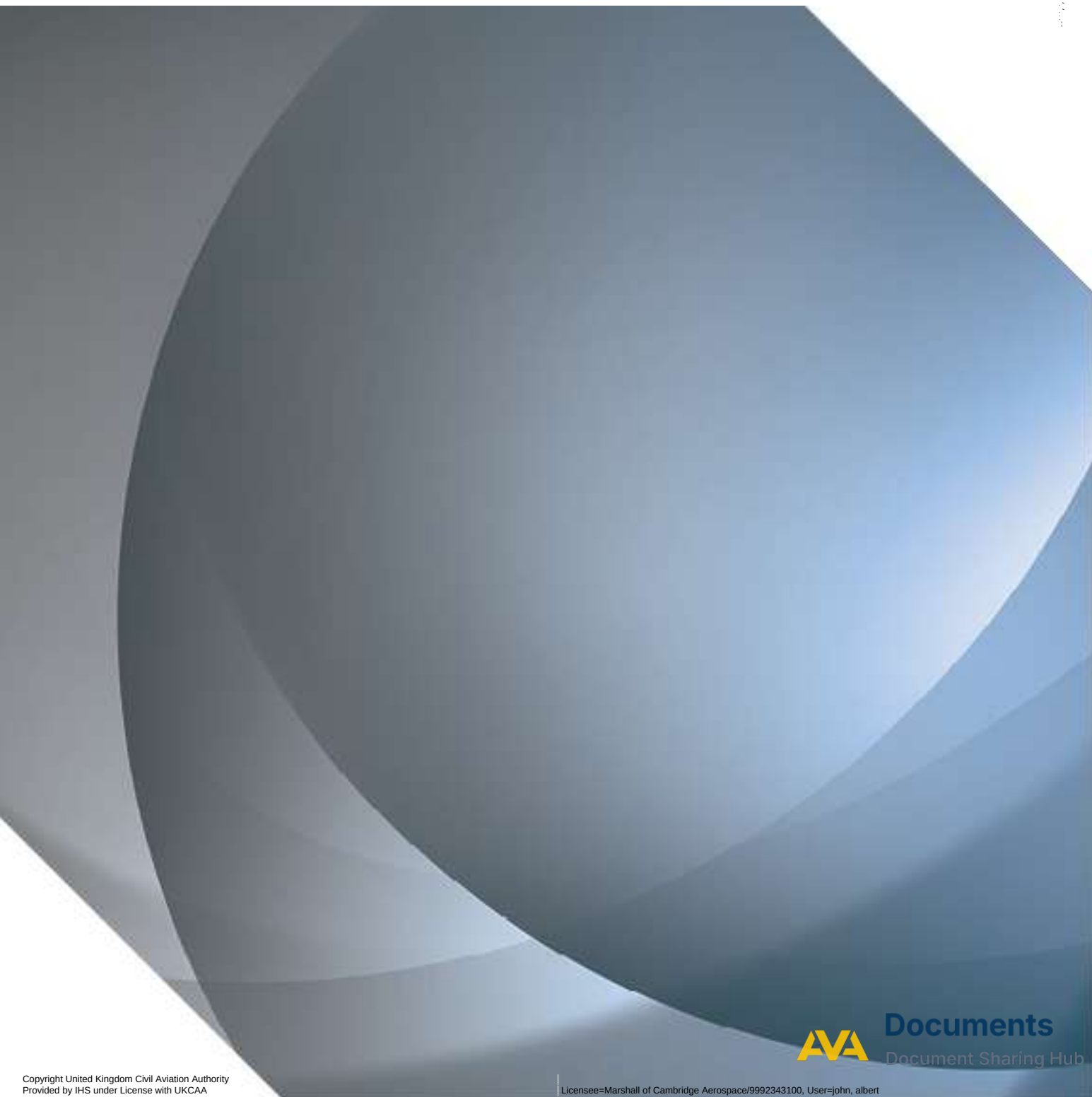


Report of the CAA's Post Implementation Review of the implementation of RNAV-1 Standard Instrument Departures at Gatwick Airport

Annex 2: PIR Environmental Analysis report

Annex 2 to CAP 1346



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Acronyms

2014 Guidance	The Secretary of State's Guidance to the CAA on Environmental Objectives Relating to the Exercise of its Air Navigation Functions published in 2014
AMSL	Above Mean Sea Level
AONB	Area of Outstanding Natural Beauty
CO ₂	Carbon Dioxide
dB	Decibel units
dBA	Decibel units measured on an A-weighted scale
ERCD	Environmental Research and Consultancy Department
Gatwick	Gatwick Airport Limited
L _{max}	Maximum sound level
LAQ	Local Air Quality
L _{eq}	Equivalent continuous sound level
PIR	Post Implementation Review
PRNAV	Precision Area Navigation
RNAV-1	Area Navigation
SEL	Sound Exposure Level
SID	Standard Instrument Departure

PIR Environmental Analysis report

1. Our original environmental assessment of the proposed airspace change taken into account in the CAA's decision in 2013 only assessed the anticipated impacts up to 4000ft AMSL as this is the height at which aircraft departing Gatwick Airport are typically able to be tactically vectored from their SID by air traffic control. Neither Gatwick nor the CAA anticipated a change to the vectoring practices after the change was implemented and therefore did not anticipate any change in impacts arising from traffic between 4000ft AMSL and 7000ft AMSL. In the first instance, our Post Implementation Review (PIR) of the environmental impact of the airspace change that is the subject of this PIR will assess the actual impacts of aircraft up to 4000ft AMSL.
2. Since making our decision in 2013, the Secretary of State has issued a further version of his Guidance to the CAA on Environmental Objectives Relating to the Exercise of its Air Navigation Functions (2014 Guidance). The 2014 Guidance clarified that the impact of aviation noise should still be considered for aircraft up to 7000ft AMSL. Specifically the 2014 Guidance says:

...in the airspace from 4,000 feet (amsl) to 7,000 feet (amsl), the focus should continue to be minimising the impact of aviation noise on densely populated areas, but the CAA may also balance this requirement by taking into account the need for an efficient and expeditious flow of traffic that minimises emissions.
3. In addition, it is apparent from feedback received from some groups and residents in the vicinity of Gatwick Airport that they feel affected by a change in noise levels from aircraft that are between 4000ft AMSL and 7000ft AMSL.
4. In this report, we will also review the noise impacts due to any changes from aircraft between 4000ft and 7000ft AMSL whilst noting that any such impacts were not part of the original decision.

Key points from the ERCD Annex E Report to the CAA Director of Airspace who made the airspace change decision in November 2013

5. ERCD submitted a report dated 30 May 2012 to be taken into account in the CAA's decision-making process for the original proposal from Gatwick. Key points from that report are as follows:
 - 5.1 An overall environmental benefit could not be demonstrated. Standard noise metrics required under CAP 725 (L_{eq} contours, 90dBA SEL footprint) would be unlikely to show any change as a result of this proposal. Equally, any impact on CO₂ emissions would in all likelihood be negligible, and it was likely that there would not be any impact upon Local Air Quality (LAQ).

- 5.2 In line with Government guidance at that time (i.e. Guidance to the CAA on Environmental Objectives Relating to the Exercise of its Air Navigation Functions issued in 2002 (the 2002 Guidance)), the introduction of the RNAV-1 SIDs was expected generally to result in fewer people being overflown, assuming all other things being equal. Of the four trialled SIDs, the distribution (below 4000ft AMSL) on Routes 1 and 3 showed that traffic was concentrated along a path similar to that of traffic on the conventional SID. On Routes 2 and 4, the portrayed distribution (below 4000ft AMSL) of traffic on the RNAV-1 SID was notably different to the traffic on the conventional SID. Specifically:
- i) **Route 2** – conventional traffic was shown to be on a wider dispersion that was concentrated to the west of the NPR centreline whilst the RNAV-1 traffic was shown to be more concentrated and on a path to the east of the NPR centreline.
 - ii) **Route 4** – conventional traffic had a wider dispersion, mostly to the west of the NPR centreline after the right-hand turn but largely within the NPR compliance monitoring swathe. The RNAV-1 traffic was more focused and initially had a similar path to the conventional traffic, but 1%-5% of traffic was shown to exceed the limit of the NPR compliance monitoring swathe below 4000ft AMSL.
- 5.3 Gatwick proposed a Management Oversight Process that included quarterly reports to its Noise and Track Monitoring Advisory Group containing a list of specific data on the impact of the RNAV-1 SIDs. It was recommended that copies of these reports should be requested as part of the post implementation review.
- 5.4 Evidence from the trialled SIDs was used as fair representations of the expected traffic dispersions that would occur on the SIDs that had not been trialled.

Environmental Analysis by ERCD to be taken into account by the CAA in the Post Implementation Review

Population overflown

Anticipated effect

6. Generally the proposed change was expected to result in some people experiencing an increase in overflights due to the nature of RNAV-1 and its improved track keeping (i.e. concentration), and others that were beneath the wider pre-implementation dispersion experiencing less overflights.

7. However, on two of the routes (Routes 2 and 4) there was expected to be a likely shift in the mean track that was not entirely due to traffic becoming more concentrated around the existing traffic pattern.
8. Gatwick's proposal explained that:

The improved track-keeping ability of PRNAV will result in less dispersal of flights across the NPR compliance monitoring swathes. Thus the noise impact of the over-flying aircraft will affect less people. However those who are directly beneath the flight path will experience a greater number of over-flights.
9. This was acknowledged by ERCD as true up to a point, but may not necessarily be true in all circumstances. The statement assumed that the reduced dispersal remained along the current route. If the route is actually moving because the SID cannot be replicated exactly, it would not necessarily be true that less people would be affected.
10. The proposal advised that:

Above 4,000ft aircraft would be tactically vectored exactly as they are today, therefore there will be no change to the environmental performance from aircraft above 4,000ft.
11. Whilst aircraft are still able to be vectored after implementation, this statement is only true if aircraft are vectored from similar points as occurred before implementation. If the new SIDs resulted in aircraft being at a different location when they achieve 4000ft AMSL then there could be a change in the environmental impact. For example, the diagrams that illustrated Route 2 in the consultation and the airspace change proposal submitted to the CAA showed that the distribution up to 4000ft AMSL was expected to be noticeably different for traffic on the conventional SID and traffic on the RNAV-1 SID.

Actual effect

12. Noting that there is no accepted definition of "overflown", we assessed the population "overflown" and the results are detailed in the tables in Appendix A (together with more information about how the results were derived), and summarised in the table below.

Table 1: Summary of the change (increase or decrease) in the number of people overflown

	Route							
	1	2	3	4	5	6	7	8
Total number of people overflown below 4000ft AMSL	+50	-50	-2,000	-500	-1,300	0	0	0
Total number of people overflown below 7000ft AMSL	+150	-850	-1,550	+6,600	-900	-2,050	-1,100	0
Overflown below 4000ft AMSL by more than ten flights per day	0	+700	+450	-300	0	-50	0	0
Overflown below 7000ft AMSL by more than ten flights per day	+100	+950	+200	+2,500	+350	-50	-50	0

13. Table 1 shows that aircraft on most of the routes overfly fewer people but notably Route 4 shows an increase in the number of people overflown between 4000ft AMSL and 7000ft AMSL. (Note that this does not necessarily mean that this increase represents “newly overflown” people – especially as some of this increase may include people that are already overflown by Route 3).

Consideration of noise impact – L_{eq} Contours and SEL Footprints

Anticipated effect

14. Neither L_{eq} contours nor SEL footprints were required from Gatwick as part of the proposal as the SID replications were not expected to have any impact upon these metrics. As part of the PIR we have undertaken noise modelling to see if the new SIDs have in fact had any impact upon either the contours or footprints.

Actual effect

L_{eq} contours

15. We have remodelled the Gatwick 2013 actual summer day L_{eq} contours with the 2014 (RNAV-1) departure mean tracks and compared the results of the two sets of contours. These two sets of contours are portrayed in the diagram at Appendix B. There are some very slight differences in the 57dBA contour, mainly to the west of the airport. This is caused by the positioning of the 26LAM track (Route 4), which was further to the west in 2014 and this shift in Route 4 was an anticipated result of the airspace change.
16. The areas, populations and households are summarised in Tables 2 to 4 below. The population and household counts have been rounded to the nearest 50. The 57dBA contour shows a very small reduction in people affected with the RNAV-1 routes in place.

Table 2

2013 average summer day - 2013 routes			
L _{eq}	Area (km ²)	Population	Households
57	40.9	3,250	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	<50	<50
72	1.9	<50	<50

Table 3

2013 average summer day with 2014 (RNAV-1) routes			
L _{eq}	Area (km ²)	Population	Households
57	40.9	3,200	1,350
60	23.1	1,250	500
63	12.5	350	150
66	6.7	150	100
69	3.5	<50	<50
72	1.9	<50	<50

Table 4

Change (difference between Table 2 & Table 3)			
L _{eq}	Area (km ²)	Population	Households
57	0.0	-50	0
60	0.0	0	0
63	0.0	0	0
66	0.0	0	0
69	0.0	0	0
72	0.0	0	0

17. L_{eq} contours are a means of portraying long-term average noise exposure, and as such they take account of both the noise level of each aircraft, its duration and the number of aircraft noise events. The 57dBA L_{eq} contour remains the accepted limit for defining the onset of significant community annoyance due to aircraft noise, namely it is the indicator that is used to portray the point at which a proportion of the community would consider itself to be significantly annoyed by aviation noise. This does not mean that no one living beyond a 57dBA L_{eq} contour will be annoyed by aviation noise – the experience of annoyance due to aviation noise is a personal experience and is influenced by a number of

subjective factors. Equally, and for the same reason, it does not mean that everyone living within a 57dBA L_{eq} contour will be annoyed by aviation noise.

18. Any effect that concentration has upon the 57dBA L_{eq} contour is reflected in the diagram at Appendix B. So whilst it is true that some residents and communities may be experiencing an increase in overflights as a result of concentration due to RNAV-1, and therefore also experiencing an increase in noise impact, that impact would not be deemed to be significant if they are beyond the 57dBA L_{eq} contour.

SEL footprints

19. We have generated 90dBA departure SEL footprints for the noisiest type of aircraft operating at night in 2013 (Airbus A330), and the most frequent type (Airbus A320 with CFM engines). In selecting the noisiest type, we only considered aircraft types with at least one movement per summer night on average.
20. The 90dBA SEL footprints for the above two aircraft types and for each of the Gatwick SIDs (pre- and post-RNAV-1) were compared. The 26WIZ SID (Route 9) was omitted as this is not available at night. As expected, the introduction of RNAV-1 SIDs has minimal effect on the 90dBA SEL footprints. Footprint areas, populations and households are unchanged by the RNAV-1 SIDs and this is shown in Tables 5 and 6 below. All figures have been rounded to the nearest 50.

Table 5

A330 90dBA SEL footprints – results for both the 2013 conventional routes and the 2014 RNAV-1 routes			
SID	Area (km²)	Population	Households
08CLN	8.1	400	150
08DTY	8.1	400	150
08KEN	8.1	400	150
08SFD	8.1	400	150
26BOG	8.3	150	50
26LAM	8.3	150	50
26SAM	8.3	150	50
26SFD	8.3	150	50

Table 6

A320 90dBA SEL footprints – results for both the conventional 2013 routes and the 2014 RNAV-1 routes			
SID	Area (km²)	Population	Households
08CLN	3.3	<50	<50
08DTY	3.3	<50	<50
08KEN	3.3	<50	<50
08SFD	3.3	<50	<50
26BOG	3.3	<50	<50
26LAM	3.3	<50	<50
26SAM	3.3	<50	<50
26SFD	3.3	<50	<50

Noise Preferential Route (NPR) compliance

21. One of the pieces of evidence submitted with the original airspace change proposal were “heat maps” – diagrams that illustrate actual traffic patterns, and portrayed the density of traffic using a colour key with each colour representing a percentage of the total number of flights. As part of the PIR, we asked Gatwick to provide equivalent diagrams to illustrate post-implementation traffic patterns and densities, using the same percentage scale. These diagrams would enable us to gauge the actual impact, notably on Route 4, of both concentration and mean track.
22. As a result of changing the supplier for their Noise & Track-Keeping system, Gatwick advised that it is not able to provide diagrams that use the same scale for the purposes of the PIR. Instead of a scale that shows densities as a percentage, the diagrams provided for the PIR show densities as a number of flights. Therefore, in the absence of being able to provide equivalent post-implementation diagrams, we sought an alternative means of comparing NPR compliance in order to gauge the impact.
23. In order to make this comparison, Gatwick has provided this summary (below) of NPR compliance. It shows the percentage of flights on each route that remain within their respective NPR compliance monitoring swathe below the height at which they can be tactically vectored, i.e. “on track”. The table illustrates periods both before and after the implementation of the RNAV-1 SIDs.

Table 7

Route no.	Vectoring height (feet amsl)	Pre-implementation (1 Sept 2013 – 1 Nov 2013)			Post-Implementation (1 Jan 2015 – 1 Mar 2015)		
		Total flights	Outside NPR swathe	On track (% within NPR swathe)	Total flights	Outside NPR swathe	On track (% within NPR swathe)
1	3,000	4,572	22	99.5%	4,166	10	99.8%
2	4,000	1,850	15	99.2%	1,045	4	99.6%
3	3,000	1,780	12	99.3%	1,161	2	99.8%
4	4,000	7,192	478	93.4%	5,488	800	85.4%
5	3,000	743	6	99.2%	396	1	99.7%
6	3,000	2,023	4	99.8%	1,180	2	99.8%
7	4,000	4,503	39	99.1%	3,913	7	99.8%
8	3,000	110	0	100.0%	14	0	100.0%
9	3,000	18	0	100.0%	1	0	100.0%

24. As Table 7 shows, the only route with a notable change in compliance rate is Route 4 which has worsened, from 93% to 85%. (Based upon the evidence submitted with the airspace change proposal and the case made by Gatwick the CAA had expected that the proportion of traffic that would exceed the NPR compliance monitoring swathe below 4000ft AMSL on Route 4 post-implementation would be 1%-5%.)

Illustrative noise levels by height

Table 8: Departure L_{max} levels by aircraft height

Height (ft)	125-180 seat single-aisle 2-eng jet (dBA L_{max})	250 seat twin-aisle 2-eng jet (dBA L_{max})
1000	85	92
2000	75	83
3000	70	77
4000	66	73
5000	63	69
6000	60	66
7000	59	64

25. The above noise levels are for illustrative purposes. They are modelled average values, based upon actual monitored noise data. The two aircraft types portrayed are the predominant types in use at Gatwick Airport.

Table 9: Aircraft groupings

Aircraft grouping	Specific types
125-180 seat single-aisle 2-eng jet	Airbus A318/319/320/321, Boeing 737-600/700/800/900
250 seat twin-aisle 2-eng jet	Airbus A330, Boeing 767-300/400

Review of each route since RNAV-1 SIDs implemented on 14 November 2013

26. Appendix C is a copy of the table that was included in the environmental report prepared by ERCD to support the 2013 decision. It summarises the expected impacts below 4000ft AMSL based upon the proposal submitted by Gatwick.
27. Using the evidence provided by Gatwick as part of the PIR, each route is considered in turn below and key observations summarised.

Route 1

28. **Expectation based on proposal:** A concentration of traffic along the existing flight path.
29. **Observation up to 4000ft AMSL:** The expected concentration along the existing flight path is evident.
30. **Observation between 4000ft AMSL and 7000ft AMSL:** Whilst the post-implementation spread of traffic due to vectoring is similar to the pre-implementation spread, there does appear to be a notable concentration of traffic remaining on the RNAV-1 SID in comparison to the conventional SID, between Ellens Green and Plaistow.

Route 2

31. **Expectation based on proposal:** The pre-implementation traffic using the conventional SID appeared to be concentrated to the west of the NPR centreline (yet within the NPR compliance monitoring swathe) on the initial right-hand turn. In addition to a general concentration of traffic as a result of RNAV-1, there was an expectation that there would be a shift in dispersion such that traffic would be concentrated to the east of the NPR centreline (yet still within the NPR compliance monitoring swathe) on the same turn. In terms of impact, this would mean that below 4000ft AMSL the population within the NPR compliance monitoring swathe to the west of the NPR centreline would be overflowed less