GATWICK RNAV-1 SIDS – CAA PIR ROUTE ANALYSIS REPORT

This section explains the track distribution of conventional SIDs and the RNAV SID replications using a selection of traffic samples since RNAV-1 SID replications were introduced on a permanent basis from November 2013. The samples compared are selected from data provided by Gatwick to try to give as close as possible, like for like samples in terms of the numbers of departures during the given period..This is so we can isolate, so far as possible, the impact of introducing the RNAV-1 SIDs; in some cases there are slightly more conventional SIDs than RNAV-1 SIDs, and likewise, in other cases, there are more RNAV-1 SIDs than conventional SIDs. The difference in samples is indicated within the tables of this report. In some comparisons of track distribution diagrams and track density plots, the CAA has analysed more than 1 sample as shown in the table.

We have also included our observations on the incidence and impacts of tactical radar vectoring. This is a response to feedback which the CAA has received from some groups and individuals located near to Gatwick.

GUIDE TO TRACK DISPERSION AND DENSITY DIAGRAMS

To fully understand this document, readers will have to view the track dispersion diagrams which are associated with the SID route numbers and the descriptions of track dispersion, track density and associated impacts.

At the beginning of each route analysis, the CAA initially refers to Gatwick's consultation diagrams and forecast impacts of RNAV-1 SID replication implementation and describes the forecast impact. This forecast by Gatwick is cross referred to the diagram figure numbers portrayed in the Gatwick Consultation and Airspace Change Proposal (see http://www.caa.co.uk/default.aspx?catid=2111&pagetype=90&pageid=16983) for ease of reference. The analysis then compares the impact of the RNAV-1 SID replications with the conventional SIDs using a number of traffic samples provided since the implementation of RNAV-1 SIDs in November 2013 and indicates where departures are more concentrated as a result of the RNAV-1 SID replications and whether the anticipated impact, has been realised. Notes relating to the details provided in the table are highlighted below. Any sections in the table where details would not be relevant are shaded out.

The explanations of track distribution are described using references to locations shown on the diagrams to help to describe impacts of the RNAV-1 SID replications. Periods of traffic samples, together with numbers of departures are shown in the tables. For traffic samples used to illustrate impacts in 3 altitude bands (4-5000ft, 5-6000ft, and 6-7000ft), different traffic samples from those shown in the track dispersion and density plots are used for comparison purposes. These altitude plots illustrate when aircraft reach the relevant altitude band and are used to illustrate the flight paths flown by both the conventional departures and RNAV-1 departures when they are at and above 4000ft and illustrate the dispersion of traffic, where they are remaining on the SID and where aircraft are being vectored. In the tables where percentages are used to describe dispersions, these are estimated by visual interpretation of the density against the width of the NPR swathe as shown in the diagrams.

A variety of track dispersion plots have been presented to the CAA for PIR analysis. These comprise:

- Track density plots of Trial SIDs used for consultation purposes, and diagrams from the consultation which were used to describe forecast impacts of the RNAV-1 SIDs.
- Track dispersion plots up to 3900 ft for Route 4 (an explanation is shown at the bottom of each diagram).
- Track dispersion plots for all routes up to 4000 ft (an explanation is shown at the bottom of each diagram).
- Track density plots (an explanation is shown at the bottom of each diagram).
- Altitude Slice Diagrams in the altitude bands: 4-5000ft, 5-6000ft, 6-7000ft.

Track dispersion diagrams portray each aircraft track on a map, based on radar data. Tracks are overlaid upon each other, such that if many tracks are overlaid on top of each other, individual tracks may no longer be visible. They are useful for illustrating the dispersion of the traffic pattern, but are not as useful for determining the density/concentration of tracks.

Track density diagrams = these portray the concentration of flight tracks using a colour code to indicate differing concentrations of flight tracks. They are sometimes referred to as “heat plot” diagrams. Whilst they can be used to illustrate traffic dispersion, they are most useful for illustrating if traffic is concentrated along a route or over a geographic location. Depending on the key used for portraying track concentration, individual tracks towards the outer limits of the dispersion may not be visible on the diagram.

NOTES RELATING TO THE DATA IN THE TABLES

Col 2 Note 1. Reference to Consultation Document (Con Doc) and ACP diagrams. Month period analysed in the PIRand number of conventional SIDs flown is inserted. Comments provided on conventional SID track dispersion.

Col 3 Note 2. Reference to Consultation Document (Con Doc) and ACP diagrams. Month period analysed in the PIRand number of RNAV-1 SIDs flown inserted. Comments provided on RNAV-1 SID track dispersion.

Col 4 Note 3. Comments provided on impact of change compared with that portrayed in Gatwick’s consultation and ACP submission.

Col 5 Note 4. Observations on any discernible variance with tactical radar vectoring by ATC post RNAV-1 SID replication implementation. The altitude when vectoring is permitted by Air Traffic Control is illustrated at the top of the column. The following information was included in the consultation document.:

The altitude of 4000ft applies to:

- All routes during the night - period 2330-0600 local time;
- Rwy 26 Routes 4,7,8,9 during the day period 0600-2330 local time.
- Rwy 08 Route 2 during the day period 0600-2330 local time.

The altitude of 3000ft applies during the day period 0600-2330 local time to:

- Rwy 26 Route 1 and to Rwy 08 Routes 3, 5 and 6.

Col 6 Note 5. Any remarks of significance.

Abbreviations used in the PIR Assessment Route Report Form below.:

NPR	Noise Preferential Route.
CL	Centreline. (Note, in SID design terminology this is referred to as ‘nominal track’; for the purposes of this report CL and Nominal Track are deemed to have the same meaning and mean the flight path we anticipate the aircraft will follow when flying the SID unless and until vectored of the SID by air traffic control. However, aircraft may be either side of the RNAV-1 CL or Nominal Track by up to one nautical mile for 95% of the flight time which is within the navigation tolerance of RNAV-1 1 SID design parameters).
Deps	Departing aircraft on the SID.

SID	Standard Instrument Departure.
AC	Aircraft.
ACP	Airspace Change Proposal (V 1.1 submitted in January 2013).
Con Doc	Consultation Document (19 July 2012).
Deg	Degree (as in the size of any turn).
Approx	Approximately.
NT	Nominal Track (see comments above regarding CL and NT).
Conv	Conventional (meaning the SIDs predicated on conventional navigation techniques in operation prior to the introduction of RNAV-1 SIDs)

Terminology:

Swathe.	This refers to the 3 km wide NPR compliance monitoring swathe .
Vectoring.	This is an extensive ATC tactical radar vectoring operational practice to provide aircraft with an expeditious route to destination and safe separation against other aircraft.

ROUTE 9 – RWY 26 WIZAD – ALTITUDE BANDS FOR COMPARISON ONLY

LINKS	SID Sample Of Relevant Track Dispersion Diagram	Conventional SID Comments (Note 1)	RNAV 1 SID Comments (Note2)	Impact of RNAV SID Replication (Note 3)	Observations on Vectoring (Note 4)	Remarks (Note 5)
900 901	Consultation Ref / Diagram	Con Doc Fig 2 Fig 4 (No actual data for Route 9)**900A** ACP Fig 14 (No actual data for Route 9)**901A**	Con Doc Fig 3 **900B** ACP Fig 7 **901B**	Due to a lack of data arising from low route usage, no assessment was made. The ERCD analysis of the impact is at Appendix TBC.		
Folder Ref	Diagram	**Month** 1Jan - 31 Dec 14 / **Number** 57	**Month** 1Jan - 31 Dec 14 / **Number** 57		Day: 4000 Night: Not available	
902	At 4000 ft	Deps reaching 4000ft before the turn near Rusper. Widespread dispersion around the turn which widens from turn initiation towards Roffrey at which point the dispersion is approx 75% across the width of the NPR swathe.	Deps reaching 4000ft before the turn near Rusper. The dispersion is significantly concentrated for those departures following the SID design. There are approx 12 deps being turned off the SID very early – the reasons for this are unknown.	There were an insufficient number of flights using this Route during the monthly review periods. Therefore the assessment is based on interpretation from the altitude bands diagrams before the deps reach the 4000-5000ft band. The width of the concentration around the turn is significantly increased reducing the dispersion. Other than for those ac turned off the SID early, the departure track keeping looks quite good as it is extremely close to the CL of the NPR around the turn although this is a very small traffic sample.	Some ac appear to be turned off the SID early. Vectoring obvious after the A23 on both conv and RNAV SIDs.	None – this is a tactical off-load SID hence low utilisation.
	Density Plot			There were an insufficient number of flights using this Route during the monthly review periods.		
	Alt Slice Diagrams (Note 7)	Period Number **1 Jan 13 - 31 Dec 13** **57**	Period Number **1 Jan 13 - 31 Dec 13** **57**			
904	Alt 4-5000ft GAL Slides:2-5 CAA Slides 2-5	Deps reaching 4000ft before the turn near Rusper. Widespread dispersion around the turn and then vectoring evident most apparent (the altitude when vectoring is initiated cannot be determined from these slides.	Deps reaching 4000ft before the turn near Rusper. Slight dispersion around the turn but much less than the conv SID and therefore some concentration occurs around the turn. A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). After passing Roffrey, vectoring is noticeably evident which is unsurprising as this is a tactical offload SID to alleviate congestion with departures following Route 4.	The width of the RNAV SID dispersion is reduced compared with the conv SID dispersion which is evident around the turn towards Roffrey. RNAV SIDs are maintaining a good position in relation to the RNAV SID design within the NPR swathe.and are only slightly offset from the NPR CL at the end of the turn before regaining the NPR CL when not subject to vectoring.	A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). This is not associated with the RNAV SID design.	Traffic above 4000ft was not assessed in the ACP analysis as deps may be tactically vectored when reaching 4000ft. The reasons for the early vectoring are unclear; however, as this is a tactical offload SID, it may be due to heavy traffic loading and the need for ATC to expedite departures onto a departure track commensurate with high intensity traffic operations. Note the requirements to adhere to the NPR do not apply to (i) any propeller driven aircraft whose MTWA does not exceed 5700 kg; or (ii) during the period between 0600 hours and 2330 hours (local time), any propeller driven aircraft whose MTWA does not exceed 17000 kg or any Dash 7 aircraft This appears to be a successful design.

905	Alt 5-6000ft GAL Slides:6-9 CAA Slides 2-5	Some deps reaching 5000ft after passing Rusper. Widespread dispersion around the turn and then vectoring evident. .	Majority (?) of deps reaching 5000ft after passing Rusper. There is much less dispersion around the turn than evident with the conv SID and therefore some concentration occurs around the turn. A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). After passing Roffrey, vectoring is evident which is unsurprising as this is a tactical offload SID to alleviate congestion with departures following Route 4.	The width of the RNAV SID dispersion is reduced compared with the conv SID dispersion which is evident around the turn towards Roffrey. RNAV SIDs are maintaining a good position in relation to the RNAV SID design within the NPR swathe.and are only slightly offset from the NPR CL at the end of the turn before regaining the NPR CL when not subject to vectoring.	A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). This is not associated with the RNAV SID design.	Traffic above 4000ft was not assessed in the ACP analysis as deps may be tactically vectored when reaching4000ft. The reasons for the early vectoring are unclear; however, as this is a tactical offload SID, it may be due to heavy traffic loading and the need for ATC to expedite departures onto a departure track commensurate with high intensity traffic operations.
906	Alt 6-7000ft GAL Slides:10-13 CAA Slides 2-5	Deps reaching 6000ft after passing Roffrey. Widespread dispersion around the turn and then vectoring evident.	Some deps reaching 6000ft after passing Rusper. There is much less dispersion around the turn than evident with the conv SID and therefore some concentration occurs around the turn. A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). After passing Roffrey, vectoring is evident which is unsurprising as this is a tactical offload SID to alleviate congestion with departures following Route 4.	The width of the RNAV SID dispersion is reduced compared with the conv SID dispersion which is evident around the turn towards Roffrey. RNAV SIDs are maintaining a good position in relation to the RNAV SID design within the NPR swathe.and are only slightly offset from the NPR CL at the end of the turn before regaining the NPR CL when not subject to vectoring.	A noticeable amount of vectoring is occurring soon after departure (12 out of 57 deps are visible). This is not associated with the RNAV SID design. (more apparent and visible in Slide 13)	Traffic above 4000ft was not assessed in the ACP analysis as deps may be tactically vectored when reaching 4000ft. The reasons for the early vectoring are unclear; however, as this is a tactical offload SID, it may be due to heavy traffic loading and the need for ATC to expedite departures onto a departure track commensurate with high intensity traffic operations.

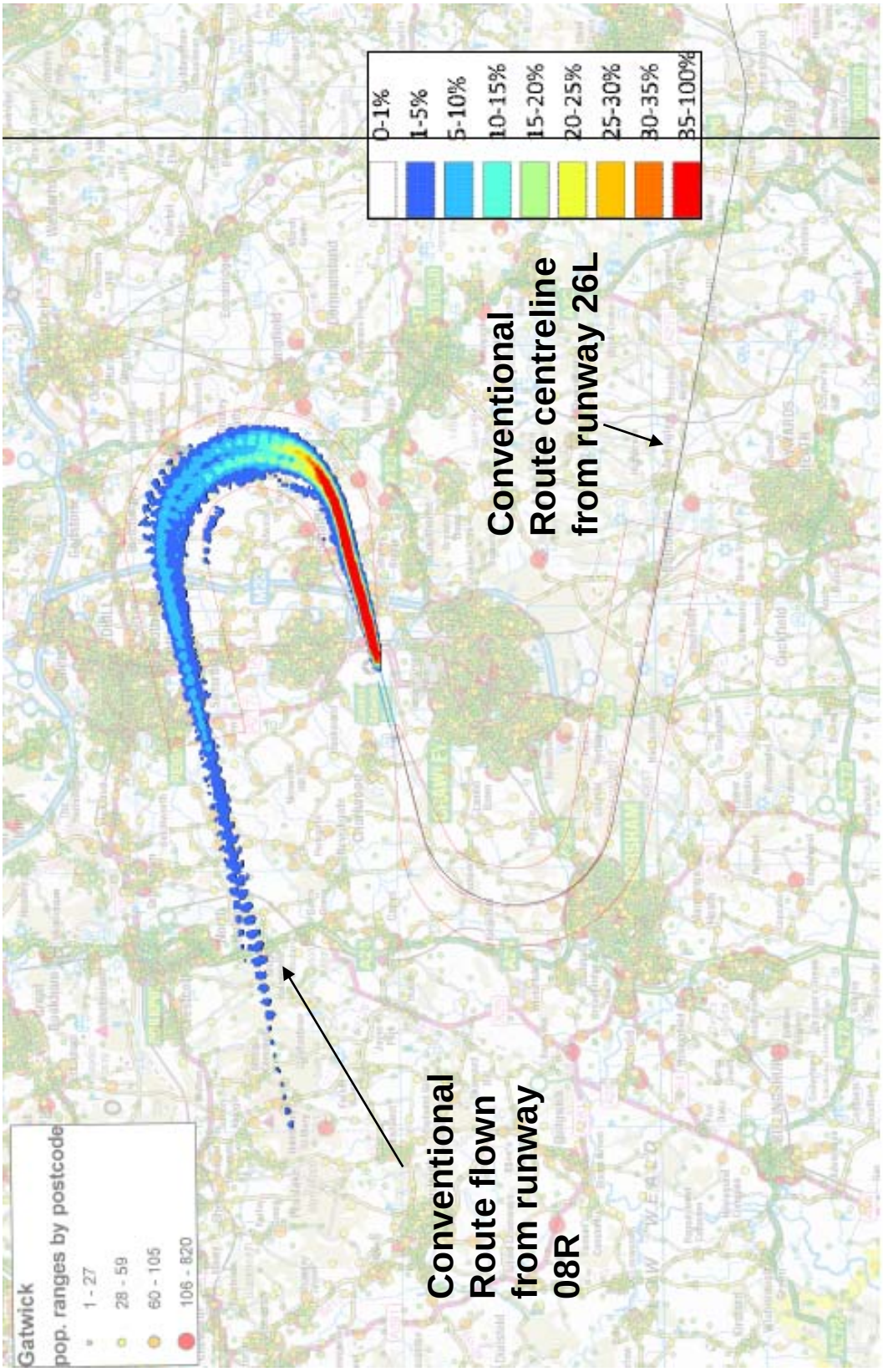

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Figure 2) Density of aircraft tracks (up to 4000 feet AMSL) following **Conventiona**l **SID departure** from runway 08R (no track density plots are available for SIDs turning left (between Crawley and Horsham) from runway 26L as there was insufficient radar track data available)

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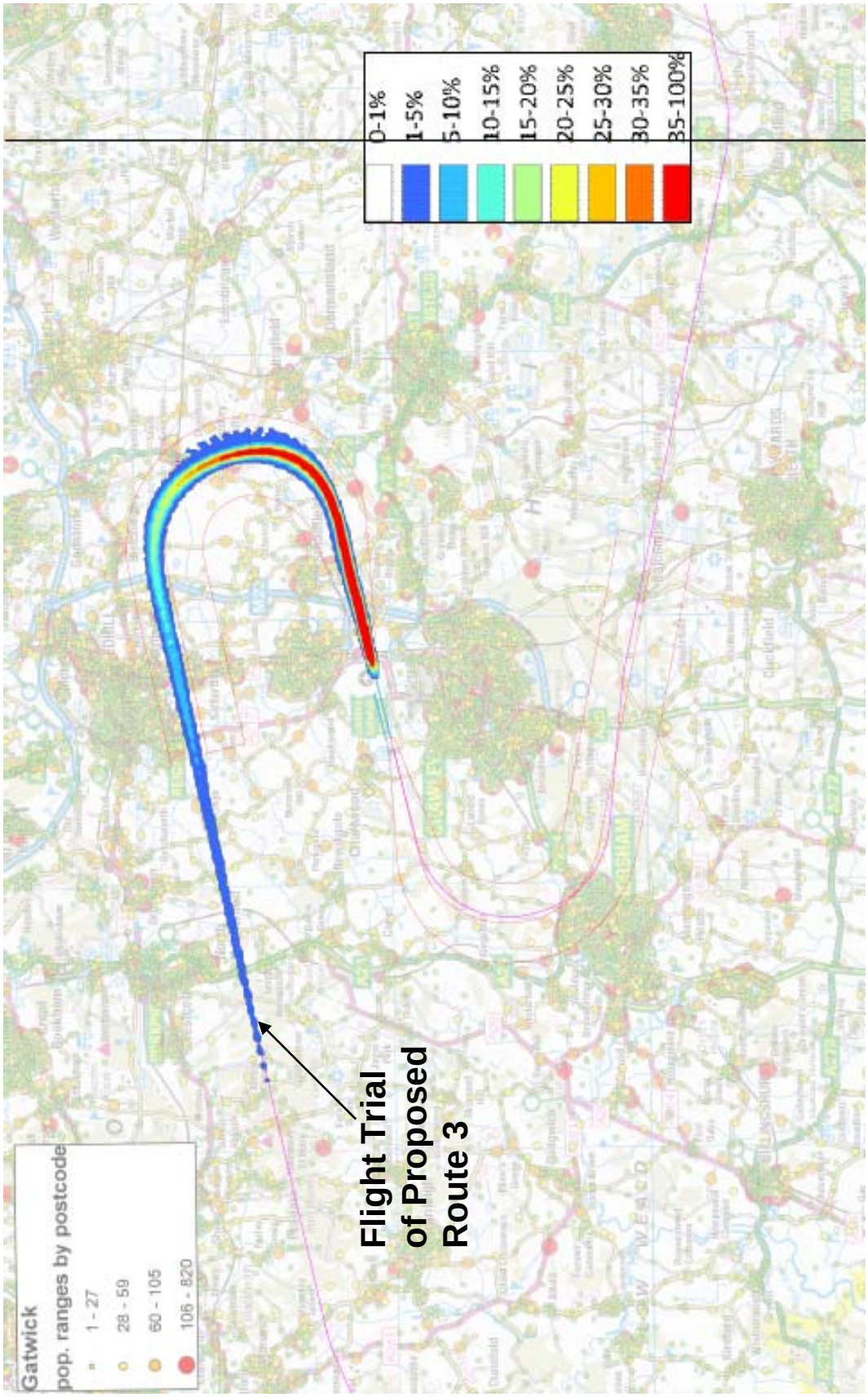

Figure 3) Density plot of aircraft tracks (up to 4000 feet AMSL) following P-RNAV (**ROUTE 3**) departure SID from runway 08R

run it further west on Route 8.

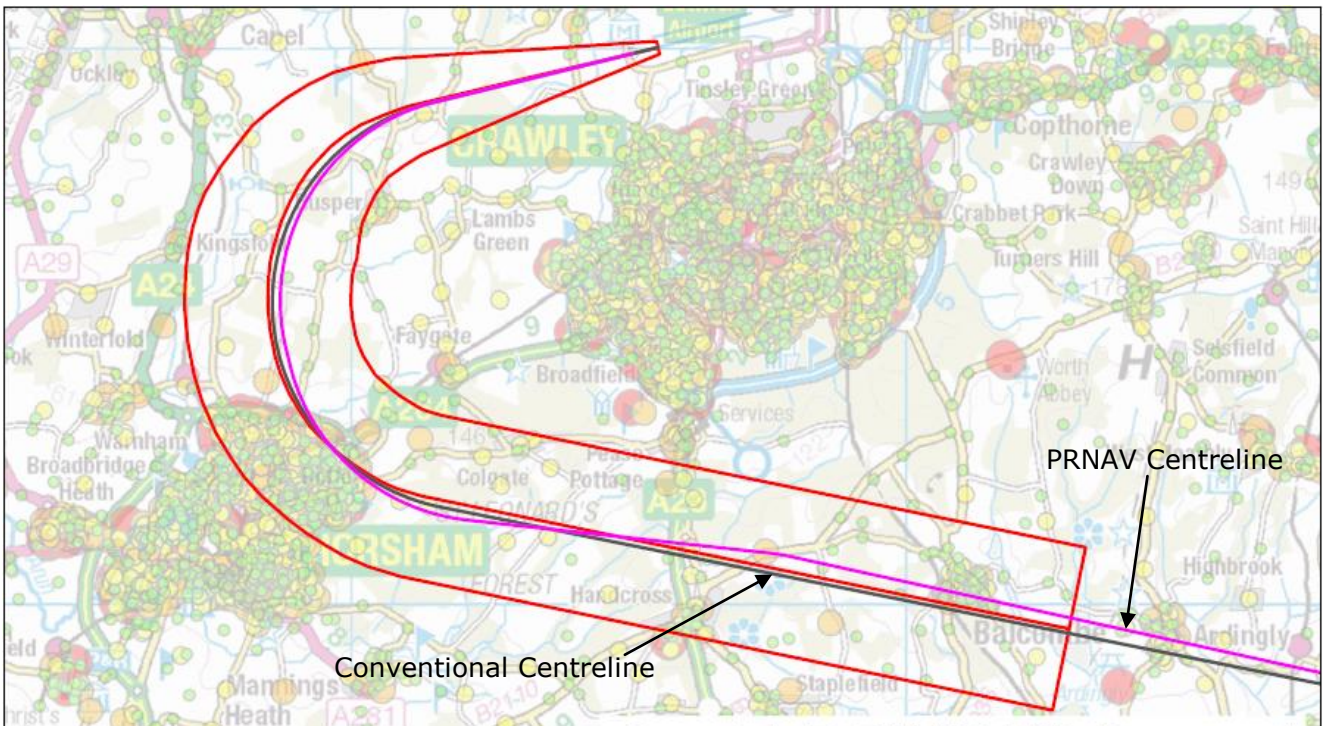

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Figure 14 Route 9 Conventional & PRNAV centrelines

The impact regarding noise and track dispersion for route 9 is expected to be identical to that seen from the flight trials of route 3.

Detailed design information for the proposed SIDs is given Appendix A (PDG SID design report).

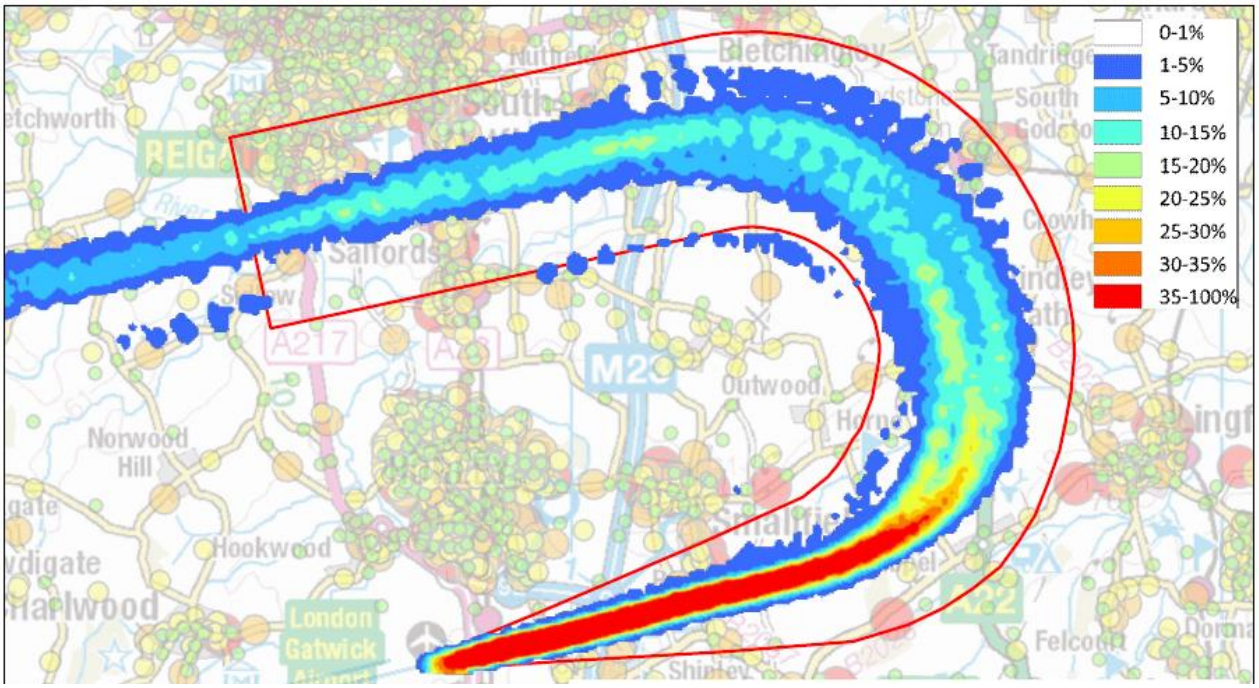

Figure 6 Route 3 Conventional Navigation

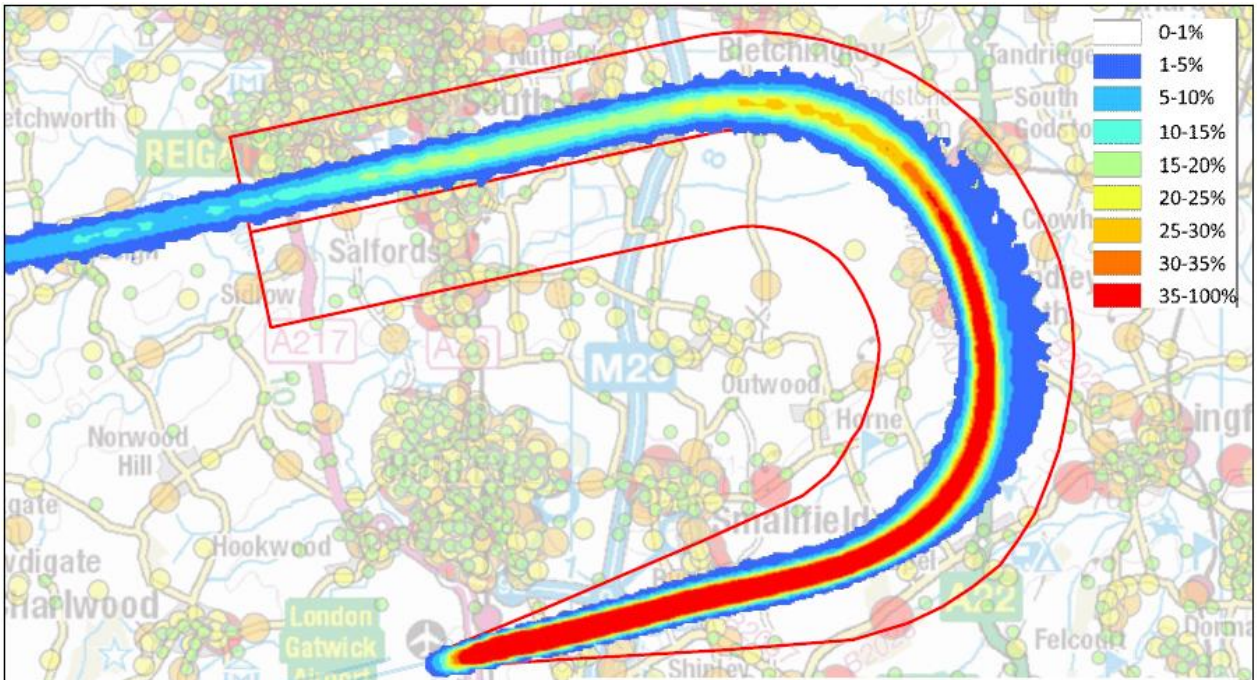

Figure 7 Route 3 PRNAV Navigation

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26 WIZAD
Route 9
(Tactical Offload Route)

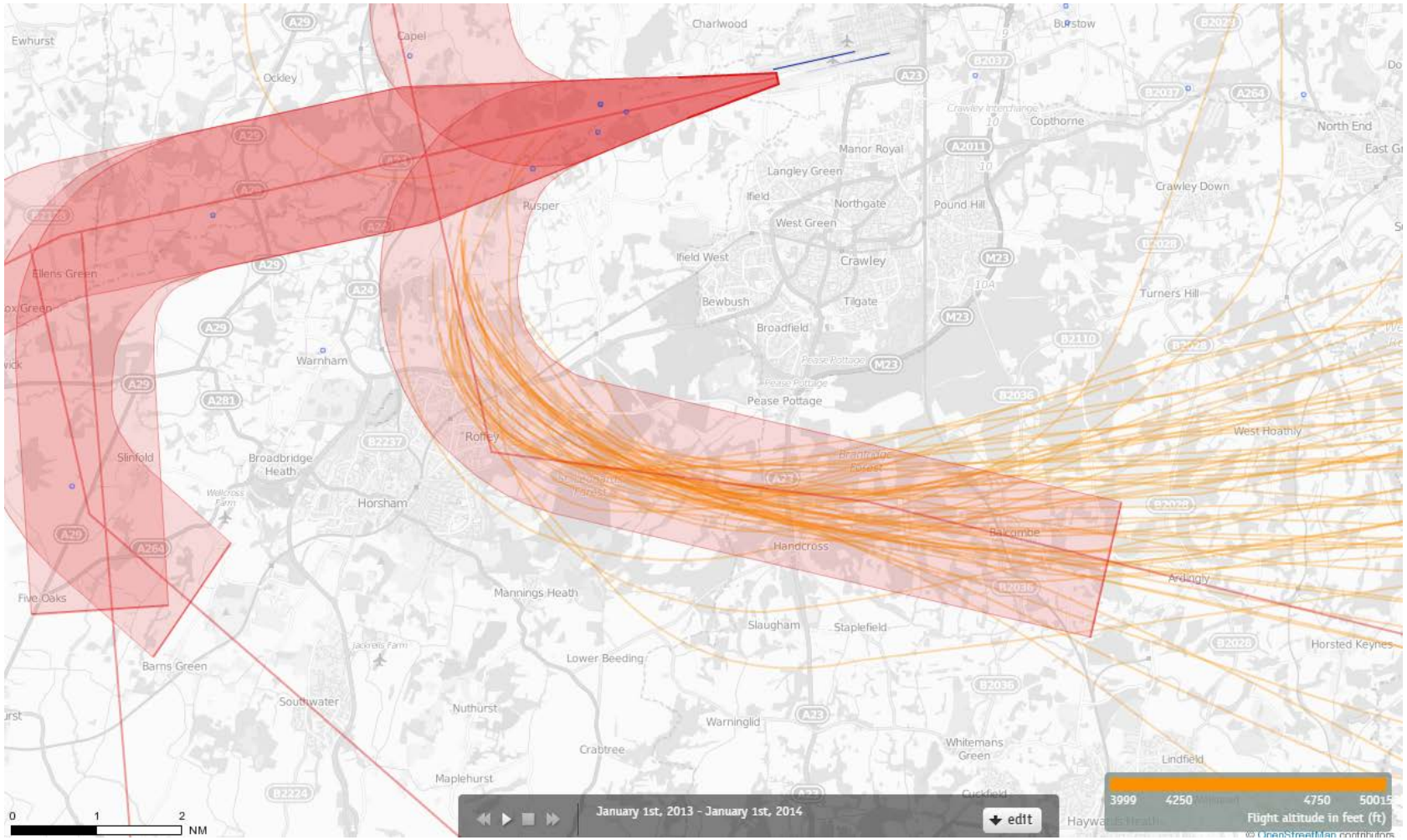
Altitude Bands

4000-5000ft

5000-6000ft

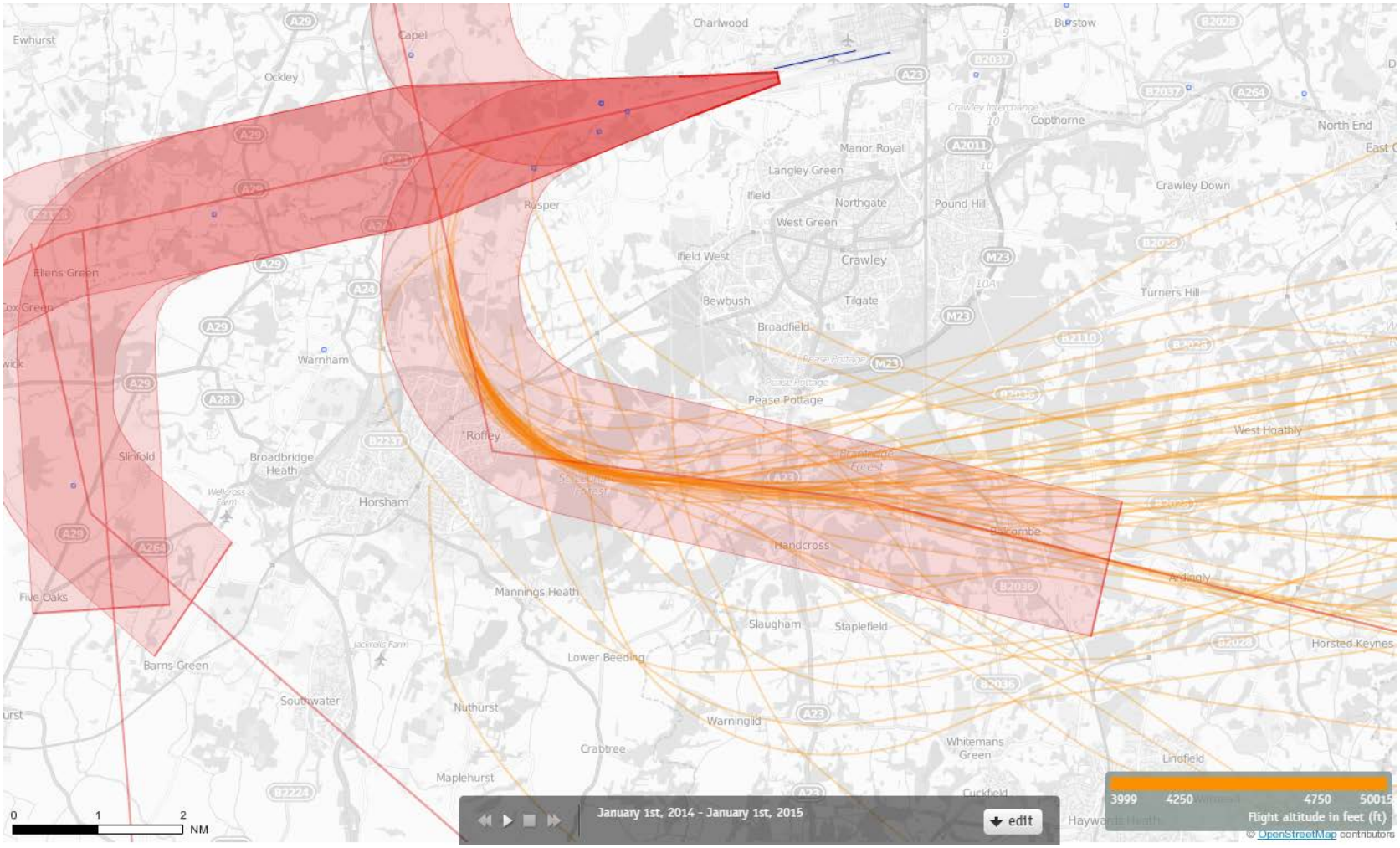
6000-7000ft

26 WIZ Departures January 1st - December 31st 2013
4000-5000 feet (57 Aircraft – CONVENTIONAL ONLY)



Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
4000-5000 feet (57 Aircraft – P-RNAV ONLY)

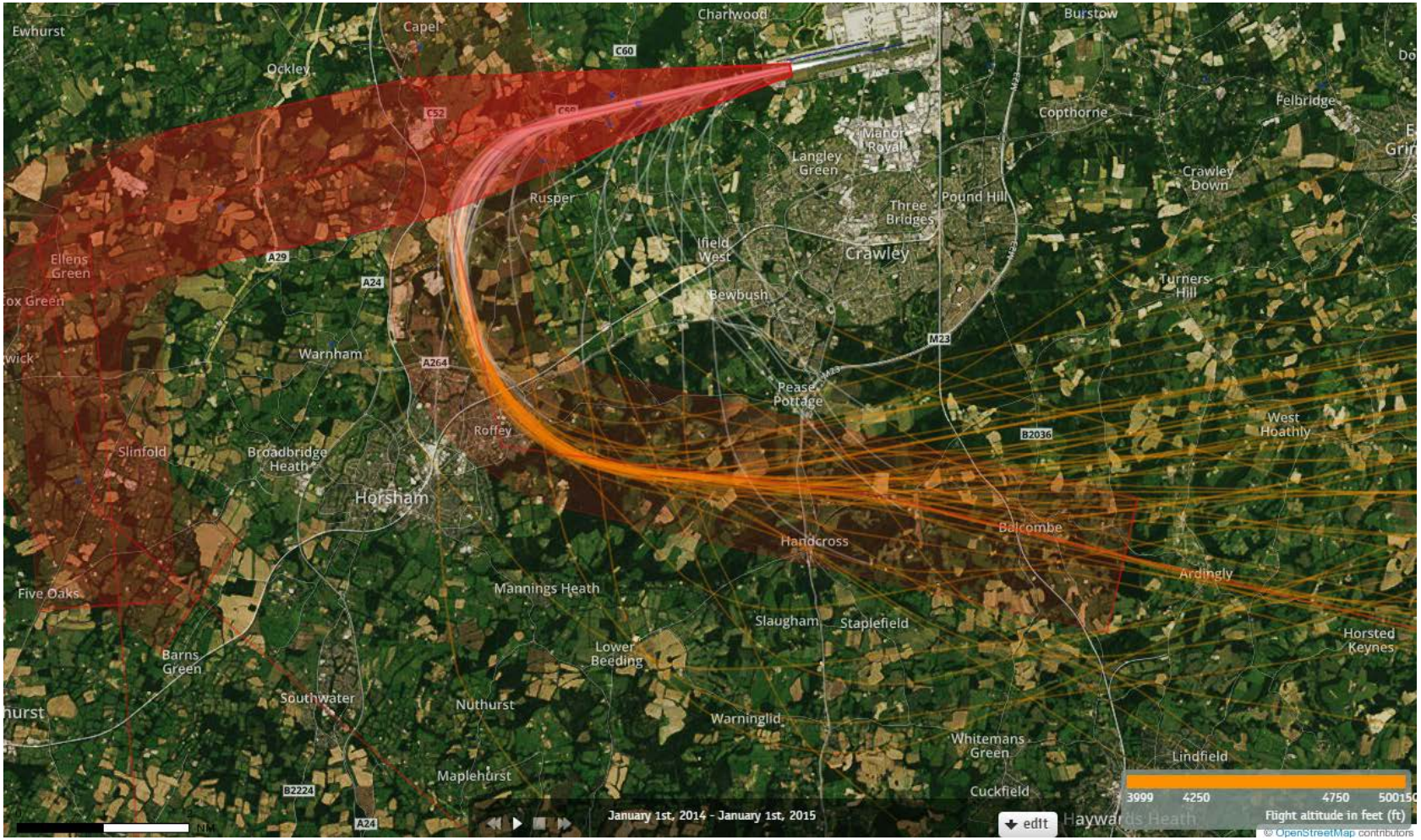


Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
4000-5000 feet (57 Aircraft – CONVENTIONAL ONLY)

Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
4000-5000 feet (57 Aircraft – P-RNAV ONLY)



Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
5000-6000 feet (57 Aircraft – CONVENTIONAL ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
5000-6000 feet (57 Aircraft – P-RNAV ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
5000-6000 feet (57 Aircraft – CONVENTIONAL ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

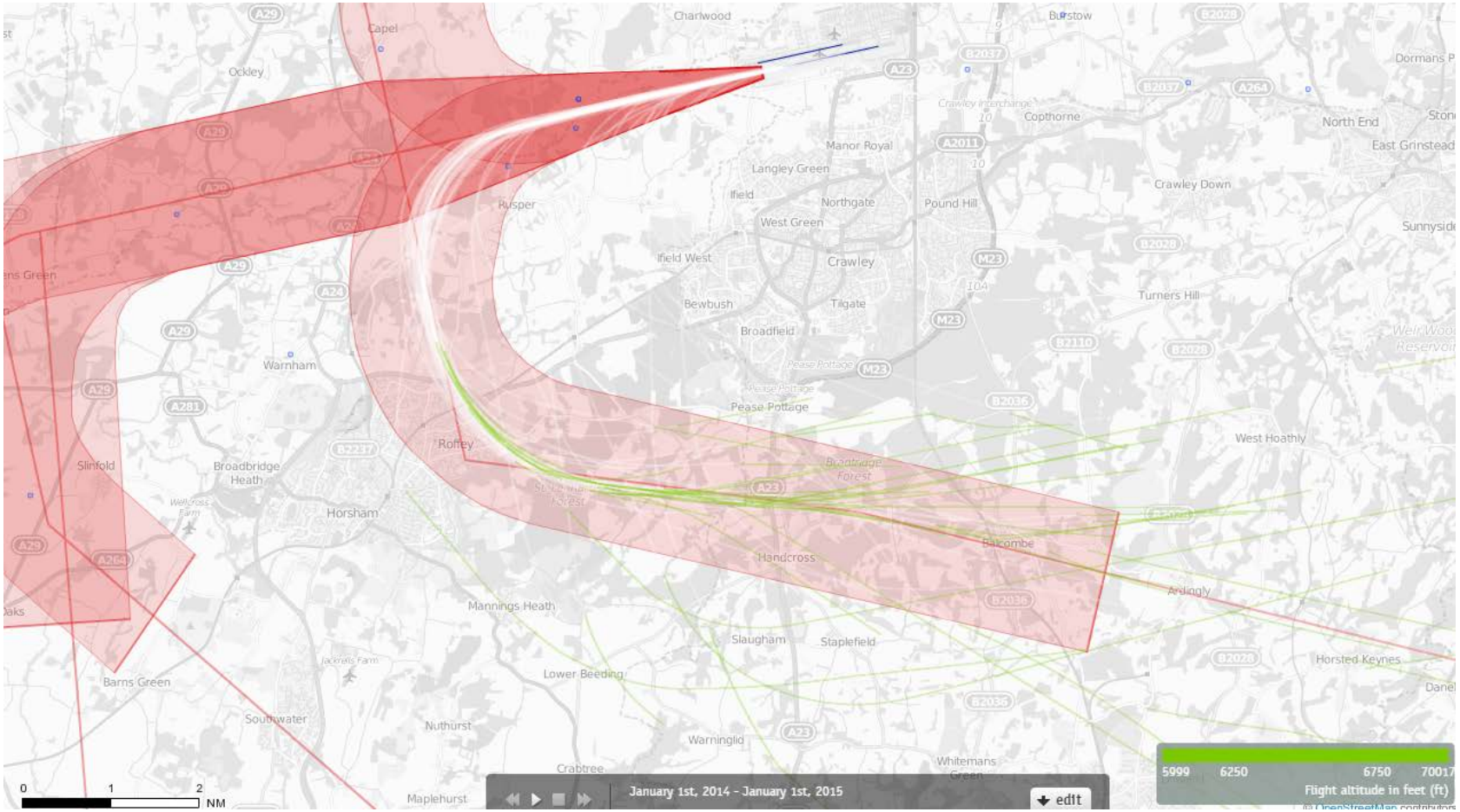
26 WIZ Departures January 1st - December 31st 2014
5000-6000 feet (57 Aircraft – P-RNAV ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
6000-7000 feet (57 Aircraft – CONVENTIONAL ONLY)

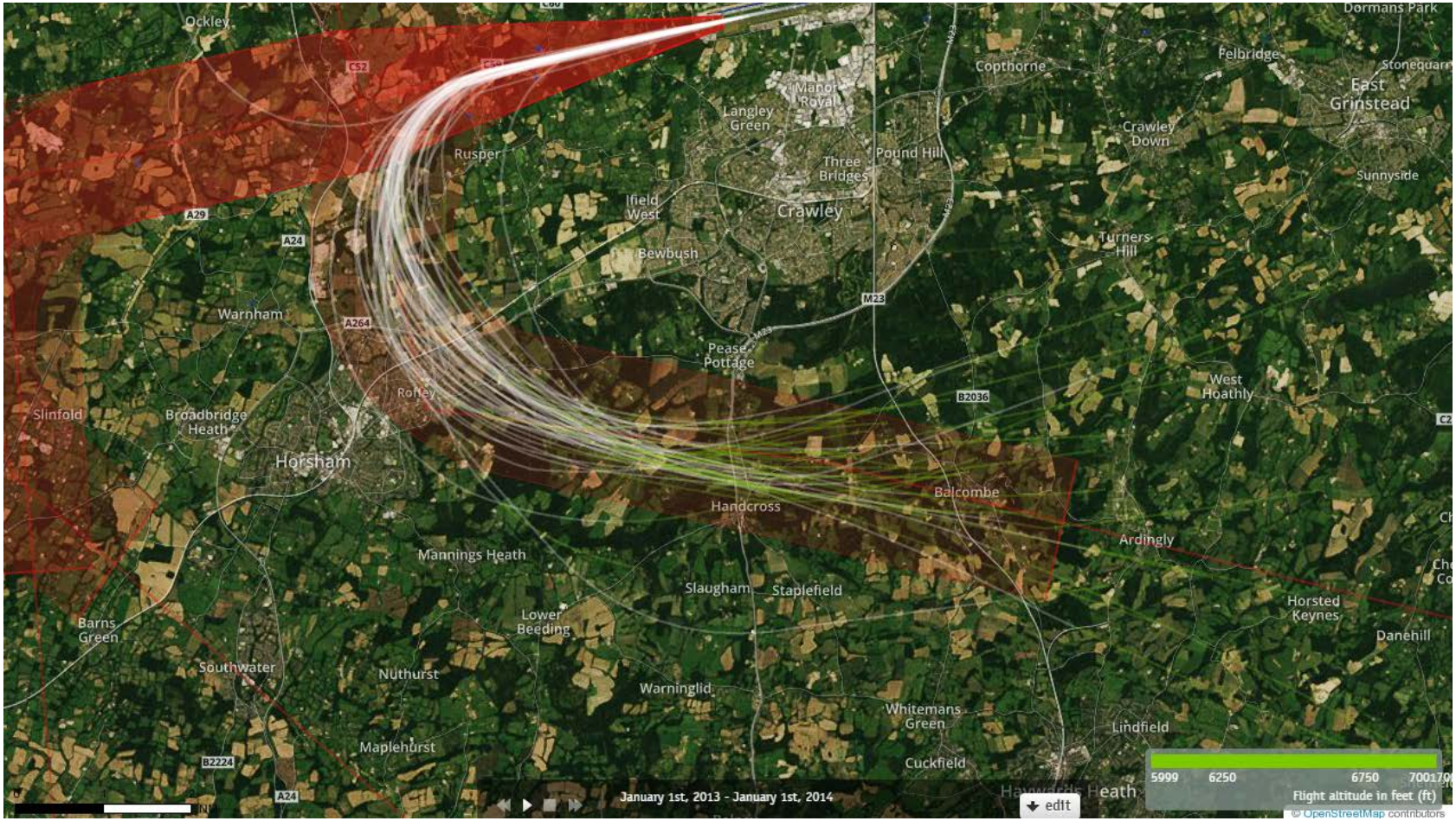
Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
6000-7000 feet (57 Aircraft – P-RNAV ONLY)



Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
6000-7000 feet (57 Aircraft – CONVENTIONAL ONLY)



Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
6000-7000 feet (57 Aircraft – P-RNAV ONLY)

Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZAD
Route 9
(Tactical Offload Route)

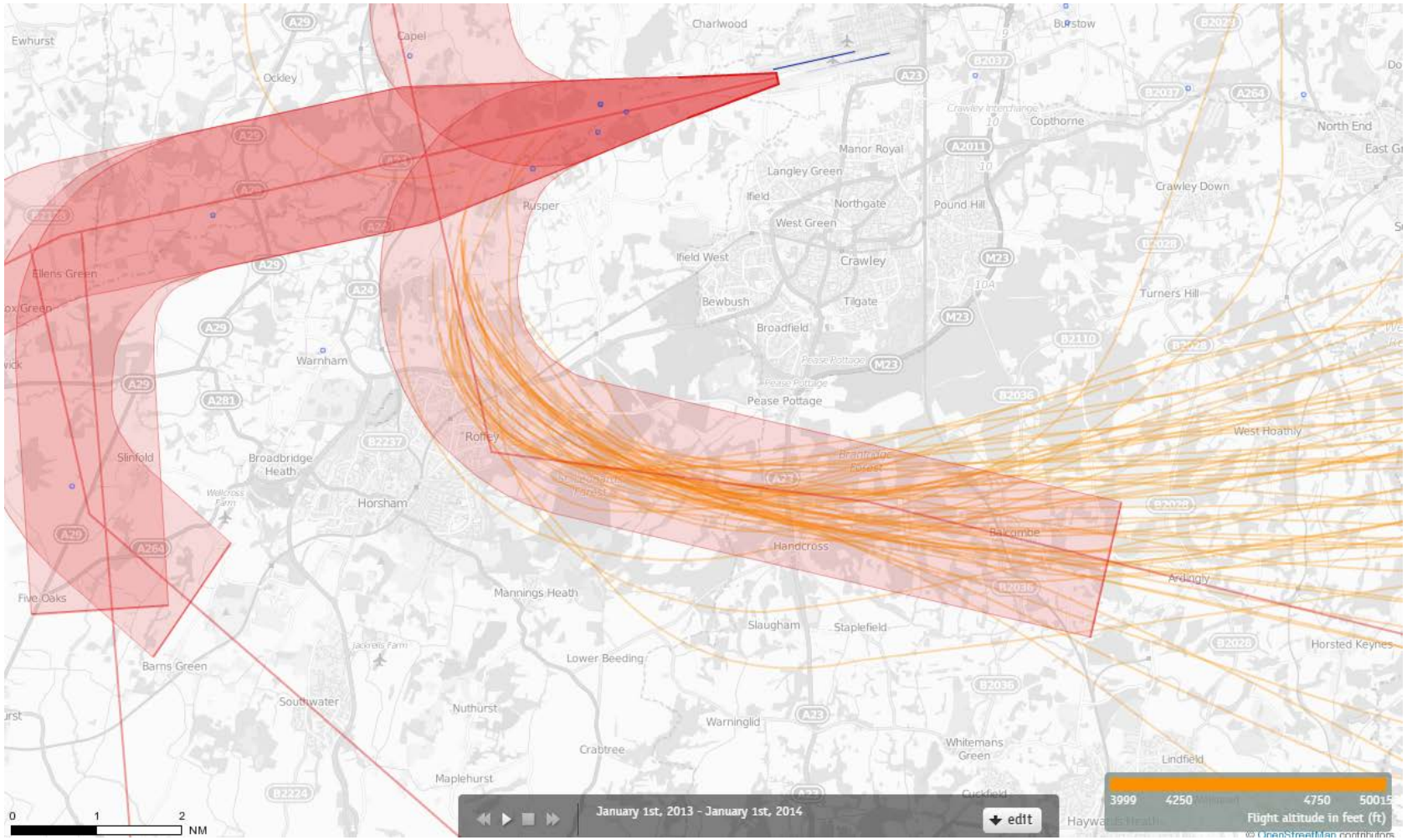
Altitude Bands

4000-5000ft

5000-6000ft

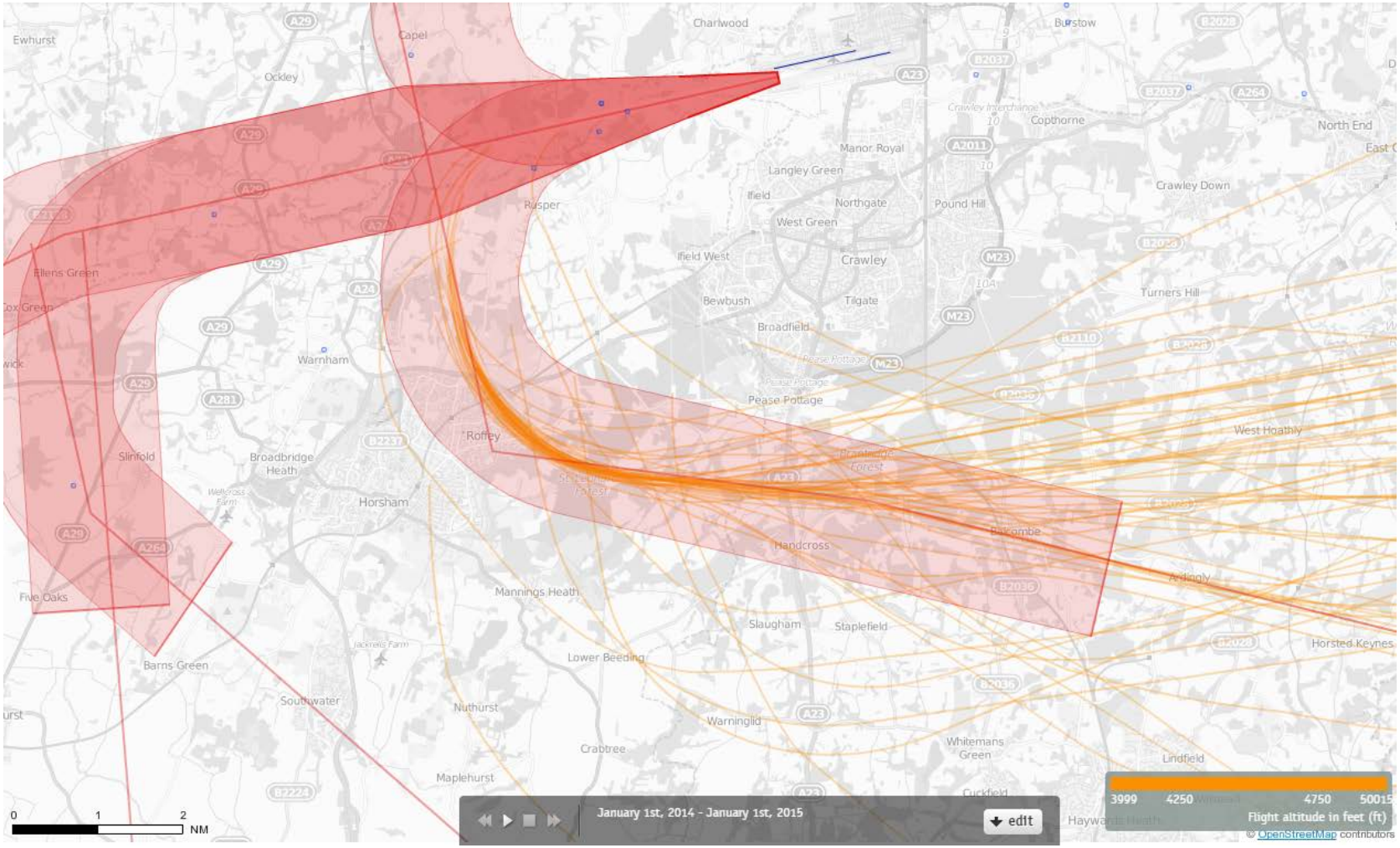
6000-7000ft

26 WIZ Departures January 1st - December 31st 2013
4000-5000 feet (57 Aircraft – CONVENTIONAL ONLY)



Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
4000-5000 feet (57 Aircraft – P-RNAV ONLY)

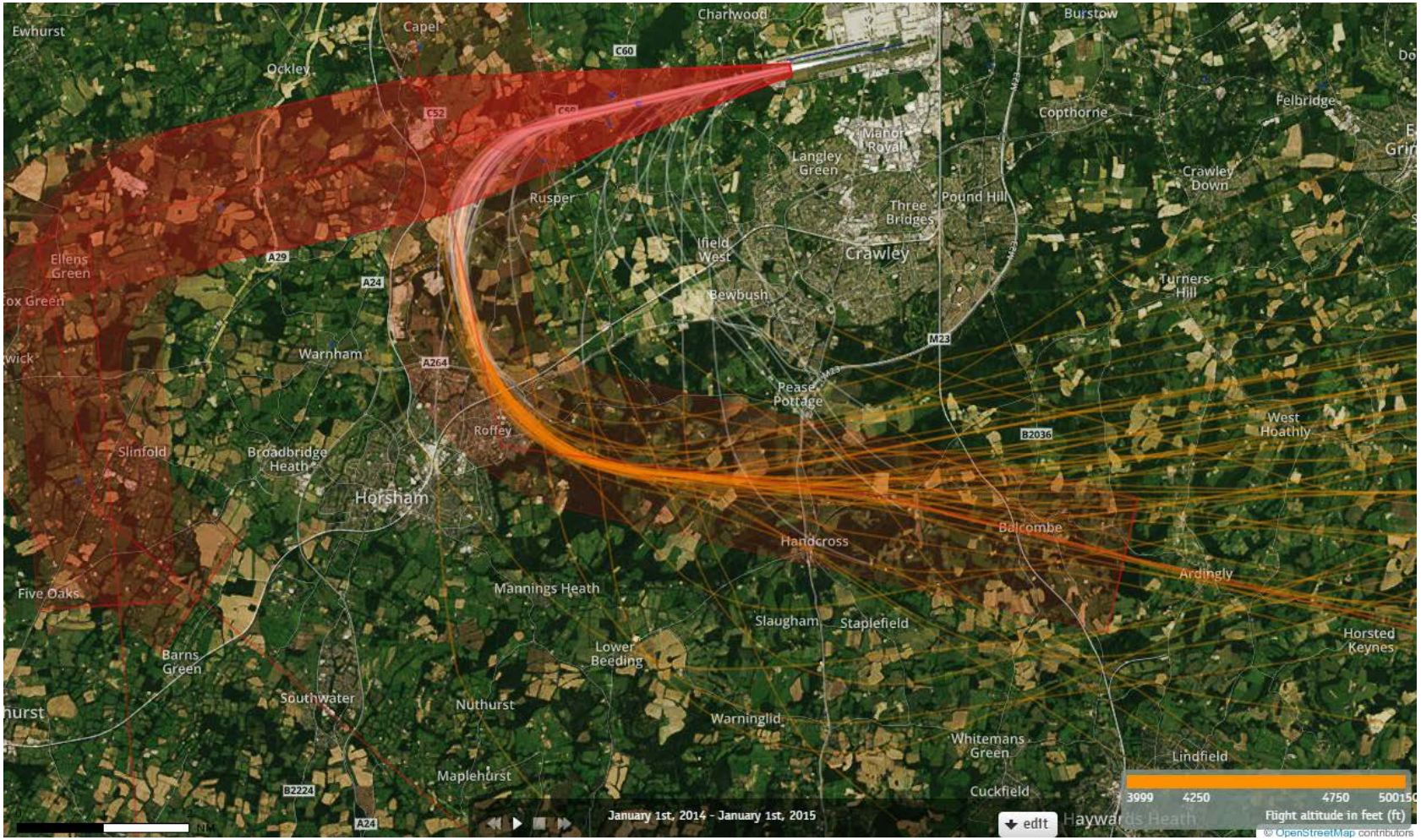


Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
4000-5000 feet (57 Aircraft – CONVENTIONAL ONLY)

Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
4000-5000 feet (57 Aircraft – P-RNAV ONLY)



Orange plots show the points at which an aircraft was between 4000 and 5000ft altitude.

26 WIZAD
Route 9
(Tactical Offload Route)

Altitude Bands

5000-6000ft

26 WIZ Departures January 1st - December 31st 2013
5000-6000 feet (57 Aircraft – CONVENTIONAL ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
5000-6000 feet (57 Aircraft – P-RNAV ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
5000-6000 feet (57 Aircraft – CONVENTIONAL ONLY)

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Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
5000-6000 feet (57 Aircraft – P-RNAV ONLY)

Blue plots show the points at which an aircraft was between 5000 and 6000ft altitude.

26 WIZAD
Route 9
(Tactical Offload Route)

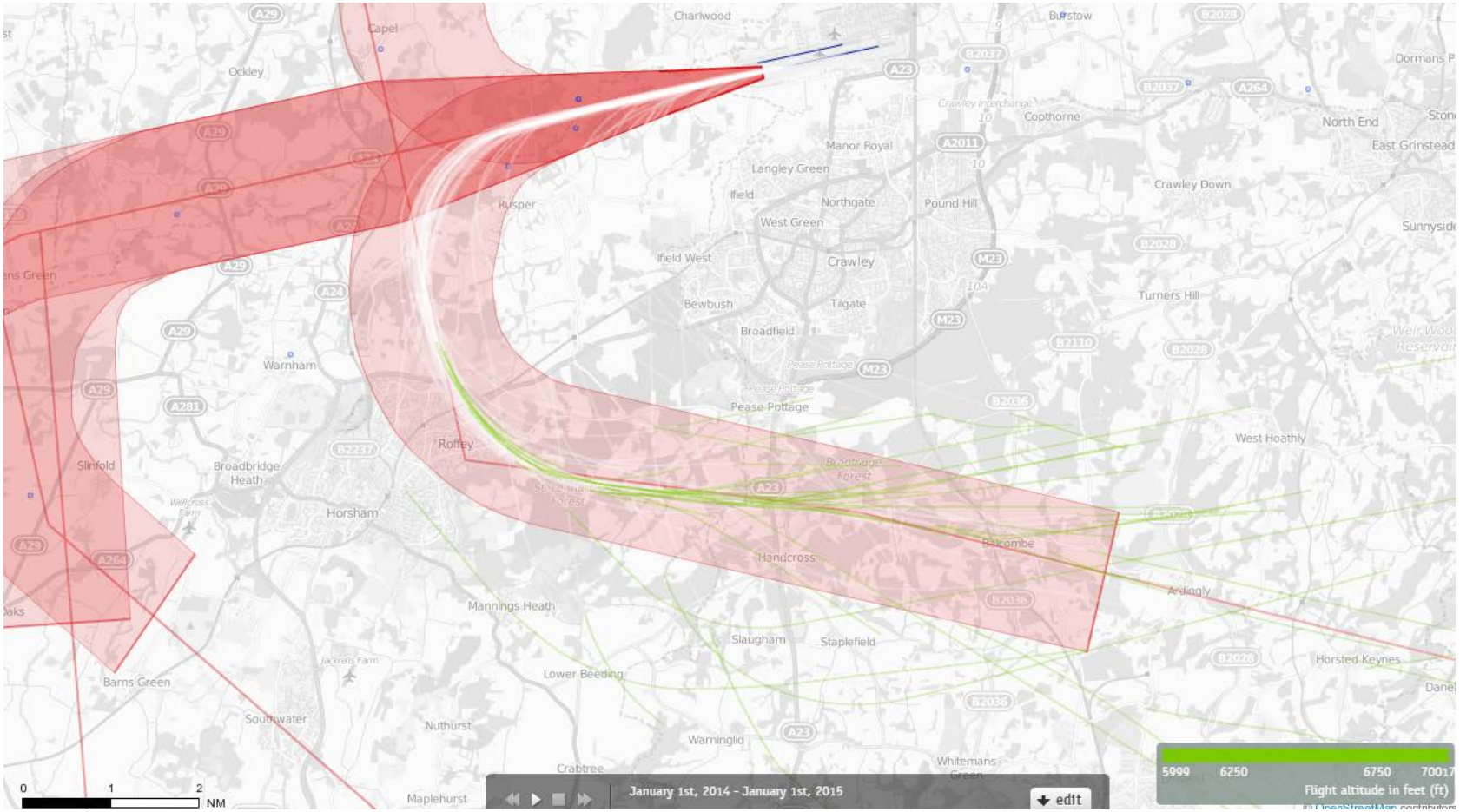
Altitude Bands

6000-7000ft

26 WIZ Departures January 1st - December 31st 2013
6000-7000 feet (57 Aircraft – CONVENTIONAL ONLY)

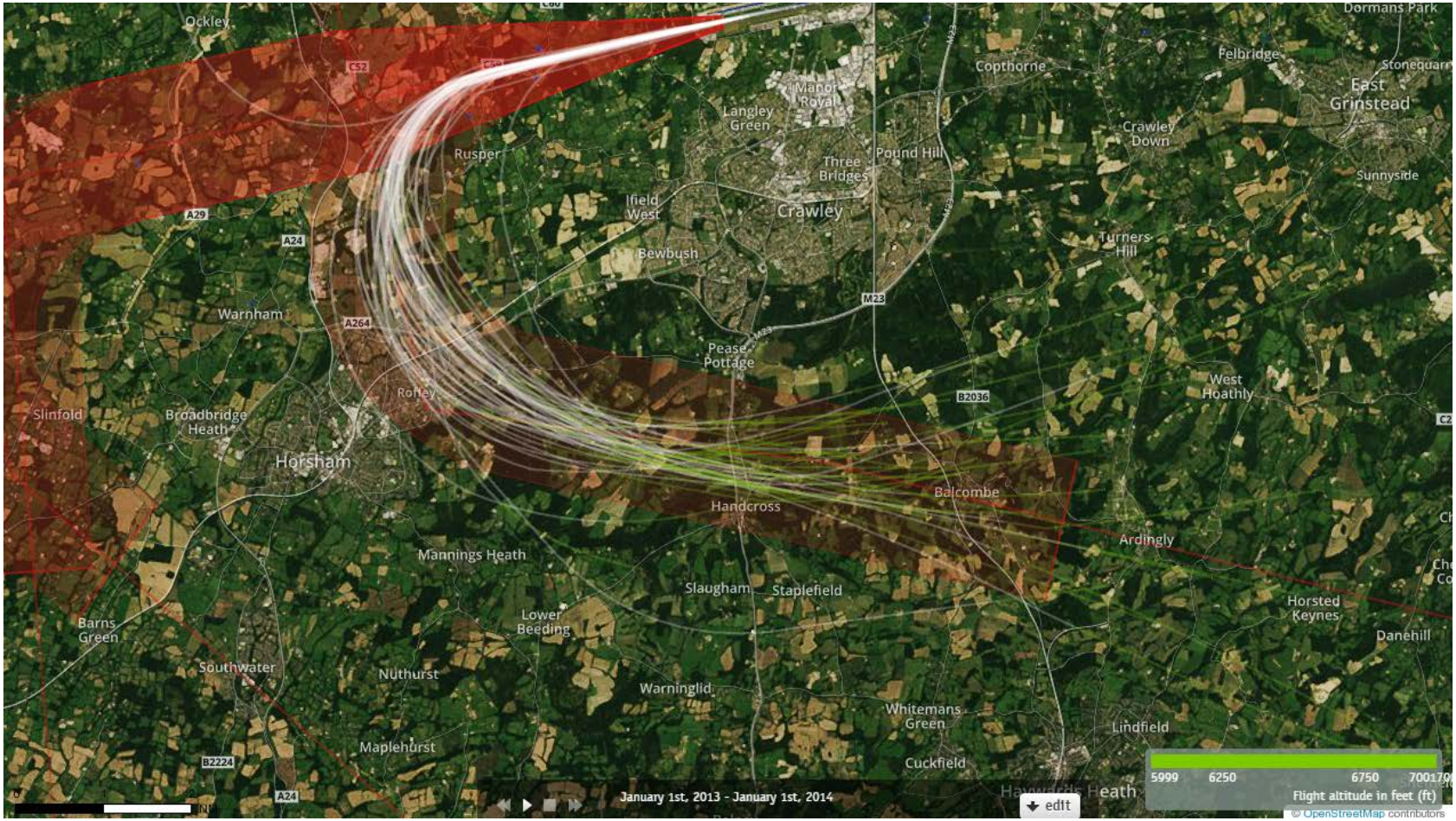
Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZ Departures January 1st - December 31st 2014
6000-7000 feet (57 Aircraft – P-RNAV ONLY)



Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

26 WIZ Departures January 1st - December 31st 2013
6000-7000 feet (57 Aircraft – CONVENTIONAL ONLY)



Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.

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6000-7000 feet (57 Aircraft – P-RNAV ONLY)

Green plots show the points at which an aircraft was between 6000 and 7000ft altitude.