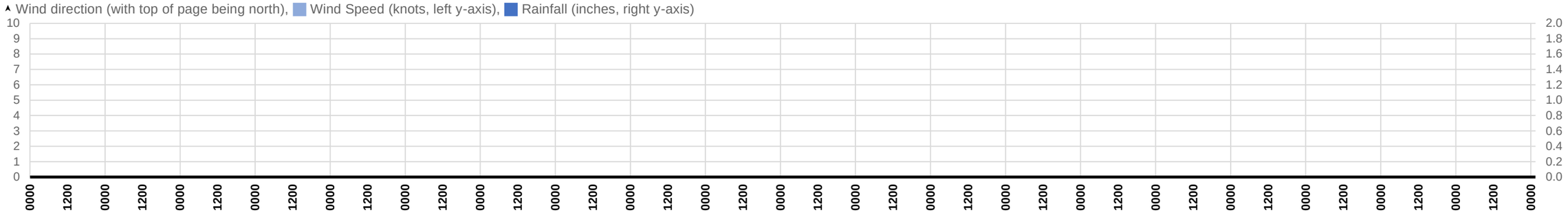
Periods of weather data are also missing due to separate power disruption issues. It is assumed that where no weather data is known, weather conditions were acceptable for noise monitoring.

Survey Data: 15 June to 4 July 2022

Data presented at intervals available against date and time (hhmm, x-axis)

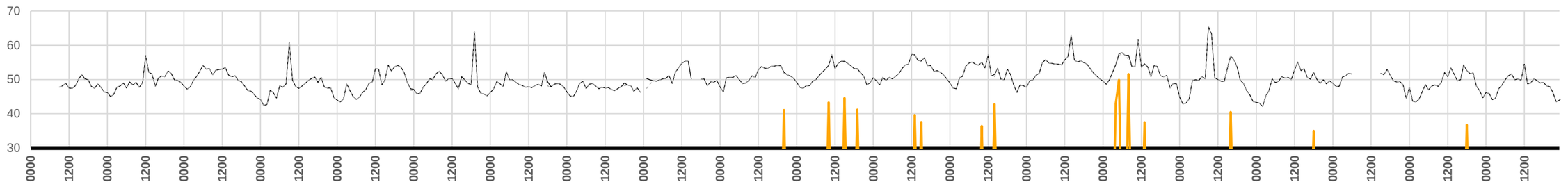
Weather Data at Location 2

▲ Wind direction (with top of page being north), Wind Speed (knots, left y-axis), Rainfall (inches, right y-axis)



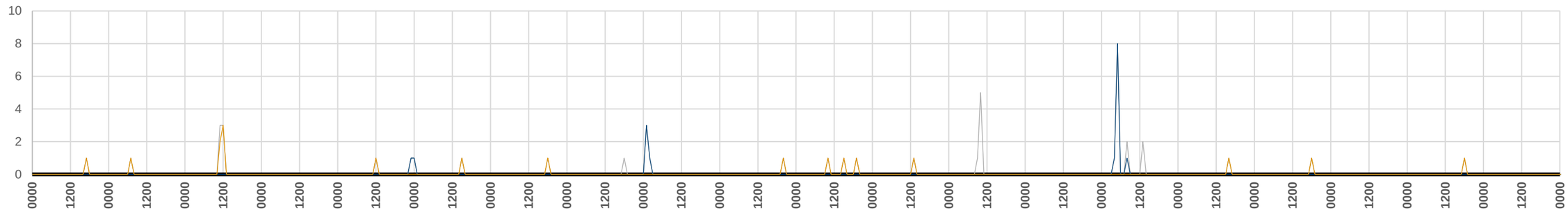
Noise at Monitoring Position (111)

Sound pressure level (dB, y-axis) in terms of total $L_{Aeq,1hour}$, without aircraft $L_{Aeq,1hour}$, and aircraft only $L_{Aeq,1hour}$



Correlated Aircraft Events

Number of movements (y-axis) in terms of Departures, Overflights, and All movements

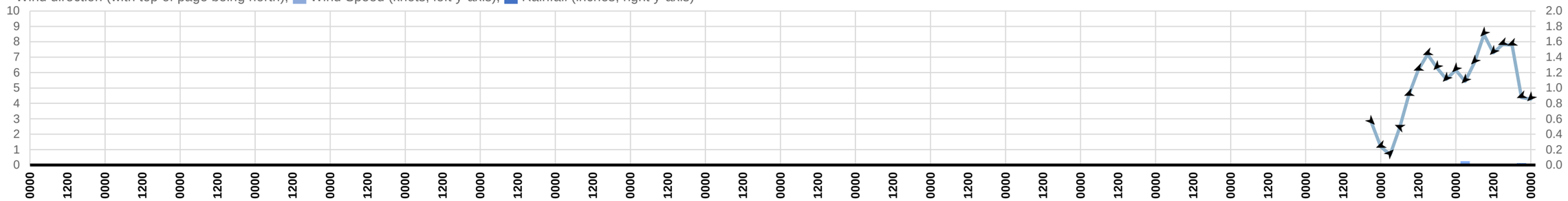


Survey Data: 5 to 25 July 2022

Data presented at intervals available against date and time (hhmm, x-axis)

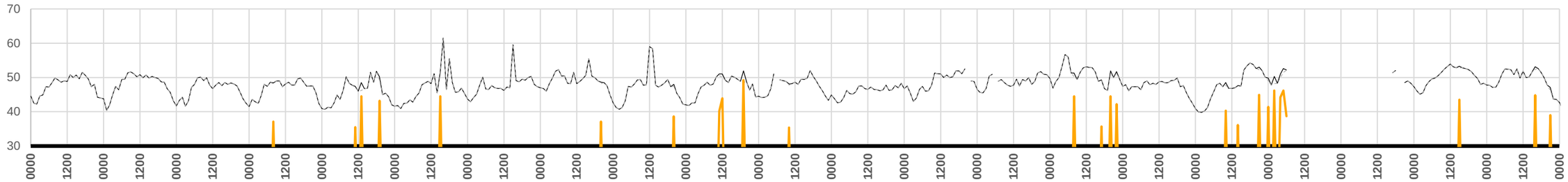
Weather at Location 2

▲ Wind direction (with top of page being north), Wind Speed (knots, left y-axis), Rainfall (inches, right y-axis)



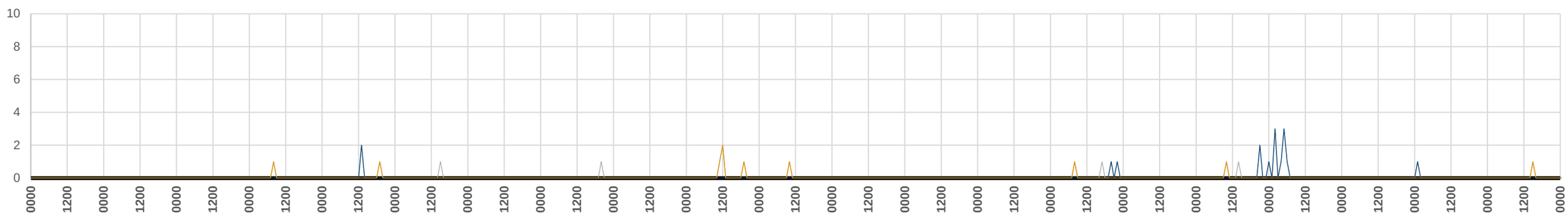
Noise at Monitoring Position (111)

Sound pressure level (dB, y-axis) in terms of total $L_{Aeq,1hour}$, without aircraft $L_{Aeq,1hour}$, and aircraft only $L_{Aeq,1hour}$



Correlated Aircraft Events

Number of movements (y-axis) in terms of Departures, Overflights, and All movements

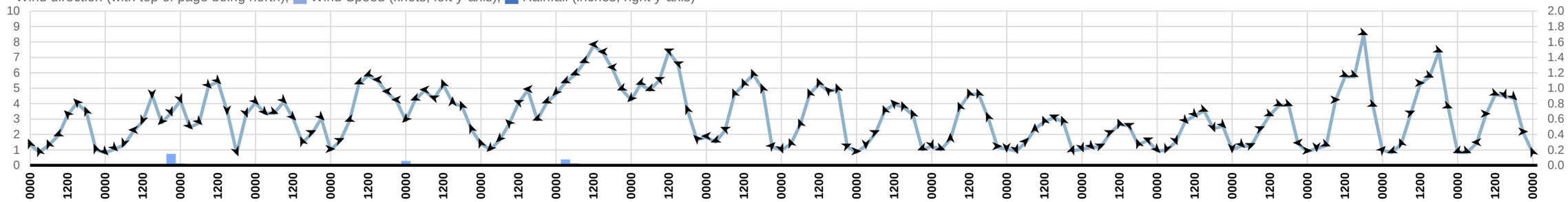


Survey Data: 26 July to 14 August 2022

Data presented at intervals available against date and time (hhmm, x-axis)

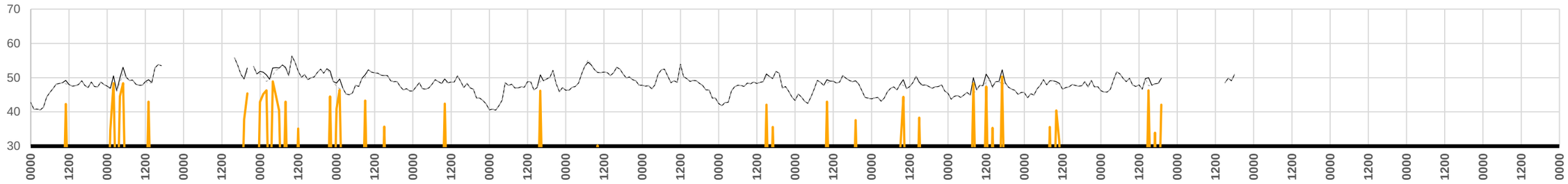
Weather at Location 2

▲ Wind direction (with top of page being north), Wind Speed (knots, left y-axis), Rainfall (inches, right y-axis)



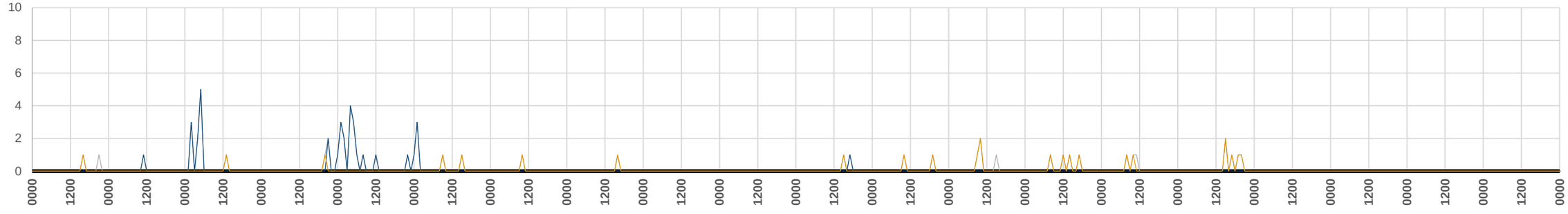
Noise at Monitoring Position (111)

Sound pressure level (dB, y-axis) in terms of total $L_{Aeq,1hour}$, without aircraft $L_{Aeq,1hour}$, and aircraft only $L_{Aeq,1hour}$



Correlated Aircraft Events

Number of movements (y-axis) in terms of Departures, Overflights, and All movements

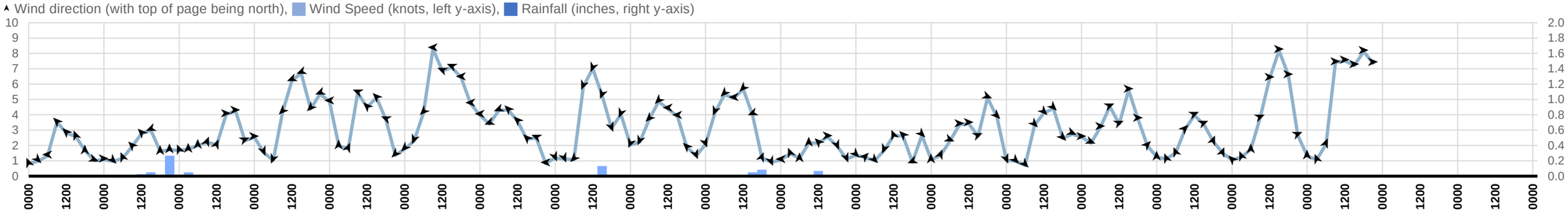


Survey Data: 15 August to 1 September 2022

Data presented at intervals available against date and time (hhmm, x-axis)
1st September until 14th September was affected by a power outage so no noise monitoring was undertaken during this period.

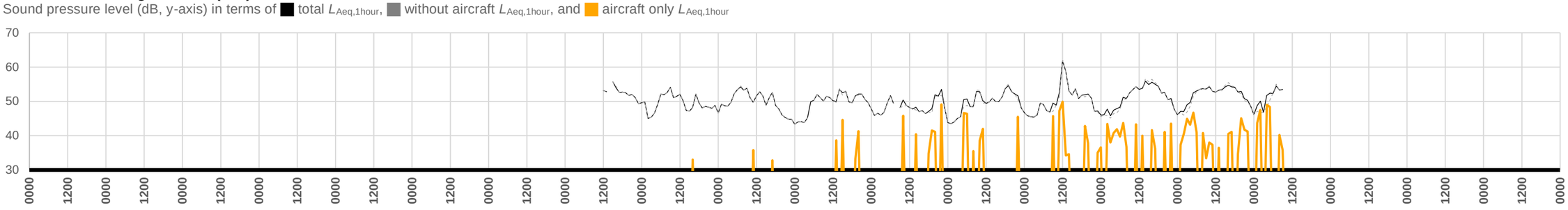
Weather at Location 2

Wind direction (with top of page being north), Wind Speed (knots, left y-axis), Rainfall (inches, right y-axis)



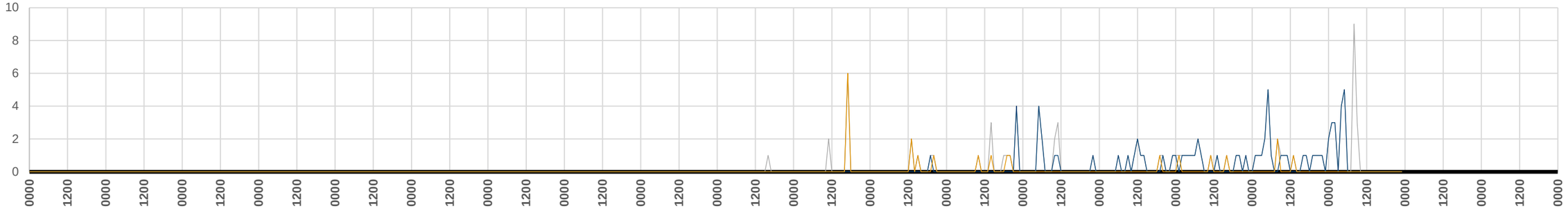
Noise at Monitoring Position (111)

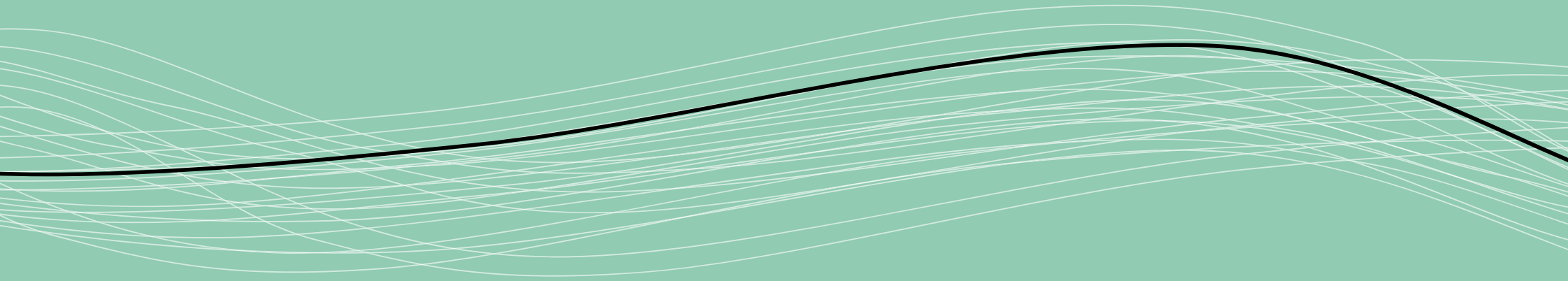
Sound pressure level (dB, y-axis) in terms of total $L_{Aeq,1hour}$, without aircraft $L_{Aeq,1hour}$, and aircraft only $L_{Aeq,1hour}$



Correlated Aircraft Events

Number of movements (y-axis) in terms of Departures, Overflights, and All movements





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