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FUTURE AIRPORT EXPANSION AT STANSTED, HEATHROW AND GATWICK: STATISTICS AND METHODOLOGY

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1 INTRODUCTION

Chapter 11 of the Government White Paper [1], the Future of Air Transport, covers the South East of England, and Chapter 11 of the same document discusses Environmental Impacts. The major potential development options recommended are at Stansted, Heathrow and Gatwick. This paper examines the way that the aircraft noise exposure implications of these options was described in the White Paper, stressing statistical and methodological aspects. The presentation and description of quantitative results and aircraft noise assessments needs to be of a high professional standard. It must be noted at the outset that this critique should not be taken as questioning the sincerity of Department for Transport (DfT) officials or their consultants: the work programme and processes that led up to the White Paper were extensive and the technical tasks were formidable. Paragraph numbers and text shown in bold italic below are from the White Paper.

2 PROVIDING A CONTEXT

The focus here is aircraft noise exposure. This is just a part of the total picture: pollution from NOX emissions, new roads, demolition of family/listed houses are just examples of the impact of airport development. Necessarily, the White Paper has at some point to bring all these factors together and weigh them against the different benefits to be obtained. But a proper context is essential – the Paper sometimes tends to assume that 'everyone knows' what the situation is. Without this context, the effects of development can be difficult to assess. The document states (paragraph 11.52) that *Daytime noise impacts at Heathrow are many times worse than at any other airport in the UK, despite significant improvements in the noise climate over many years.* It is certainly important to recognise the technological improvements and investments in engines and airframes, but this does not stress sufficiently quantitatively the situation at Heathrow.

Noise exposure information on Stansted, Heathrow and Gatwick is available on the DfT website [2]. How is it best to compare the noise impact at the three airports? Table 1 below shows comparisons for 2001 using 'Standard' contours. The year 2001 is chosen because the traffic effects of 9/11 did not distort traffic, and because there were very few Concorde movements during the period for which the contours are calculated. Standard contours use the average runway usage over a long period – Actual contours in each year vary considerably with wind direction. Other sets of contours could easily be chosen, of course.

	Heathrow		Gatwick		Stansted	
Leq dBA	**Area sq km**	**Population 000s**	**Area sq km**	**Population 000s**	**Area sq km**	**Population 000s**
>69	13.8	6.1	5.9	0.1	3.6	<0.1
>63	41.2	56.9	19.7	0.9	11.6	0.5
>57	116.7	243.4	56.0	5.4	32.2	2.3

Table 1. Comparison of contour areas/populations enclosed (Standard contours for 2001)

The numbers tend to speak for themselves, but an illustration makes the point more strongly. A stone's throw away is Nelson's column, which is 173 feet high (or more or less depending on the information source). Suppose the Heathrow >57 contour population – 243,000 – is taken as represented by the height of the column. From the table, Gatwick and Stansted' together have a population of 7,700 within this contour. This scales to a height of 5 feet 6 inches. So the relative populations exposed at the two airports compared with Heathrow correspond to a not particularly tall man standing next to Nelson's column. This puts the size of the aircraft noise problem at Heathrow into a quantitative context. The problems at other airports are significant and important to those affected, but they are not of a comparable magnitude to those at Heathrow.

Why is population used in this illustration rather than the area affected? The answer is that it is the amount of disturbance to people that is surely the most relevant. The most direct impacts are through people's general annoyance and that arising from the interference with their personal activities. Fields, woods and ponds do not express annoyance.

3 HEATHROW OPERATION

Paragraph 11.66 states re Heathrow:

> *…It is important, therefore, to consider the scope for greater utilisation of the two existing runways. For example, mixed mode operation in peak hours might be introduced, while retaining runway alternation for the rest of the time. The impacts and benefits of any such proposal would have to be studied in detail, and there would need to be a full public consultation…The proposals will need to take account of air quality and noise implications, including review of existing procedures such as westerly preference and the 'Cranford Agreement'…*

The tone of the text tends to suggest something that is not particularly perturbing, but this paragraph has potentially extremely significant noise implications. The present Heathrow operation can be summarised as:

> Segregated operation: landings on one runway, takeoffs on the other
>
> Westerly runway alternation: the departure and arrival runways are swapped over during the day, so some communities get periods of respite from the highest noise exposure (which are said by local groups to be highly valued)
>
> Cranford Agreement: on easterly operations, departures use the southern runway.

This is complicated by 'TEAM' [3]. TEAM allows NATS to land some additional aircraft on the designated departure runway, if this relieves severe inbound congestion (leading to many aircraft stacking).

Mixed mode allows simultaneous take-offs and landings on both runways – so Heathrow looks like 'two Gatwicks'. In the simplest case, each would have a repeating sequence of departure and arrival. Full mixed mode would require essentially independent operation of the parallel runways: Heathrow does not meet the International Civil Aviation Organization requirements for runway separation in this regard – the minimum is 5000 feet, about four hundred feet more than the actual separation. Airports in the USA do however operate in mixed mode with smaller distances between runways, but they need special radars and warning devices for controllers.

The text mentions 'peak hours' but does not say what they might be. In fact, Heathrow has become such a valuable airport for operators that its peak hours have expanded over the day, over the week and over the year. Tether and Metcalfe [4] provide a useful insight into the ways that historically Heathrow's runway capacity and annual movement capacity have increased. The key message is that the peak hours for Heathrow progressively extend to cover virtually the whole period not subject to restrictions.

Full mixed mode would increase the peak hour capacity by up to 15% - and hence increase the noise contour area and the population covered significantly. A crude calculation illustrates the probable magnitude on a 'like-for-like' basis.

Leq Level dBA	Area sq km	Ratio of areas	Population 000s	Ratio of populations
>72	7.0		1.4	
>69	13.8	1.97	6.1	4.36
>66	25.5	1.85	20.7	3.39
>63	41.2	1.62	56.9	2.75
>60	67.2	1.63	111.1	1.95
>57	116.7	1.74	243.4	2.19

Table 2. Comparison of contour areas/populations enclosed for Heathrow (Standard contours for 2001)

Table 2 is a more detailed version of Table 1 specifically for Heathrow. A cell in the columns under the heading 'ratio…' is the ratio of the number to the cell's left to the number immediately above that. Thus, 1.74 in the bottom row is the ratio of 116.7 to 67.2. The ratios show some regularity. The rightmost column shows that, in the range >60 to >57, a decrease of 3 Leq corresponds to a more than doubling (a factor of 2.19) of the population affected. A 15% increase in traffic, with all other things being equal, corresponds to an increase in the Leq value of 0.61 dBA ($10^{0.6070/10} = 1.15$). This implies that the >57 contour expands to cover a population of $243.4 \times 2.19^{(0.607/3)} = 243.4 \times 1.172 = 285.3$. This is an increase of about 42,000 people.

Obviously, this is a rough estimate, but as a marginal analysis, it is probably not too bad a figure. Higher figures were in fact estimated in some of the supporting documents for the White Paper (these were probably the consequence of comparatively high population densities at the easterly end of the current contours – note that population ratio in Table 2 increases at a greater rate than the area ratio). Compare this 42,000 with the increased populations within the >57 dBA Leq contour for the developments identified at Stansted and Gatwick: respectively *'8,000 by 2015 and 14,000 by 2030'* (paragraph 11.31) and *'close parallel option would increase the number of people within the 57dBA noise contour in 2030 by around 3,000, and the wide space option by around 15,000'* (paragraph 11.74). So mixed mode at Heathrow would be a more significant change in population affected than those at the two other airports combined.

4 CONTOUR CAP AT HEATHROW

Paragraph 11.53 states:

> *We believe that development of Heathrow should be subject to a stringent limit on the area significantly affected by aircraft noise, with the objective of incentivising airlines to introduce the quietest suitable aircraft as quickly as is reasonably practicable…Specifically for Heathrow, we propose that any further development could only be considered on the basis that it resulted in no net increase in the total area of the 57dBA noise contour compared with summer 2002, a contour area of 127 sq. km.*

Would a contour cap of this kind be a 'good thing'? Several kinds of concern have been expressed, including:

- How is the 'right' cap to be set?
- Would a cap be consistent with International Civil Aviation Organization (ICAO)/European Union (EU) legislation/intentions?
- Would a cap cause other environmental problems, eg increased fuel burn and NOX emissions?

These are substantial questions; indeed the third lies outside the scope of aircraft noise questions. The comments here focus on the first two questions.

The 127 sq km figure is the 2002 Actual area, ie according the runway model split in that year. It is in fact the same as the Standard area for 2002, as the modal split was near the average value. But it includes some Concorde flights whereas the 2001 contour included hardly any (0.1 per day in 2001 and 2.1 in 2002). One Concorde produces about the same noise energy as thirty five B747-400s, so it has an extremely large noise footprint, with even one or two Concordes per day affect the >57 contour area markedly. Is it appropriate to use contours that had a significant number of such flights?

Why is the area used, rather than the population affected? As already noted it is people who are disturbed not sq. km. of land surface. A population contour would therefore be better. But a 57 dBA Leq contour is not sufficient in itself. How could it be if it covers a markedly higher number of people within the higher value noise contours? Table 2 shows that large numbers of people at Heathrow live within higher value contours. It is not just that people are more disturbed on average at these higher values but that the proportion of people who say that the aircraft noise exposure is 'unacceptable' or in the highest rating of annoyance is so much greater (Brooker et al [5] – ANIS Report) for examples of disturbance scales).

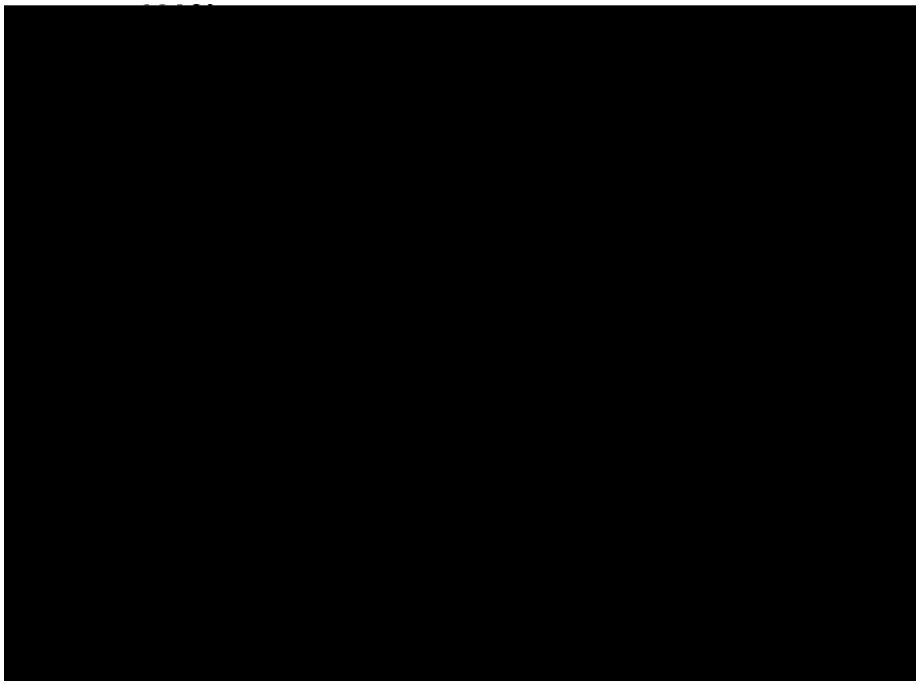

Figure 1. Percentage of survey respondents saying that levels of aircraft noise are unacceptable (rough trend approximation to Figure 9.10, ANIS Report)

Figure 1 illustrates the typical variation of 'Aircraft noise unacceptable' with Leq. The percentage increases from around 15% at 57 Leq to 75% at 69 Leq. These numbers are used in Table 3. This takes the proportion rating unacceptable – at the lower end of each Leq band and multiples it by the population in the band. This produces an estimate of the population within each band who rate aircraft noise unacceptable. The total number is 66,000.

Leq Band dBA	Population in band - 000s	% unacceptable	Number rating unacceptable 000s
>72	1.4	90	1.3
69-72	4.7	75	3.5
66-69	14.6	60	8.8
63-66	36.2	45	16.3
60-63	54.2	30	16.3
57-60	132.3	15	19.8
		Total	66.0

Table 3. Illustrative comparison of populations enclosed for Heathrow and % rating unacceptable (Standard contours for 2001)

Now suppose that there has been a slight upwards change in the Leq values except near the 57 dBA Leq boundary. Make a series of 'not unreasonable' assumptions. First, assume a shift of 5 percentage points in the unacceptable rating, eg 90 becomes 95, etc, but leave the percentage value in the 57-60 band unchanged. This is a device to produce the rough equivalent of a 1 dBA

upwards shift in the Leq bands affected. Table 4 shows that it produces the column marked A as the number rating aircraft noise unacceptable. The total number of people offering this rating increases to 71,500, an increase of about 8%.

Leq Band dBA	Population in band - 000s	Assumed % unacceptable (shifted up)	Number rating unacceptable A	Assumed population factor	Number rating unacceptable B
>72	1.4	95	1.3	0	0.0
69-72	4.7	80	3.8	0	0.0
66-69	14.6	65	9.5	1.05	10.0
63-66	36.2	50	18.1	1.05	19.0
60-63	54.2	35	19.0	1.05	19.9
57-60	132.3	15	19.8	1.05	20.8
		Total	**71.5**	**Total**	**69.7**

Table 4. Illustrative comparison of populations enclosed for Heathrow and unacceptable %, with 'unacceptable shift' and population growth – see text (Standard contours for 2001)

Next, a more complex model, assume that the population has increased by 5% except for Leq > 69, but that all the population within the 69 contour disappears. This assumption together with the previous one produce the calculation set out in Table 4 column B. The increase in numbers of people rating unacceptable is from 66,000 to 69,700 – about 6%. How realistic might the population assumptions be? The disappearance of all the people within >69 dBA Leq is probably too drastic. The increase in the other populations is very difficult to forecast – but the >69 people have to go somewhere, and the London suburbs – in the widest sense of the phrase – have tended to increase in population. As noted, the shift in the unacceptable rating is no more that the equivalent of 1 dBA, so hardly remarkable.

The key point of these illustrations is that a constant contour area for >57 dBA Leq can readily hide a marked increase in the number of people rating the aircraft noise environment as unacceptable (or whatever other measure of disturbance is used).

This increase in population affected links in to European policy on noise. Details on existing EU documents are at [6, 7, 8]. The European Union's Sixth Environmental Action Programme has a political target of "substantially reducing the number of people regularly affected by long-term average levels of noise". On the evidence above, it is difficult to believe that a UK policy based on a noise area contour cap could be compatible with an EU objective of reducing 'substantially' the numbers of people affected by aircraft noise. Note that the White Paper (paragraph 11.52) states that:

> *The Government's policy - reaffirmed in the consultation document - is to take all practicable steps to prevent any deterioration in the noise climate at Heathrow, and to continue to do everything practicable to improve it over time.*

5 HEATHROW THIRD RUNWAY

The White Paper's paragraphs dealing with a possible third runway at Heathrow devote considerable attention to pollutants and emissions, especially air quality. Regarding noise, it notes (paragraph 11.52) that:

> *The Government's support would also be conditional on measures to prevent deterioration of the noise climate…*

However, the White Paper does not indicate the possible effects of a third runway on the population exposed to aircraft noise.

There are many examples in the DfT's supporting technical documents about the potential impact of such a runway. The most straightforward comparison can be found in [9], which shows *inter alia* >57 DBA Leq populations projected in 2015 for:

> Table 2.1(b): Maximum-use existing runway, 480,000 Passenger Air Transport Movements (PATMs)
>
> Table 2.3(b): Short third runway, 655,000 PATMs, revised forecast, no change to present operation on two main runways.

The respective populations are 195,500 and 304,900: an increase of 109,400 – 55%.

The White Paper does not suggest that this additional runway would be in place by 2015 – a more likely date would be 2030. Over the next 25 years, there will be population shifts and major changes in aircraft types and performance characteristics, so it is not easy to produce simple 'likefor-like' estimates of the effect of the third runway. But a 50% increase in contour area might be reasonable?

6 CONCLUSIONS

This paper has examined the ways that the aircraft noise exposure implications of major potential development options recommended at Stansted, Heathrow and Gatwick were described in the White Paper, stressing statistical and methodological aspects. The presentation and description of quantitative results and aircraft noise assessments needs to be of a high professional standard, but the White Paper has several failings in this regard. It does not provide a clear picture of the implications of potential development at Heathrow on affected populations. Specific concerns are:

1. The size of the aircraft noise problem at Heathrow is not put into a quantitative context. The problems at other airports are significant and important to these affected, but are not of a comparable magnitude to those at Heathrow.

2. It is not made apparent that mixed mode operations at Heathrow would lead to a more significant change in the population affected than recommended developments at Stansted and Gatwick combined.

3. A >57 dBA Leq noise contour area cap for Heathrow is shown to be a flawed concept: it can hide a marked increase in the number of people rating the aircraft noise environment as unacceptable.

4. A UK policy based on a noise area contour cap would be incompatible with an EU policy objective of "substantially reducing the number of people regularly affected by long-term average levels of noise".

5. A three runway Heathrow would increase contour area by perhaps 50% in 2030 compared with a maximum-use two runway airport, but this kind of estimate is not presented.

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