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Module 5: Noise
Local Assessment - Addendum

Heathrow Extended Northern Runway Offset Route and Sound Exposure Level (SEL) Contours

Prepared for the
Airports Commission

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Contents

Executive Summary

The Airports Commission Appraisal Framework considers the aviation noise implications of airport schemes at both a national and local level.

This document forms an addendum to the Aviation Noise Local Report published for consultation in November 2014 by the Airports Commission. This addendum focuses on an additional operational scenario developed to minimise the total number of people affected by the Heathrow Extended Northern Runway (Heathrow ENR) scheme, which was identified during the consultation process. This additional operational scenario considers the use of 'offset arrival' approaches from the east, whereby aircraft avoid overflying the most densely populated areas.

The effects of the scenario are determined through comparison with the population noise exposure of the baseline scenarios; these are defined as the 'Do-Minimum' (DM) level of development, which can be described as '*how noise will develop in the surrounding area in the absence of an additional runway scheme'*. The DM cases account for any proposed changes to the airports as indicated in their respective current master plans. The current situation is calculated from the actual aircraft movements at each airport in 2011 and 2013. The population noise exposures for the current and DM situations are detailed in the Noise: Baseline Report (Jacobs 2014).

The Appraisal Framework requires base and end year comparisons. For the Local Noise Assessment, a base date of 2030, an interim date of 2040 and an end date of 2050 are used. These dates do not coincide with the wider appraisal start and end dates, which are derived from an available scheme completion date (2025 / 2026) and a 60 year appraisal period.

This is because longer-term forecasts of the input data on which noise modelling is based cannot be made with reasonable accuracy. The potential noise impacts are therefore considered only over the period where reasonable forecasts can be made.

For the carbon capped Heathrow Extended Northern Runway 'Offset Arrival' option, the following differences in aircraft noise exposure are predicted in comparison to the DM situation for each assessment year:

Table A1: Predicted impacts of Heathrow Extended Northern Runway 'Offset Arrival' Option

Metric	Period	Value	Area (km²)			Population		
			2030	2040	2050	2030	2040	2050
$L_{Aeq,16h}$	Summer average	>54	31.5	36.3	32.3	(13,300)	28,300	27,100
$L_{Aeq,16h}$	Summer average	>57	19.1	22	19.6	36,700	45,300	41,600
$L_{Aeq,8h}$	Summer average	>48	20.9	24.2	17.1	(7,400)	(38,100)	(66,400)
L_{den}	Annual average	>55	36.1	44.1	38.3	(21,900)	12,000	(13,400)
N70	Summer average	>20	17.8	22	12.6	15,300	36,200	23,200
N60	Summer average	>25	23.4	32.8	23.5	43,400	7,100	(53,300)

Note: Numbers in parentheses show a reduction in population exposure

1 Introduction

1.1 Purpose

This document forms an addendum to the Aviation Noise Local Report published for consultation in December 2014 by the Airports Commission. This addendum focuses on an additional operational scenario developed to minimise the total number of people affected by the Heathrow Extended Northern Runway (Heathrow ENR) scheme, which has arisen through the consultation process. This additional operational scenario considers the use of 'off-set' approaches from the east, whereby aircraft avoid the most densely populated areas, and is based on the Assessment of Need (AoN) Carbon Capped capacity forecasts.

Noise contours and exposure metrics presented in this report have been calculated by ERCD using the ANCON2 noise model. Schedules of anticipated aircraft movements by aircraft type, runway and timeslot for the noise models were provided by LeighFisher, based on higher level Airport Commission carbon capped demand forecasts. Further details on the noise modelling and aircraft movement forecasts can be found in the Aviation Local Noise Report. For convenience, the information associated with the Heathrow Do-Minimum (DM) scenarios which is presented in the Aviation Noise Local Report is reproduced in this document, enabling easy comparison between the DM and this operational scenario (Heathrow-ENR-O).

In addition, this addendum provides Sound Exposure Level (SEL) Footprints for the A380 aircraft in 2050 arriving for the Heathrow North West Runway (Heathrow NWR) scheme scenarios and Heathrow ENR schemes scenarios.

1.2 Heathrow ENR Offset Approaches Scheme

The basic premise of the proposed Heathrow ENR scheme is the extension of the existing northern runway at Heathrow Airport to approximately double its current length, and the introduction of a safety area mid-way along the extended runway, allowing it to operate as two runways.

Since the publication of the Noise: Local Report[1], further noise modelling has been undertaken in respect of offset approaches for the Heathrow ENR scenario. ERCD have merged the offset approaches routes used for the Heathrow NWR minimise total people affected scenario (Heathrow-NWR-T) with the runway configuration of the Heathrow ENR scenario (Heathrow-ENR-X) to provide the Heathrow ENR scheme with indicative off-set approaches (Heathrow-ENR-O). The noise effects of the Heathrow-ENR-O scenario are set out in this addendum.

Amongst the benefits of this scheme that the Proposer cites in their submission is the fact that the new runway capacity maintains the existing runway centrelines, so their assumption is there are no new people included in the noise footprint. However, for this particular scenario the offset approaches overfly different areas to the existing standard approaches, and therefore new people will be included in the noise footprints for this option.

[1] 5. Noise: Local Assessment, Prepared for the Airports Commission by Jacobs, 2014.

2 Heathrow Airport Noise Baseline

The current baseline (2013) and future (2030, 2040 and 2050) Do-Minimum noise levels that are calculated for Heathrow Airport are set out in the Noise Baseline Report, and are repeated in this section for convenience. The noise study area for the Heathrow ENR proposal was derived from the total area covered by the original Do-Minimum and Do-Something noise contours that were calculated by ERCD on behalf of the Airports Commission, shown below.

Figure 2.1 : Heathrow Extended Northern Runway Noise Study Area

The original noise study area for Heathrow ENR includes the urban areas of:

- Barnes, Richmond Upon Thames
- Battersea, Wandsworth
- Brentford, Hounslow
- Brixton, Lambeth
- Camberwell, Southwark
- Chelsea, Kensington and Chelsea
- Chiswick, Hounslow
- Clapham, Lambeth
- Ealing, Ealing
- Egham, Surrey County
- Eton, Windsor and Maidenhead
- Feltham, Hounslow
- Fulham, Hammersmith and Fulham
- Hounslow, Hounslow
- Isleworth, Hounslow
- Putney, Wandsworth
- Richmond, Richmond Upon Thames
- Twickenham, Richmond Upon Thames
- Wandsworth, Wandsworth
- Windsor, Windsor and Maidenhead

The original study area also includes the smaller settlements of:

- Boveney, Buckinghamshire County
- Bray, Windsor and Maidenhead
- Burnham, Buckinghamshire County
- Colnbrook, Slough
- Cranbourne, Bracknell Forest
- Cranford, Hounslow

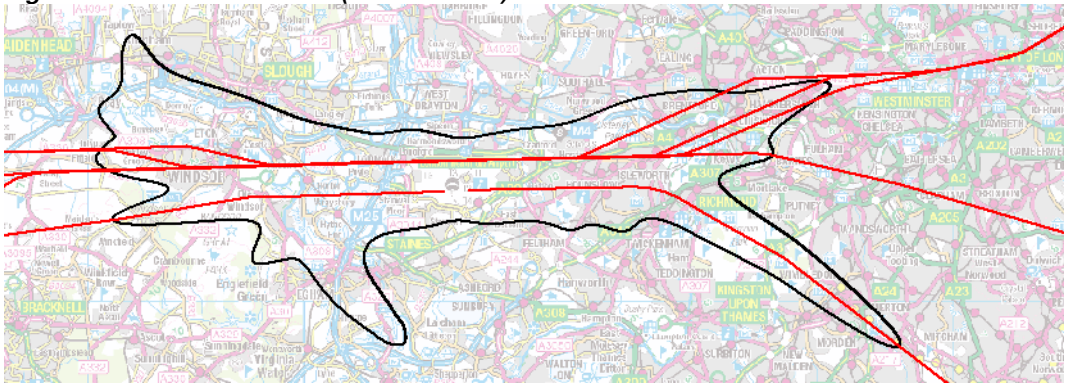
- Datchet, Windsor and Maidenhead
- Dorney, Buckinghamshire County
- East Bedfont, Hounslow
- Fifield, Windsor and Maidenhead
- Hanworth, Hounslow
- Harmondsworth, Hillingdon
- Hatton, Hounslow
- Heston, Hounslow
- Horton, Windsor and Maidenhead
- Hythe End, Windsor and Maidenhead
- Kew, Richmond Upon Thames
- Laleham, Surrey County
- Longford, Hillingdon
- Mortlake, Richmond Upon Thames
- Norwood Green, Ealing
- Oakley Green, Windsor and Maidenhead
- Old Windsor, Windsor and Maidenhead
- Paley Street, Windsor and Maidenhead
- Poyle, Slough
- Roehampton, Wandsworth
- Sipson, Hillingdon
- Stanwell, Surrey County
- Stanwell Moor, Surrey County
- Taplow, Buckinghamshire County
- Thorpe, Surrey County
- Upton, Slough
- Wraysbury, Windsor and Maidenhead

In addition to these settlements identified within the original study area, the offset approach paths extend some noise contours south west of Heathrow Airport over Richmond Park, and a small number of contours extend over Wimbledon to Merton, as can be seen in Figure 2.2 below.

2.1 Routes

The proposed routes for the Heathrow ENR-O scheme are shown in Figure 2.2 below. These routes have been developed for noise modelling purposes and should not be considered as the final routes of an expanded option.

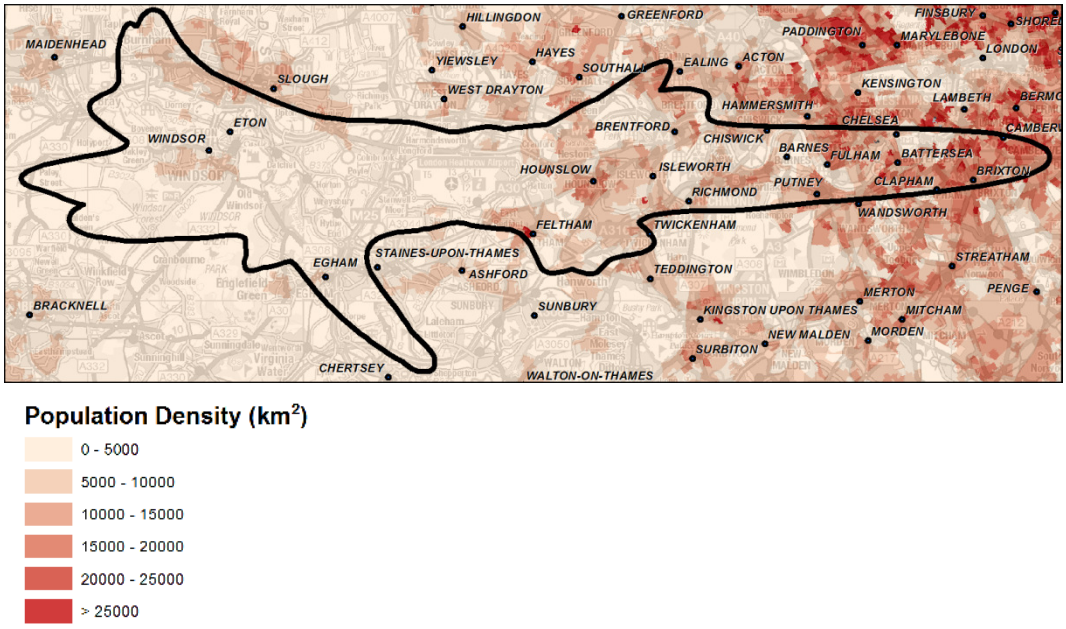
Figure 2.2 : Heathrow-ENR-O (Offset Arrival) Routes



2.2 Population

To visualise the population distribution around Heathrow Airport, the forecast 2030 populations associated with the postcode points falling within each Lower Super Output Area (LSOA) have been summated and then divided by the area of the LSOA to give an approximate population density as shown in Figure 2.3 below.

Figure 2.3 : Heathrow Extended Northern Runway Forecast Population Densities (2030)

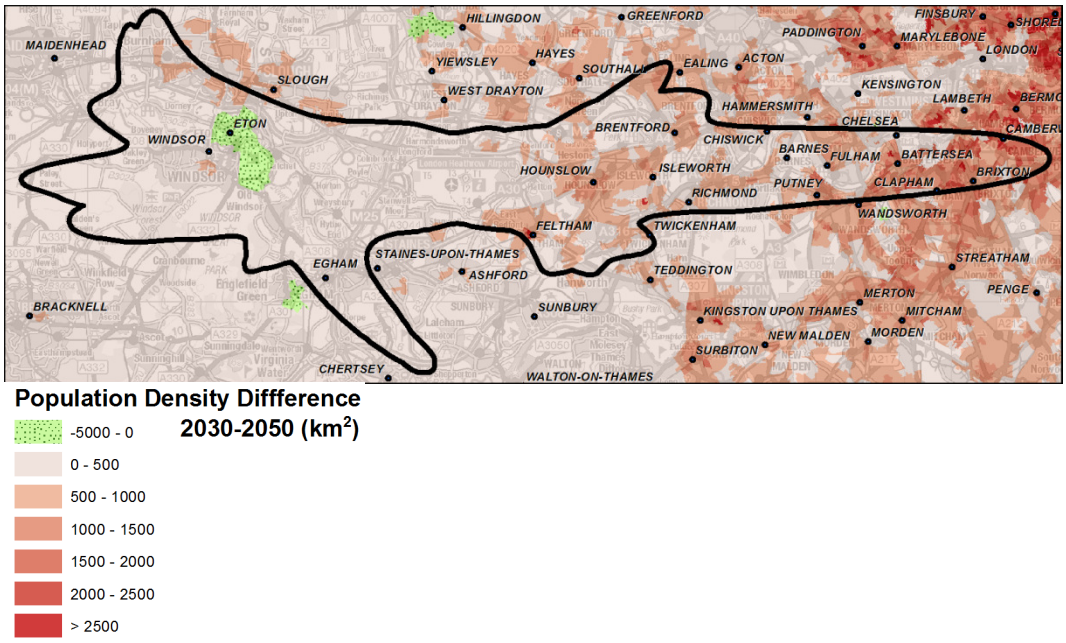


The population density in the part of the study area to the west of Heathrow Airport is generally lower than 5,000 People/km^2, with the exception of Windsor and the southern extent of Slough which are higher. Population densities in the areas to the east of the airport increase with proximity to central London, and the eastern extent of the study area includes populous areas such as Battersea, Brentford, Brixton, Camberwell, Clapham, Chelsea, Chiswick, Fulham, Isleworth, Putney and Wandsworth. Other highly populous areas within or adjacent to the study area include Feltham, Hounslow, Twickenham and West Drayton.

Figure 2.4 below shows the change in population densities that are forecast in the period 2030 to 2050. Most of the study area to the west of the airport is expected to have population growth in the range 0-500 People/km^2, apart from the around Eton where a reduction in population is forecast. (This result is explained by changes to a single postcode point associated with a population which is present in the 2030 forecast but not in the 2050 forecast; results should be treated with caution).

Again, it is generally the most populous areas that are forecast to have the greatest population increases; the areas to the east of the airport identified above as having higher population densities all show greater increases than in the remaining parts of the study area. The population exposure metrics for 2050 can therefore be expected to be particularly sensitive to any changes in contour areas towards the eastern extent of the study area.

Figure 2.4 : 2030 vs 2050 Difference in Population Densities around Heathrow Airport



2.3 Baseline Noise Levels

The current and future Do-Minimum noise levels due to Heathrow Airport are presented in Table 2.1 to Table 2.4 below, using the range of metrics advocated by the 'scorecard' approach of the noise appraisal module.

Table 2.1 : Current aviation noise levels for Heathrow Airport (2011 and 2013)

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on number above contour)	
Day	>54 dB $L_{Aeq,16h}$	632,600			N70 >20	368,100
	>57 dB $L_{Aeq,16h}$	266,100			N70 >50	217,700
	>60 dB $L_{Aeq,16h}$	118,800			N70 >100	113,000
	>63 dB $L_{Aeq,16h}$	48,400			N70 >200	62,700
	>66 dB $L_{Aeq,16h}$	14,000			N70 >500	<50
	>69 dB $L_{Aeq,16h}$	2,700				
	>72 dB $L_{Aeq,16h}$	200				
Night	>48 dB $L_{Aeq,8h}$	421,300			N60 >25	346,300
	>51 dB $L_{Aeq,8h}$	190,800			N60 >50	2,600
	>54 dB $L_{Aeq,8h}$	103,200			N60 >100	0
	>57 dB $L_{Aeq,8h}$	48,200			N60 >200	0
	>60 dB $L_{Aeq,8h}$	16,700			N60 >500	0
	>63 dB $L_{Aeq,8h}$	4,500				
	>66 dB $L_{Aeq,8h}$	1,200				
	>69 dB $L_{Aeq,8h}$	<50				
	>72 dB $L_{Aeq,8h}$	<50				
24-hour			>55 dB L_{den}	766,100		
			>60 dB L_{den}	191,500		
			>65 dB L_{den}	52,700		
			>70 dB L_{den}	6,600		
			>75 dB L_{den}	100		

Note: L_{den} results relate to 2011.

Table 2.2 : 2030 Do-Minimum Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on number above contour)	
Day	>54 dB $L_{Aeq,16h}$	493,600			N70 >20	291,800
	>57 dB $L_{Aeq,16h}$	221,200			N70 >50	184,100
	>60 dB $L_{Aeq,16h}$	109,000			N70 >100	122,600
	>63 dB $L_{Aeq,16h}$	35,200			N70 >200	63,300
	>66 dB $L_{Aeq,16h}$	7,900			N70 >500	<50
	>69 dB $L_{Aeq,16h}$	2,100				
	>72 dB $L_{Aeq,16h}$	<50				
Night	>48 dB $L_{Aeq,8h}$	271,200			N60 >25	150,500
	>51 dB $L_{Aeq,8h}$	151,300			N60 >50	50
	>54 dB $L_{Aeq,8h}$	61,100			N60 >100	0
	>57 dB $L_{Aeq,8h}$	21,900			N60 >200	0
	>60 dB $L_{Aeq,8h}$	3,900			N60 >500	0
	>63 dB $L_{Aeq,8h}$	1,300				
	>66 dB $L_{Aeq,8h}$	<50				
	>69 dB $L_{Aeq,8h}$	<50				
	>72 dB $L_{Aeq,8h}$	<50				
24-hour			>55 dB L_{den}	580,500		
			>60 dB L_{den}	169,600		
			>65 dB L_{den}	34,800		
			>70 dB L_{den}	3,000		
			>75 dB L_{den}	<50		

Table 2.3 : 2040 Do-Minimum Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on number above contour)	
Day	>54 dB $L_{Aeq,16h}$	460,600			N70 >20	278,300
	>57 dB $L_{Aeq,16h}$	219,400			N70 >50	187,900
	>60 dB $L_{Aeq,16h}$	103,800			N70 >100	124,700
	>63 dB $L_{Aeq,16h}$	33,900			N70 >200	62,200
	>66 dB $L_{Aeq,16h}$	7,100			N70 >500	<50
	>69 dB $L_{Aeq,16h}$	2,100				
	>72 dB $L_{Aeq,16h}$	<50				
Night	>48 dB $L_{Aeq,8h}$	337,000			N60 >25	258,300
	>51 dB $L_{Aeq,8h}$	184,600			N60 >50	<50
	>54 dB $L_{Aeq,8h}$	81,300			N60 >100	0
	>57 dB $L_{Aeq,8h}$	31,400			N60 >200	0
	>60 dB $L_{Aeq,8h}$	6,400			N60 >500	0
	>63 dB $L_{Aeq,8h}$	2,400				
	>66 dB $L_{Aeq,8h}$	<50				
	>69 dB $L_{Aeq,8h}$	<50				
	>72 dB $L_{Aeq,8h}$	<50				
24-hour			>55 dB L_{den}	588,900		
			>60 dB L_{den}	179,500		
			>65 dB L_{den}	36,200		
			>70 dB L_{den}	3,100		
			>75 dB L_{den}	<50		

Table 2.4 : 2050 Do-Minimum Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on number above contour)	
Day	>54 dB $L_{Aeq,16h}$	435,800			N70 >20	274,100
	>57 dB $L_{Aeq,16h}$	219,600			N70 >50	189,500
	>60 dB $L_{Aeq,16h}$	103,800			N70 >100	129,400
	>63 dB $L_{Aeq,16h}$	34,900			N70 >200	71,200
	>66 dB $L_{Aeq,16h}$	7,700			N70 >500	<50
	>69 dB $L_{Aeq,16h}$	2,100				
	>72 dB $L_{Aeq,16h}$	<50				
Night	>48 dB $L_{Aeq,8h}$	373,100			N60 >25	320,700
	>51 dB $L_{Aeq,8h}$	197,400			N60 >50	6,500
	>54 dB $L_{Aeq,8h}$	89,200			N60 >100	0
	>57 dB $L_{Aeq,8h}$	33,900			N60 >200	0
	>60 dB $L_{Aeq,8h}$	7,100			N60 >500	0
	>63 dB $L_{Aeq,8h}$	2,600				
	>66 dB $L_{Aeq,8h}$	<50				
	>69 dB $L_{Aeq,8h}$	<50				
	>72 dB $L_{Aeq,8h}$	<50				
24-hour			>55 dB L_{den}	583,500		
			>60 dB L_{den}	182,100		
			>65 dB L_{den}	36,400		
			>70 dB L_{den}	3,100		
			>75 dB L_{den}	<50		

Table 2.5 below summarises the predicted difference in noise levels over the periods of interest for the noise assessment.

Table 2.5 : Predicted difference in Do-Minimum noise levels for Heathrow Airport

Metric		Current vs 2030 DM	2030 DM vs 2040 DM	2030 DM vs 2050 DM	Current vs 2050 DM
$L_{Aeq,16h}$ (day)	>54	(139,000)	(33,000)	(24,800)	(196,800)
	>57	(44,900)	(1,800)	200	(46,500)
$L_{Aeq,8h}$ (night)	>48	(150,100)	65,800	36,100	(48,200)
L_{den} (24-hour)	>55	(185,600)	8,400	(5,400)	(182,600)
N70 (day)	>20	(76,300)	(13,500)	(4,200)	(94,000)
N60 (night)	>25	(195,800)	107,800	62,400	(25,600)

Note: Numbers in parentheses represent reductions

It can be seen from Table 2.5 above that a significant decrease in population noise exposure is predicted between the current 2013 situation and the 2030 DM scenario. This reduction is due to improvements in aircraft technology, and uptake over this period of those aircraft by airlines operating at the airport, leading to a quieter fleet mix with a greater proportion of 'imminent' type aircraft such as the Boeing 787 Dreamliner and the Airbus 350 models.

Further reductions in noise are expected between the 2030 DM and 2040 DM scenarios, also as a result of the quieter fleet mix. When comparing the 2040 and 2050 DM scenarios, there is a reduction of 24,800 people exposed to daytime noise levels of 54 dB $L_{Aeq,16h}$ or greater, and a reduction of 4,200 people included in the daytime N70 >20 contour, but all other noise metrics either show no difference or slight increases. As Air Transport Movements (ATM) reduce between 2040 and 2050 in the Do-Minimum scenario, this effect is likely to be linked to population growth within contours, possibly combined with the impacts of specific aircraft types in the fleet mix.

2.4 Noise Scorecards for Heathrow-ENR-O

Noise metrics have been produced by ERCD on behalf of the Airport Commission for the Heathrow Airport Extended Northern Runway Offset Approach proposal for 2030, 2040 and 2050.

Table 2.6 : 2030 Heathrow-ENR-O Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on above contour)	number
Day	>54 dB LAeq,16h	480,300			N70 >20	307,100
	>57 dB LAeq,16h	257,900			N70 >50	212,500
	>60 dB LAeq,16h	157,500			N70 >100	146,700
	>63 dB LAeq,16h	63,700			N70 >200	98,000
	>66 dB LAeq,16h	17,100			N70 >500	<50
	>69 dB LAeq,16h	3,900				
	>72 dB LAeq,16h	600				
Night	>48 dB LAeq,8h	263,800			N60 >25	193,900
	>51 dB LAeq,8h	177,400			N60 >50	18,900
	>54 dB LAeq,8h	87,800			N60 >100	0
	>57 dB LAeq,8h	31,000			N60 >200	0
	>60 dB LAeq,8h	4,900			N60 >500	0
	>63 dB LAeq,8h	800				
	>66 dB LAeq,8h	200				
	>69 dB LAeq,8h	<50				
	>72 dB LAeq,8h	<50				
24-hour			>55 dB L_{den}	558,600		
			>60 dB L_{den}	212,300		
			>65 dB L_{den}	60,300		
			>70 dB L_{den}	4,700		
			>75 dB L_{den}	400		

Table 2.7 : 2040 Heathrow-ENR-O Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on above contour)	number
Day	>54 dB LAeq,16h	488,900			N70 >20	314,500
	>57 dB LAeq,16h	264,700			N70 >50	220,500
	>60 dB LAeq,16h	164,400			N70 >100	155,900
	>63 dB LAeq,16h	67,500			N70 >200	106,600
	>66 dB LAeq,16h	17,700			N70 >500	<50
	>69 dB LAeq,16h	4,000				
	>72 dB LAeq,16h	700				
Night	>48 dB LAeq,8h	298,900			N60 >25	265,400
	>51 dB LAeq,8h	193,800			N60 >50	47,900
	>54 dB LAeq,8h	107,300			N60 >100	0
	>57 dB LAeq,8h	36,900			N60 >200	0
	>60 dB LAeq,8h	6,800			N60 >500	0
	>63 dB LAeq,8h	1,600				
	>66 dB LAeq,8h	300				
	>69 dB LAeq,8h	100				
	>72 dB LAeq,8h	<50				
24-hour			>55 dB L_{den}	600,900		
			>60 dB L_{den}	223,500		
			>65 dB L_{den}	66,000		
			>70 dB L_{den}	5,100		
			>75 dB L_{den}	400		

Table 2.8 : 2050 Heathrow-ENR-O Heathrow Airport Scorecard

Period	Population Noise Exposure UK measure		EU measure		Frequency measure (based on above contour)	number
Day	>54 dB LAeq,16h	462,900			N70 >20	297,300
	>57 dB LAeq,16h	261,200			N70 >50	224,100
	>60 dB LAeq,16h	165,500			N70 >100	166,800
	>63 dB LAeq,16h	67,100			N70 >200	111,600
	>66 dB LAeq,16h	17,800			N70 >500	<50
	>69 dB LAeq,16h	3,900				
	>72 dB LAeq,16h	600				
Night	>48 dB LAeq,8h	306,700			N60 >25	267,400
	>51 dB LAeq,8h	197,200			N60 >50	46,000
	>54 dB LAeq,8h	110,300			N60 >100	0
	>57 dB LAeq,8h	36,400			N60 >200	0
	>60 dB LAeq,8h	6,200			N60 >500	0
	>63 dB LAeq,8h	1,600				
	>66 dB LAeq,8h	200				
	>69 dB LAeq,8h	<50				
	>72 dB LAeq,8h	<50				
24-hour			>55 dB L_{den}	570,100		
			>60 dB L_{den}	223,600		
			>65 dB L_{den}	65,200		
			>70 dB L_{den}	4,900		
			>75 dB L_{den}	400		

3 Assessment of Heathrow Airport Extended Northern Runway Offset Approach (Heathrow-ENR-O)

The predicted differences between the equivalent year DM and Heathrow-ENR-O scenarios for each noise metric are considered in detail below. The ATMs used in the noise modelling of these two scenarios are set out in Table 3.1 below.

Table 3.1 : Heathrow Airport – Extended Northern Runway Offset Approach ATMs

	Air Transport Movements		
	2030	**2040**	**2050**
Heathrow DM	483,856	484,517	471,132
Heathrow ENR-O	654,489	700,000	700,000

3.1 Day Metrics

3.1.1 $L_{Aeq,16h}$ Noise Exposure Metric

This section considers the potential changes in terms of the $L_{Aeq,16h}$ noise exposure metric, calculated for an average summer's day, that may result from the development of the Heathrow Extended Northern Runway Offset Approach option.

For convenience, extracts from the relevant 2030, 2040 and 2050 DM and Do-Something scenario $L_{Aeq,16h}$ contour plots are shown in Figure 3.1 to Figure 3.6 to provide visual context to the comparisons. The full contour plots are included in Appendix A.

The analysis in this section indicates that the number of people within the daytime $L_{Aeq,16h}$ noise contours will generally be greater in the Heathrow-ENR-O scenario (when compared to the DM situation), for all of the assessment years considered except for the >54 dB contour in 2030.

Figure 3.1 : 2030 Do-Minimum Heathrow $L_{Aeq,16h}$ Contours

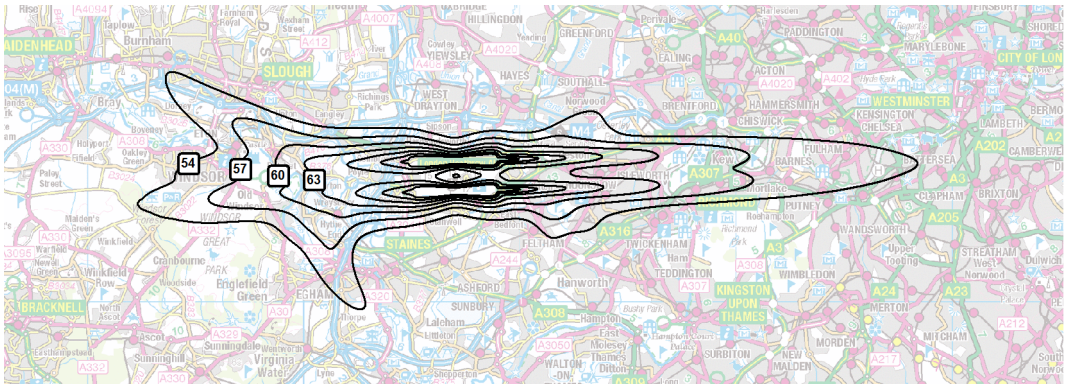
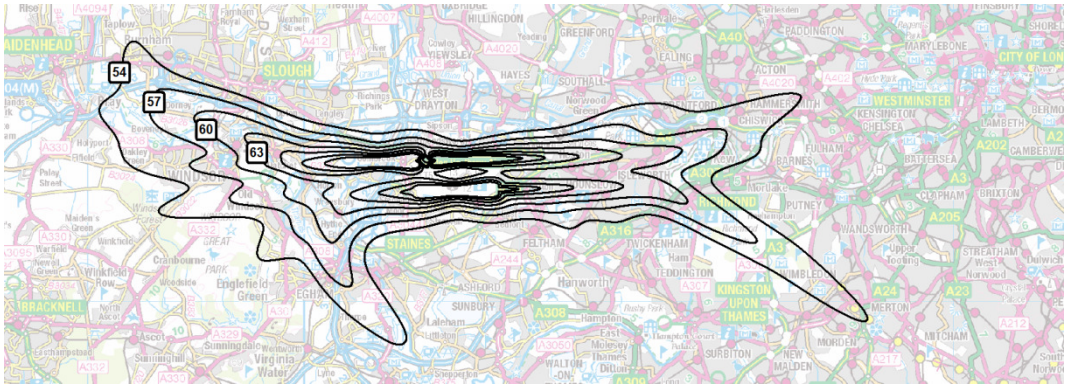


Figure 3.2 : 2030 Do-Something Heathrow-ENR-O $L_{Aeq,16h}$ Contours



The difference in $L_{Aeq,16h}$ contour areas, population exposures and number of households included in each contour is summarised in Table 3.2 below.

Table 3.2 : 2030 Do-Minimum Heathrow vs 2030 Heathrow-ENR-O, $L_{Aeq,16h}$

Contour	Area (km²)	Population	Households
>54	31.5	(13,300)	(10,400)
>57	19.1	36,700	13,600
>60	15.7	48,500	18,800
>63	8.3	28,500	11,300
>66	5.0	9,200	3,500
>69	3.2	1,800	700
>72	2.0	<50 to 600	<50 to 300

Note: Numbers in parentheses represent reductions

The noise contours for the 2030 Heathrow-ENR-O scenario differ significantly from the 2030 Do-Minimum scenario. The Do-Minimum scenario exhibits a single spur due east of the runways, with the 54 dB $L_{Aeq,16h}$ contour extending over west London to Battersea. However, in the offset approaches scenario, there are two spurs aligned approximately north-east and south-east from the airport due to the offset approach routes. The north-eastern spur overflies Hammersmith, Chiswick, Kew and Isleworth, while the south-eastern spur overflies Wimbledon, Richmond and Hounslow. In particular, the area falling within the >54 and >57 dB $L_{Aeq,16h}$ contours of the south-eastern spur primarily comprises Richmond Park, which is sparsely populated. This is the primary reason why the >54 dB $L_{Aeq,16h}$ contour in the Heathrow-ENR-O scenario includes fewer people in that in the equivalent Do-Minimum scenario despite being 31.5km^2 greater in area.

To the west of airport, there are also differences in the shape of the contours, with the Heathrow-ENR-O scenario resulting in five relatively indistinct spurs, compared with three more distinct spurs in the Do-Minimum scenario. This is because departures from proposed runway 27E may continue west, or turn left or right, whilst in the Do-Minimum scenario departures from 27R travel only west or turn right. Of the five spurs to the west of the airport in the Heathrow-ENR-O scenario, the northerly (overflying Burnham) and southerly (overflying Egham and Thorpe) are the most developed.

In summary, the offset approaches are predicted to reduce the number of people within the >54 dB $L_{Aeq,16h}$ contour in comparison to the Do-Minimum scenario. However, the increased number of aircraft movements offsets has a greater effect than the offset approaches for all other contour bands, as shown below:

- >54 dB: A reduction of 13,300 (from 493,600 to 480,300)
- >57 dB: An increase of 36,700 (from 221,200 to 257,900)
- >60 dB: An increase of 48,500 (from 109,000 to 157,500)
- >63 dB: An increase of 28,500 (from 35,200 to 63,700)
- >66 dB: An increase of 9,200 (from 7,900 to 17,100)
- >69 dB: An increase of 1,800 (from 2,100 to 3,900)
- >72 dB: An increase from <50 to 600

For the Heathrow-ENR-O scenario, the number of people newly affected by noise levels of >57 dB $L_{Aeq,16h}$ in the 2030 Do-Something scenario compared to the 2030 DM scenario is 72,800, and the number of people newly removed is 35,500. This results in a net increase in the number of people newly affected of 37,300. The net increase in number of people newly affected differs from the overall increase people within the 57 dB contour in Table 3.2 above because the do-minimum and do-something contours are different shapes and the population is not evenly distributed throughout the study area.

Figure 3.3 : 2040 Do-Minimum Heathrow LAeq,16h Contours

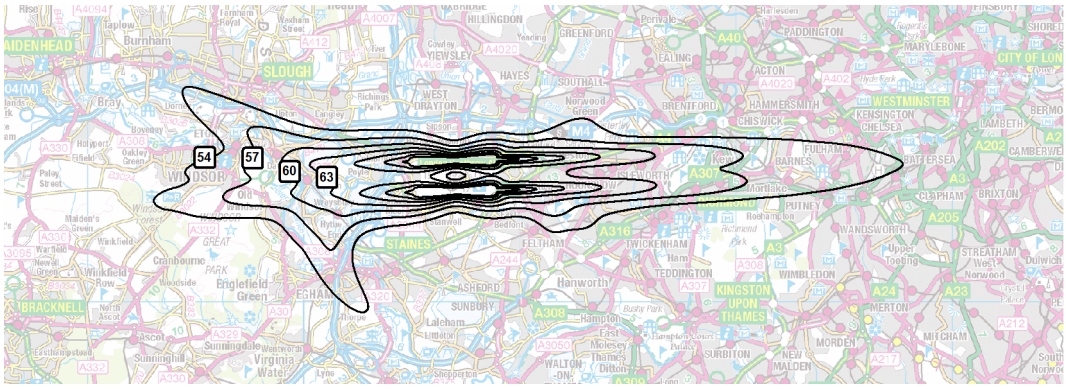


Figure 3.4 : 2040 Do-Something Heathrow-ENR-O $L_{Aeq,16h}$ Contours

The differences in $L_{Aeq,16h}$ contour areas, population exposures and number of households between the 2040 Do-Minimum and Heathrow-ENR-O scenarios are summarised in Table 3.3 below.

Table 3.3 : 2040 Do-Minimum Heathrow vs 2040 Heathrow-ENR-O, $L_{Aeq,16h}$

Contour	Area (km²)	Population	Households
>54	36.3	28,300	6,400
>57	22.0	45,300	17,100
>60	17.1	60,600	23,400
>63	8.8	33,600	13,100
>66	5.3	10,600	4,100
>69	3.4	1,900	800
>72	2.0	<50 to 700	<50 to 300

Note: Numbers in parentheses represent reductions

Similar differences in the shapes of the $L_{Aeq,16h}$ contours between the Do-Minimum and Heathrow-ENR-O scenarios are evident for 2040 as for 2030, with two spurs to the east of the airport in the Heathrow-ENR-O scenario as a result of the offset approaches.

The areas covered by the 2040 Do-Minimum contours are smaller than the equivalent 2030 contours, due to forecast improvements in aircraft technology and similar ATMs between the 2030 and 2040 Do-Minimum scenarios.

The areas covered by the 2040 Heathrow-ENR-O $L_{Aeq,16h}$ contours are also smaller than the equivalent 2030 contours as a result of improvements in aircraft technology, however, the difference is not as marked as in the Do-Minimum scenario as there is greater growth in the forecast ATMs between the do-something scenarios.

When considering the combined effects of population growth, ATMs and improvements in aircraft technology, the following differences in population exposure are predicted for the 2040 Heathrow-ENR-O scenario compared to the 2040 Do-Minimum scenario:

- >54 dB: An increase of 28,300 (from 460,600 to 488,900)
- >57 dB: An increase of 45,300 (from 219,400 to 264,700)
- >60 dB: An increase of 60,600 (from 103,800 to 164,400)
- >63 dB: An increase of 33,600 (from 33,900 to 67,500)
- >66 dB: An increase of 10,600 (from 7,100 to 17,700)
- >69 dB: An increase of 1,900 (from 2,100 to 4,000)
- >72 dB: A change from <50 to 700

For the Heathrow-ENR-O option, the number of people newly affected by noise levels of 57 dB $L_{Aeq,16h}$ in the 2040 Do-Something scenario compared to the 2040 DM scenario is 76,000, and the number of people newly removed is 30,800. This results in a net increase in the number of people newly affected of 45,200.

Figure 3.5 : 2050 Do-Minimum Heathrow $L_{Aeq,16h}$ Contours

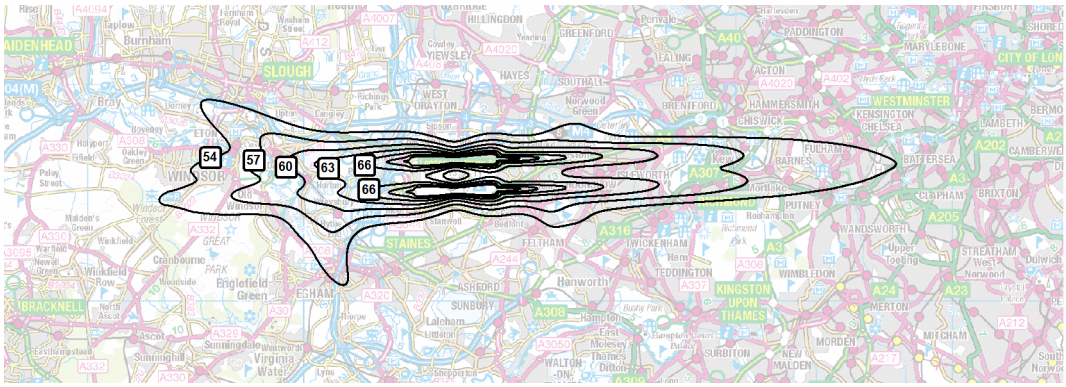
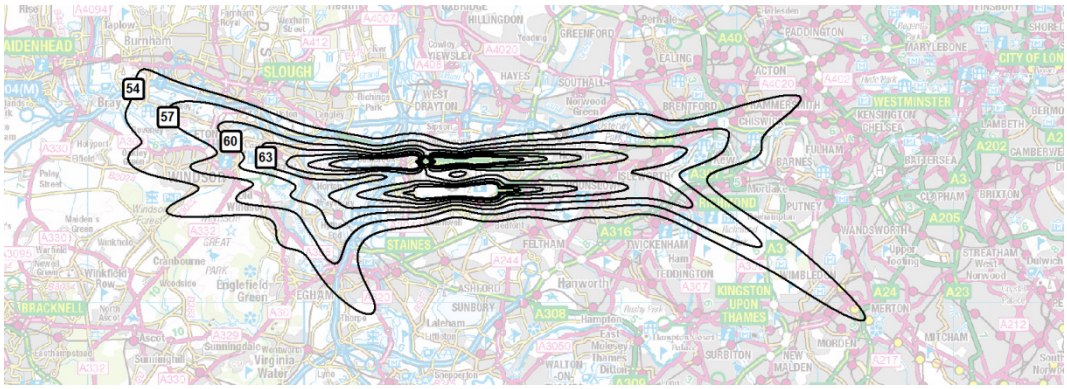


Figure 3.6 : 2050 Do-Something Heathrow-ENR-O $L_{Aeq,16h}$ Contours



The difference in $L_{Aeq,16h}$ contour areas, population exposures and number of households included in each contour is summarised in Table 3.4 below.

Table 3.4 : 2050 Do-Minimum Heathrow vs 2030 Heathrow-ENR-O, $L_{Aeq,16h}$

Contour	Area (km²)	Population	Households
>54	32.3	27,100	6,300
>57	19.6	41,600	15,500
>60	15.7	61,700	23,900
>63	7.8	32,200	12,800
>66	5.2	10,100	3,900
>69	3.2	1,800	700
>72	1.9	<50 to 600	<50 to 300

Note: Numbers in parentheses represent reductions

The differences in the shapes of the $L_{Aeq,16h}$ contours between the 2050 Do-Minimum and 2050 Heathrow-ENR-O scenarios are similar to those calculated for 2030, with the two eastern spurs in the Heathrow-ENR-O scenario due to the offset approaches extending further from the airport as a result of increased ATMs. The Do-Minimum noise contours in 2050 are very similar in extent and shape to the Do-Minimum contours calculated for 2030.

The areas covered by the 2050 Do-Minimum contours are smaller than the equivalent 2040 contours, due to forecast improvements in aircraft technology and similar ATMs between the 2040 and 2050 Do-Minimum scenarios.

The areas covered by the 2050 Heathrow-ENR-O $L_{Aeq,16h}$ contours are also smaller than the equivalent 2040 contours as a result of improvements in aircraft technology. There are no increases in ATMs forecast between the 2040 and 2050 Do-Something scenarios, and therefore these improvements in aircraft technology cause similar benefits in the Do-Minimum and Do-Something scenarios.

When considering the combined effects of population growth, ATMs and improvements in aircraft technology, the following differences in population exposure are predicted for the 2050 Heathrow-ENR-O scenario compared to the 2050 Do-Minimum scenario:

- >54 dB: An increase of 27,100 (from 435,800 to 462,900)
- >57 dB: An increase of 41,600 (from 219,600 to 261,200)
- >60 dB: An increase of 61,700 (from 103,800 to 165,500)
- >63 dB: An increase of 32,200 (from 34,900 to 67,100)
- >66 dB: An increase of 10,100 (from 7,700 to 17,800)
- >69 dB: An increase of 1,800 (from 2,100 to 3,900)
- >72 dB: A change from <50 to 600

For the Heathrow-ENR-O scenario, the number of people newly affected by noise levels of 57 dB $L_{Aeq,16h}$ in the 2050 Do-Something scenario compared to the 2050 DM scenario is 73,000, and the number of people newly removed is 31,100. This results in a net increase in the number of people newly affected of 41,900.

3.1.2 N70 Supplementary Metric

This section considers predicted changes in terms of the N70 supplementary noise metric, which is a count of the number of people subject to more than 20, 50, 100, 200 or 500 events which exceed 70 dB $L_{AS,Max}$ in an average annual day.

Extracts from the 2030, 2040 and 2050 Do-Minimum and Do-Something scenario N70 contour plots are shown in below Figure 3.7 to Figure 3.12 to provide visual context to the comparisons. Full contour plots are included in Appendix A.

Figure 3.7 : 2030 Do-Minimum Heathrow N70

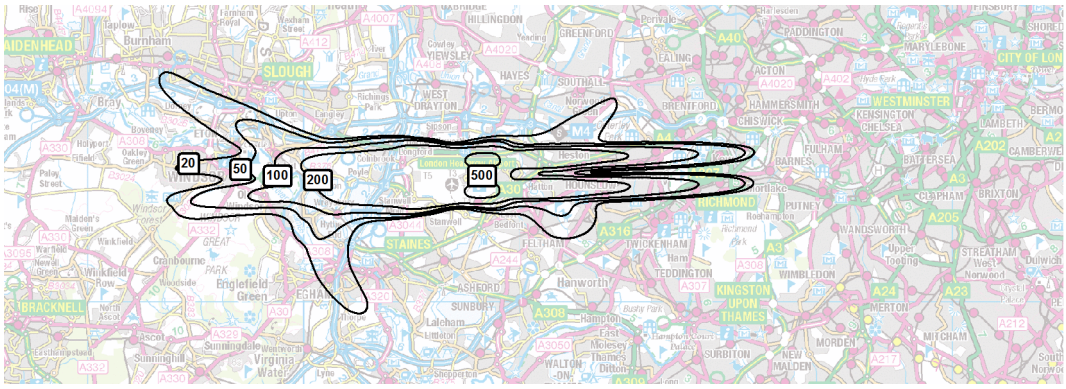
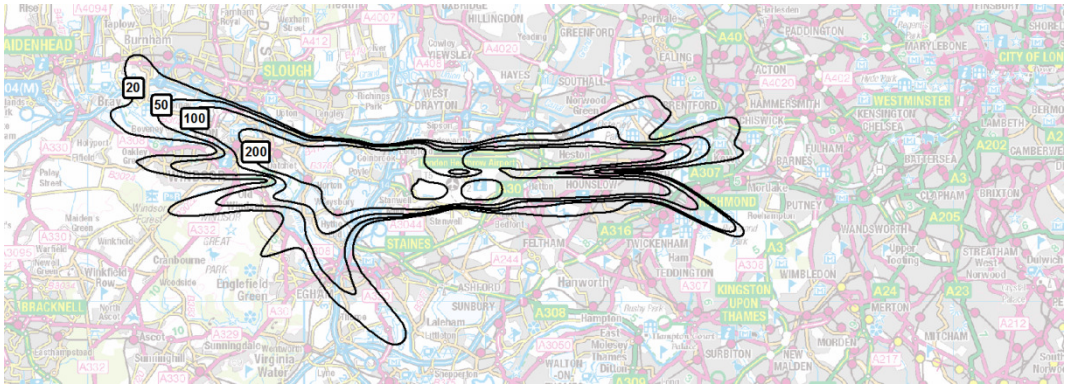


Figure 3.8 : 2030 Do-Something Heathrow-ENR-O N70 Contours



The difference in N70 contour areas, population exposures and number of households included in each contour is summarised in Table 3.5 below.

Table 3.5 : 2030 Do-Minimum Heathrow vs 2030 Heathrow-ENR-O, N70

Contour	Area (km²)	Population	Households
>20	17.8	15,300	5,700
>50	11.7	28,400	10,400
>100	10.5	24,100	9,300
>200	7.5	34,700	13,700
>500	0.8	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

It can be seen from Figure 3.7 and Figure 3.8 that the offset arrival paths in the Heathrow-ENR-O scenario create a wider but shorter north-eastern spur to the east of the airport than the in-line approaches in the Do-Minimum scenario. The south-eastern spur to the east of the airport is a similar length to the Do-Minimum scenario, but covers the less populated area around Richmond Park as opposed to Barnes.

To the west of the airport, a greater number and spread of spurs are seen in the Heathrow-ENR-O scenario due to the greater number of departure tracks; this is

because departures from proposed runway 27E may continue west, or turn left or right, whilst in the Do-Minimum scenario departures from 27R travel only west or turn right.

The forecast ATMs associated with the Heathrow-ENR-O option are expected to be 35% greater than the Do-Minimum situation, which results in contours which are between 17% (N70 > 20) and 44% (N70 > 500) greater in area compared with the Do-Minimum scenario. Correspondingly, there is a greater number of people included in the DS scenario contours than the DM scenario contours, with the exception of the N70 > 500 contours which mostly fall within the airport site in both scenarios:

- >20: An increase of 15,300 (from 291,800 to 307,100)
- >50: An increase of 28,400 (from 184,100 to 212,500)
- >100: An increase of 24,100 (from 122,600 to 146,700)
- >200: An increase of 34,700 (from 63,300 to 98,000)
- >500: No discernible change (from <50 to <50)

Figure 3.9 : 2040 Do-Minimum Heathrow N70 Contours

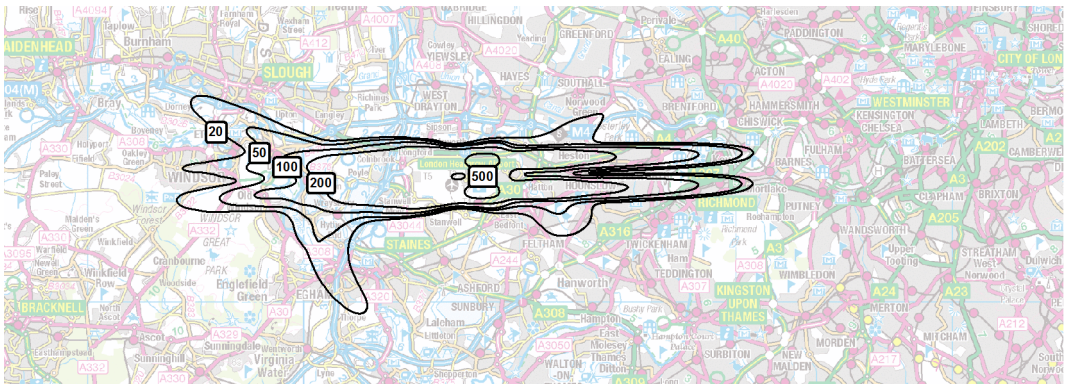
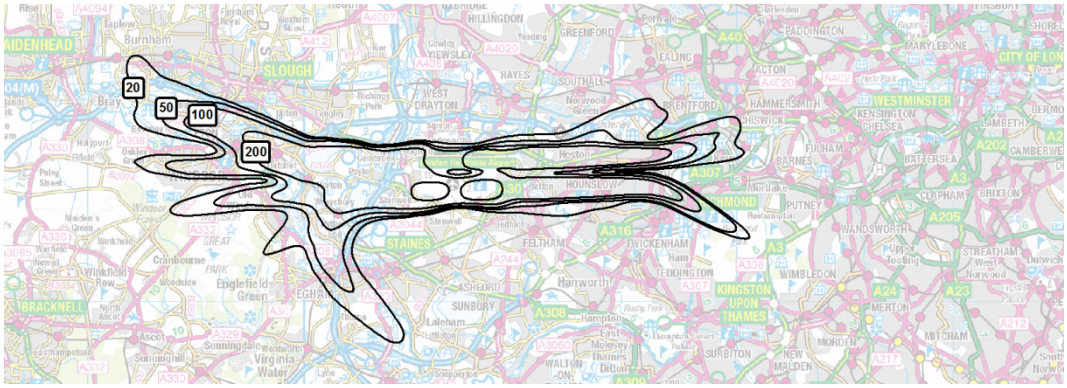


Figure 3.10 : 2040 Do-Something Heathrow-ENR-O N70 Contours



The difference in N70 contour areas, population exposures and number of households included in each contour is summarised in Table 3.6 below.

Table 3.6 : 2040 Do-Minimum Heathrow vs 2040 Heathrow-ENR-O, N70

Contour	Area (km^2)	Population	Households
>20	22.0	36,200	13,700
>50	14.9	32,600	12,200
>100	11.8	31,200	12,300
>200	8.9	44,400	17,400
>500	0.9	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

It can be seen from Figure 3.9 and Figure 3.10 that the offset arrival paths to the east of the airport in the Heathrow-ENR-O scenario create a wider but shorter north-eastern spur than the in-line approaches in the Do-Minimum scenario. The south-eastern spur is a similar length to the Do-Minimum scenario, but covers the less populous area around Richmond Park as opposed to Barnes.

To the west of the airport, a greater number and spread of spurs are seen in the Heathrow-ENR-O scenario due to the greater number of departure tracks; this is because departures from proposed runway 27E may continue west, or turn left or right, whilst in the Do-Minimum scenario departures from 27R travel only west or turn right.

The forecast ATMs associated with the Heathrow-ENR-O option are expected to be 44% greater than the Do-Minimum situation, which in results in contours which are between 23% (N70 > 20) and 50% (N70 > 500) greater in area compared with the Do-Minimum scenario. Correspondingly, there is a greater number of people included in the DS scenario contours than the DM scenario contours, with the exception of the N70 > 500 contours which mostly fall within the airport site in both scenarios:

- N70 >20: An increase of 36,200 (from 278,300 to 314,500)
- N70 >50: An increase of 32,600 (from 187,900 to 220,500)
- N70 >100: An increase of 31,200 (from 124,700 to 155,900)
- N70 >200: An increase of 44,400 (from 62,200 to 106,600)
- N70 >500: No discernible change (from <50 to <50)

Figure 3.11 : 2050 Do-Minimum Heathrow N70 Contours

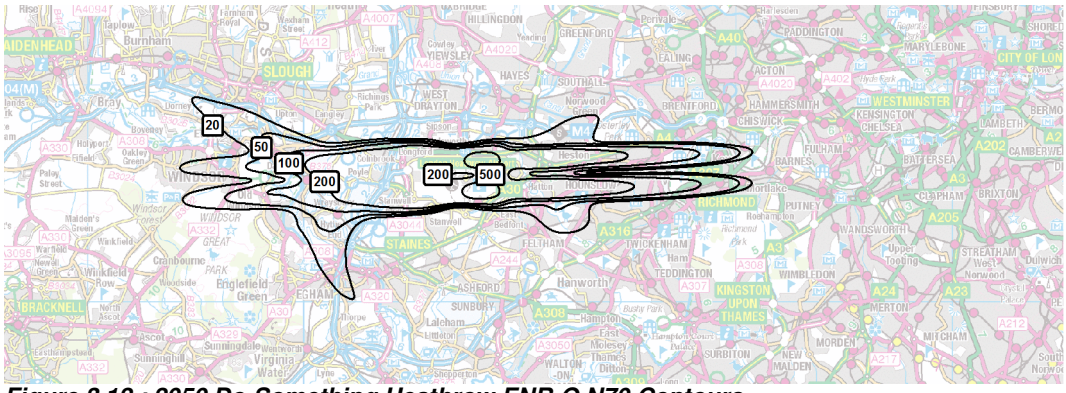
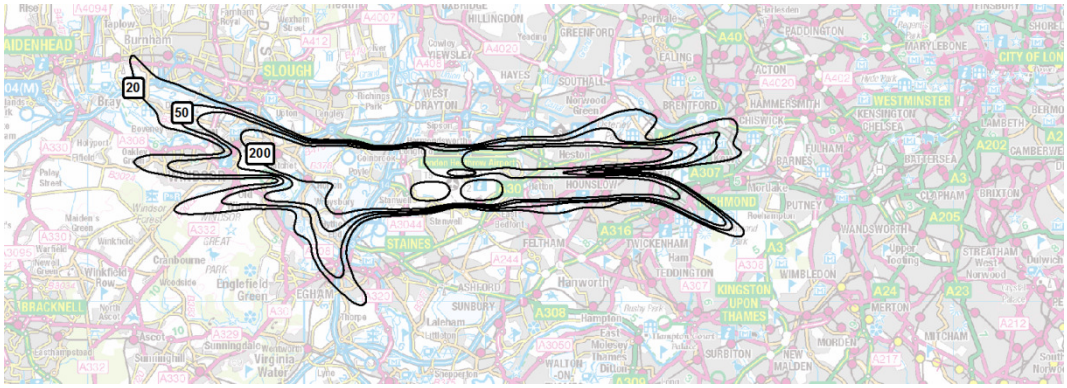


Figure 3.12 : 2050 Do-Something Heathrow-ENR-O N70 Contours



The difference in N70 contour areas, population exposures and number of households included in each contour is summarised in Table 3.7 below.

Table 3.7 : 2050 Do-Minimum Heathrow vs 2050 Heathrow-ENR-O, N70

Contour	Area (km^2)	Population	Households
>20	12.6	23,200	8,600
>50	13.4	34,600	12,800
>100	12.1	37,400	14,800
>200	8.0	40,400	15,900
>500	0.8	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

It can be seen from Figure 3.11 and Figure 3.12 that the offset arrival paths to the east of the airport in the Heathrow-ENR-O scenario create a wider but shorter north-eastern spur than the in-line approaches in the Do-Minimum scenario. The south-eastern spur is a similar length to the Do-Minimum scenario, but covers the less populous area around Richmond Park as opposed to Barnes.

To the west of the airport, a greater number and spread of spurs are seen in the Heathrow-ENR-O scenario due to the greater number of departure tracks; this is because departures from proposed runway 27E may continue west, or turn left or right, whilst in the Do-Minimum scenario departures from 27R travel only west or turn right.

The forecast ATMs associated with the Heathrow-ENR-O option are expected to be 49% greater than the Do-Minimum situation, which in results in contours which are between 14% (N70 > 20) and 38% (N70 > 500) greater in area compared with the Do-Minimum scenario. Correspondingly, there is a greater number of people

included in the DS scenario contours than the DM scenario contours, with the exception of the N70 > 500 contours which mostly fall within the airport site in both scenarios:

In comparison to the DM scenario, the difference in populations contained in the Do-Something contour is as follows:

- N70 >20: An increase of 23,200 (from 274,100 to 297,300)
- N70 >50: An increase of 34,600 (from 189,500 to 224,100)
- N70 >100: An increase of 37,400 (from 129,400 to 166,800)
- N70 >200: An increase of 40,400 (from 71,200 to 111,600)
- N70 >500: No discernible change (from <50 to <50)

3.2 Night Metrics

This section presents the predicted noise contours for night-time operations with offset approach paths. It should be noted however that the results do not include any effects due to displaced thresholds, which could be equally applied to offset or standard approach paths, and which are considered in Section 4 below.

3.2.1 $L_{Aeq,8h}$ Noise Exposure Metric

This section considers predicted changes in terms of the $L_{Aeq,8h}$ noise exposure metric, calculated for an average summer's night.

Extracts from the 2030, 2040 and 2050 DM and Do-Something scenario $L_{Aeq,8h}$ contour plots are shown in Figure 3.13 to Figure 3.18 provide visual context to the comparisons. Full contour plots are included in Appendix A.

The analysis in this section indicates that the number of people within the >48 and >63 dB $L_{Aeq,8h}$ night-time noise contours will be fewer in the Heathrow-ENR-O scenario (when compared to the DM situation) for all of the assessment years considered. In general, increases in the population contained within the other contours are predicted.

Figure 3.13 : 2030 DM Heathrow $L_{Aeq,8h}$ Contours

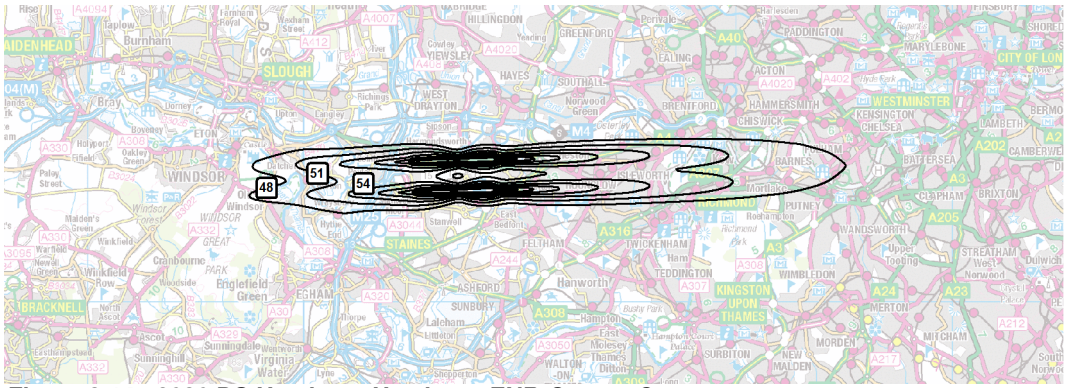
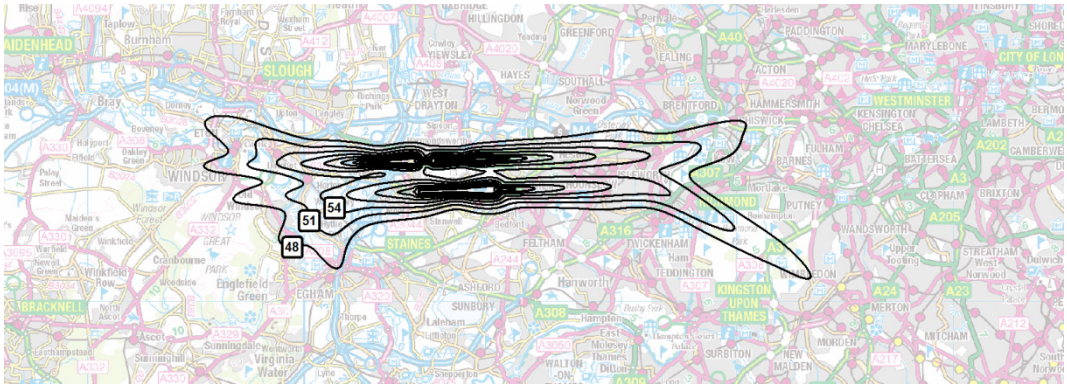


Figure 3.14 : 2030 DS Heathrow Heathrow-ENR-O $L_{Aeq,8h}$ Contours



The difference in $L_{Aeq,8h}$ contour areas, population exposures and number of households included in each contour is summarised in Table 3.8 below.

Table 3.8 : 2030 DM Heathrow vs 2030 Heathrow-ENR-O, $L_{Aeq,8h}$

Contour	Area (km²)	Population	Households
>48	20.9	(7,400)	(6,500)
>51	14.9	26,100	10,000
>54	14.3	26,700	10,400
>57	7.8	9,100	3,600
>60	4.3	1,000	400
>63	2.6	(500)	(200)
>66	1.3	<50 to 200	<50 to 100
>69	0.6	<50 to <50	<50 to <50
>72	0.1	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

The $L_{Aeq,8h}$ noise contours for the 2030 Heathrow-ENR-O scenario differ significantly from the 2030 Do-Minimum scenario. To the east of the airport, the Do-Minimum scenario exhibits a single spur due east of the runways, with the 48 dB $L_{Aeq,8h}$ contour extending over west London to Battersea. However, in the offset approaches scenario, there are two spurs aligned approximately north-east and south-east from the airport due to the offset approach routes. The north-eastern spur overflies Chiswick, Kew and Heston, while the south-eastern spur overflies Wimbledon, Richmond and Hounslow. In particular, the area falling within the >48 and >51 dB $L_{Aeq,16h}$ contours of the south-eastern spur primarily comprises Richmond Park, which is sparsely populated. This is the primary reason why the

>48 dB $L_{Aeq,16h}$ contour in the Heathrow-ENR-O scenario includes fewer people than in the equivalent Do-Minimum scenario despite being 20.9 km^2 greater in area.

To the west of airport, there are also differences in the shape of the contours, with the Heathrow-ENR-O scenario resulting in five relatively indistinct spurs, compared with two parallel spurs in the Do-Minimum scenario. This is because departures from proposed runway 27E may continue west, or turn left or right, whilst in the Do-Minimum scenario departures from both runways only travel west within the extent of the 48 dB $L_{Aeq,8h}$ contour. Of the five spurs to the west of the airport in the Heathrow-ENR-O scenario, the northern and southern most ones are the most developed.

In summary, the offset approaches are predicted to reduce the number of people within the >48 and >63 dB $L_{Aeq,16h}$ contour bands in comparison to the Do-Minimum scenario. However, the increased number of aircraft movements offsets has a greater effect than the offset approaches for all other contour bands, as shown below:

- >48 dB: A reduction of 7,400 (from 271,200 to 263,800)
- >51 dB: An increase of 26,100 (from 151,300 to 177,400)
- >54 dB: An increase of 26,700 (from 61,100 to 87,800)
- >57 dB: An increase of 9,100 (from 21,900 to 31,000)
- >60 dB: An increase of 1,000 (from 3,900 to 4,900)
- >63 dB: A reduction of 500 (from 1,300 to 800)
- >66 dB: An increase from <50 to 200
- >69 dB: No discernible change (from <50 to <50)
- >72 dB: No discernible change (from <50 to <50)

Figure 3.15 : 2040 DM Heathrow $L_{Aeq,8h}$ Contours

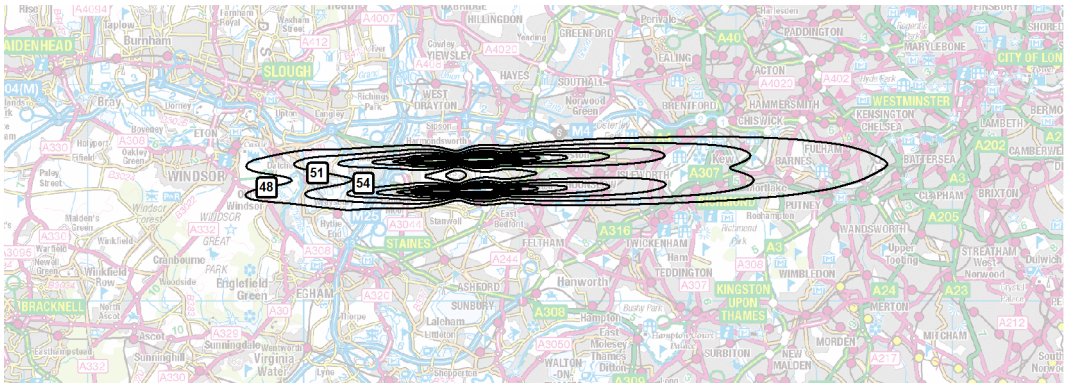
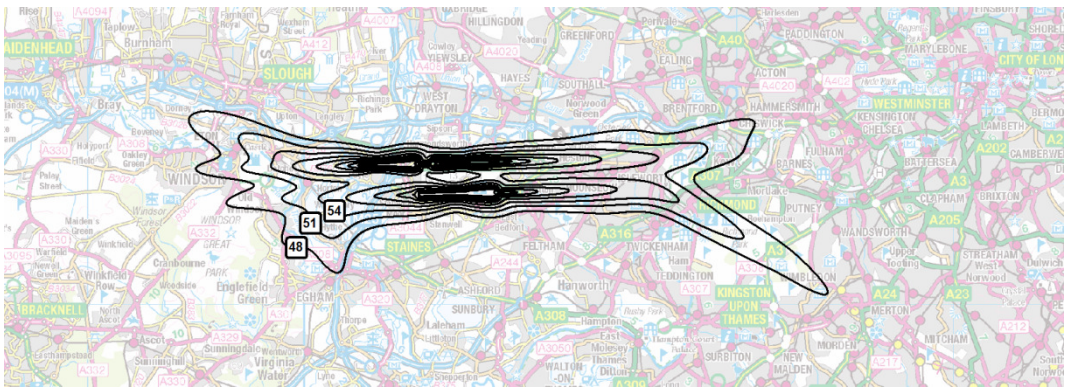


Figure 3.16 : 2040 DS Heathrow-ENR-O $L_{Aeq,8h}$ Contours



The difference in $L_{Aeq,8h}$ contour areas, population exposures and number of households included in each contour is summarised in Table 3.9 below.

Table 3.9 : 2040 DM Heathrow vs 2040 Heathrow-ENR-O, $L_{Aeq,8h}$

Contour	Area (km²)	Population	Households
>48	24.2	(38,100)	(21,000)
>51	16.7	9,200	2,600
>54	16.5	26,000	10,400
>57	8.8	5,500	2,100
>60	4.9	400	200
>63	3.0	(800)	(300)
>66	1.6	<50 to 300	<50 to 100
>69	0.8	<50 to 100	<50 to <50
>72	0.3	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

Similar differences in the shapes of the $L_{Aeq,8h}$ contours between the Do-Minimum and Heathrow-ENR-O scenarios are evident for 2040 as for 2030, with two spurs to the east of the airport in the Heathrow-ENR-O scenario as a result of the offset approaches.

Both the Heathrow-ENR-O and the Do-Minimum contours cover smaller areas in the 2040 scenarios than the equivalent 2030 scenarios, as a result of improvements in aircraft technology. The >48 contour in the 2040 Heathrow-ENR-O scenario included fewer people than the equivalent contours in the 2040 Do-Minimum scenario as they do not overfly Barnes.

When considering the combined effects of population growth, ATMs and improvements in aircraft technology, the following differences in population exposure are predicted for the 2040 Heathrow-ENR-O scenario compared to the 2040 Do-Minimum scenario:

- >48 dB: A reduction of 38,100 (from 337,000 to 298,900)
- >51 dB: An increase of 9,200 (from 184,600 to 193,800)
- >54 dB: An increase of 26,000 (from 81,300 to 107,300)
- >57 dB: An increase of 5,500 (from 31,400 to 36,900)
- >60 dB: An increase of 400 (from 6,400 to 6,800)
- >63 dB: A reduction of 800 (from 2,400 to 1,600)
- >66 dB: An increase from <50 to 300
- >69 dB: An increase from <50 to 100
- >72 dB: No discernible change (from <50 to <50)

Figure 3.17 : 2050 DM Heathrow $L_{Aeq,8h}$ Contours

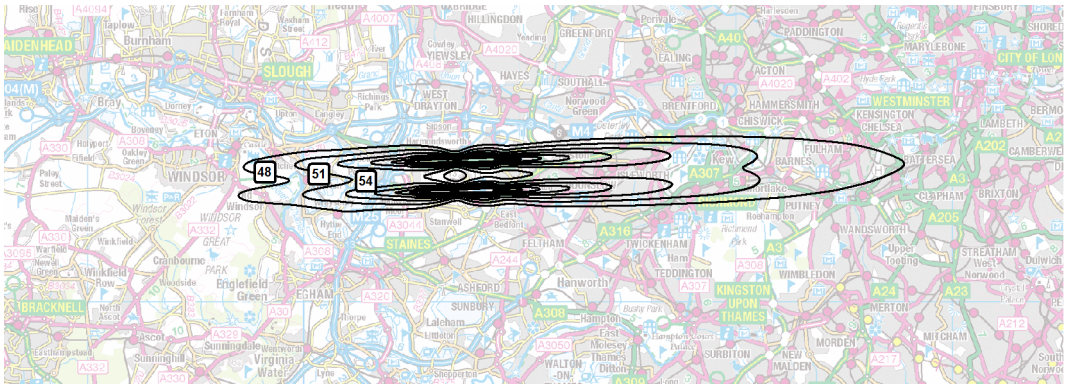
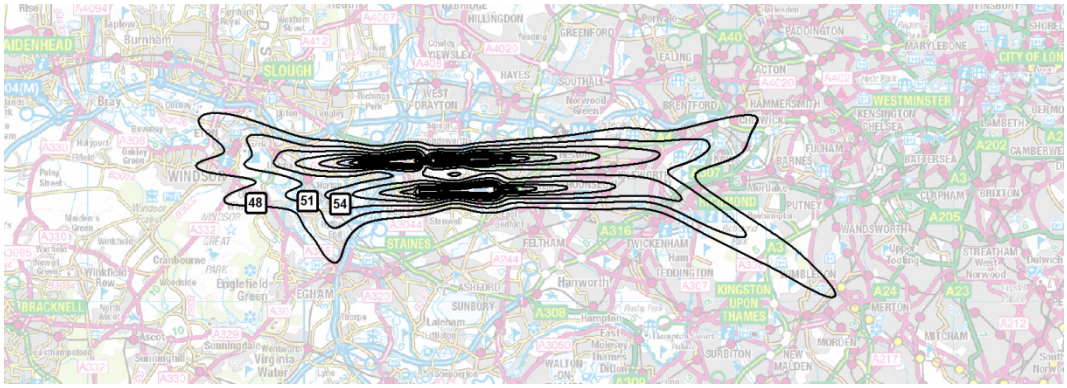


Figure 3.18 : 2050 DS Heathrow-ENR-O $L_{Aeq,8h}$ Contours



The difference in $L_{Aeq,8h}$ contour areas, population exposures and number of households included in each contour is summarised in Table 3.10 below.

Table 3.10 : 2050 DM Heathrow vs 2050 Heathrow-ENR-O, $L_{Aeq,8h}$

Contour	Area (km²)	Population	Households
>48	17.1	(66,400)	(32,900)
>51	12.4	(200)	(1,400)
>54	12.8	21,100	8,400
>57	6.7	2,500	900
>60	3.8	(900)	(300)
>63	2.3	(1,000)	(300)
>66	1.3	<50 to 200	<50 to 100
>69	0.6	<50 to <50	<50 to <50
>72	0.1	<50 to <50	<50 to <50

Note: Numbers in parentheses represent reductions

Similar differences in the shapes of the $L_{Aeq,8h}$ contours between the Do-Minimum and Heathrow-ENR-O scenarios are evident for 2050 as for 2030, with two spurs to the east of the airport in the Heathrow-ENR-O scenario as a result of the offset approaches.

Both the Heathrow-ENR-O and the Do-Minimum contours cover smaller areas in the 2050 scenarios than the equivalent 2030 scenarios, as a result of improvements in aircraft technology. The >48 and >51 contours in the 2050 Heathrow-ENR-O scenario included fewer people than the equivalent contours in the 2050 Do-

Minimum scenario as they do not overfly the densely populated area between Kew and Battersea.

When considering the combined effects of population growth, ATMs and improvements in aircraft technology, the following differences in population exposure are predicted for the 2050 Heathrow-ENR-O scenario compared to the 2050 Do-Minimum scenario:

- >48 dB: A reduction of 66,400 (from 373,100 to 306,700)
- >51 dB: A reduction of 200 (from 197,400 to 197,200)
- >54 dB: An increase of 21,100 (from 89,200 to 110,300)
- >57 dB: An increase of 2,500 (from 33,900 to 36,400)
- >60 dB: A reduction of 900 (from 7,100 to 6,200)
- >63 dB: A reduction of 1,000 (from 2,600 to 1,600)
- >66 dB: An increase from <50 to 200
- >69 dB: An increase from <50 to <50
- >72 dB: No discernible change (from <50 to <50)

3.2.2 N60 Supplementary Metric

This section considers predicted changes in terms of the N60 supplementary noise metric, which is a count of the number of people subject to more than 25 50, 100 or 200 events which exceed 60 dB $L_{AS,Max}$ in an average annual night.

Extracts from the 2030, 2040 and 2050 DM and Do-Something scenario N60 contour plots are shown in Figure 3.19 to Figure 3.24 below to provide visual context to the comparisons. Full contour plots are included in Appendix A.

The analysis in this section indicates that the number of people exposed to more than 50 night time noise events of over 60 dB L_{Amax} will increase as a result of the Heathrow Airport Extended Northern Runway Offset Approaches proposal (when compared to the DM situations), for all of the assessment years considered. The largest differences are expected for the 2040 assessment year. However, a reduction in population is predicted for the Do-Something N60 >25 contour in comparison to the Do-Minimum scenario in the 2050 comparison.

Figure 3.19 : 2030 DM Heathrow N60 Contours

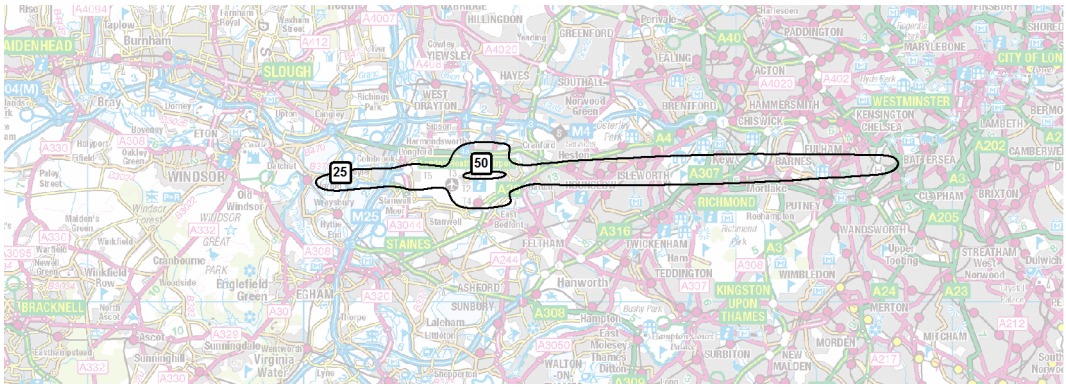
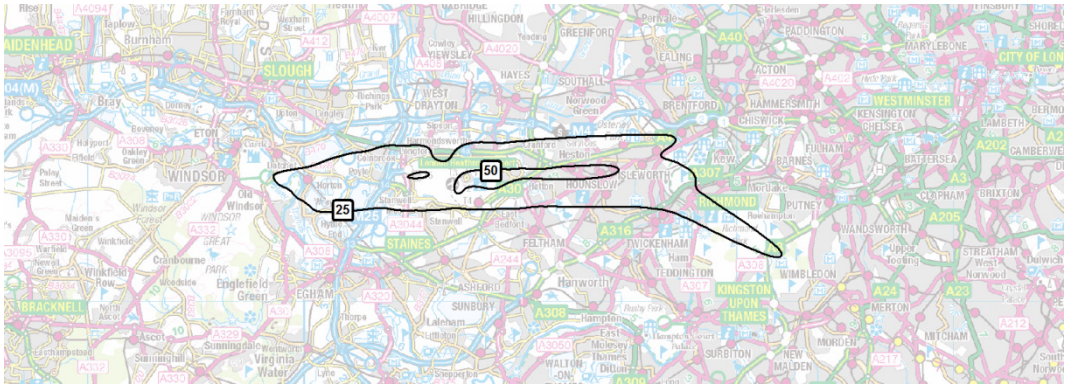


Figure 3.20 : 2030 DS Heathrow-ENR-O N60 Contours



The difference in N60 contour areas, population exposures and number of households included in each contour is summarised in Table 3.11 below.

Table 3.11 : 2030 DM Heathrow vs 2030 Heathrow-ENR-O, N60

Contour	Area (km2)	Population	Households
>25	23.4	43,400	13,500
>50	4.3	<50 to 18,900	<50 to 7,400

Note: Numbers in parentheses represent reductions

The area covered by the N60 >25 contour in the 2030 Heathrow-ENR-O scenario is predicted to be 23.4 km^2 greater than in the corresponding Do-Minimum scenario, and the N60 >50 contour in the Heathrow-ENR-O scenario is predicted to be 4.3 km^2 greater than in the Do-Minimum scenario. Although the N60 >25 contour for the Heathrow-ENR-O scenario includes the less populous area around Richmond Park, the overall increase in area causes more people to be included than in the Do-Minimum scenario.

The corresponding increases in the populations within the Do-Something contours compared to the DM contours are:

- N60 >25: An increase of 43,400 (from 150,500 to 193,900)
- N60 >50: An increase from <50 to 18,900

Figure 3.21 : 2040 DM Heathrow N60 Contours

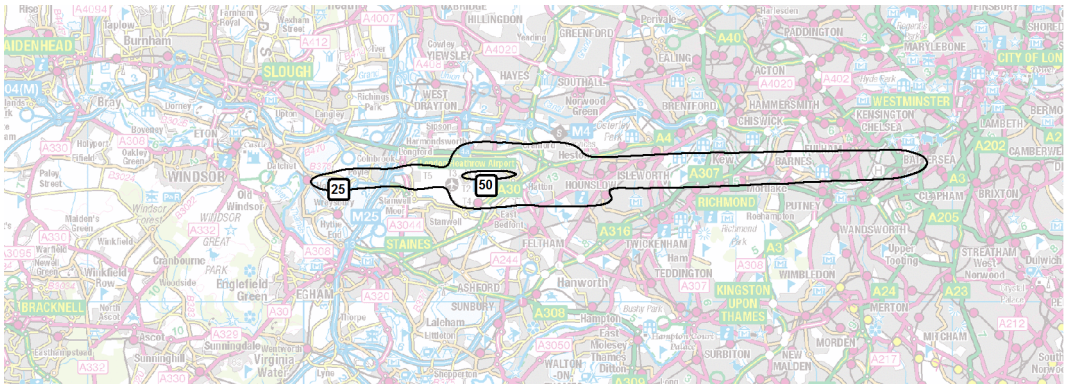
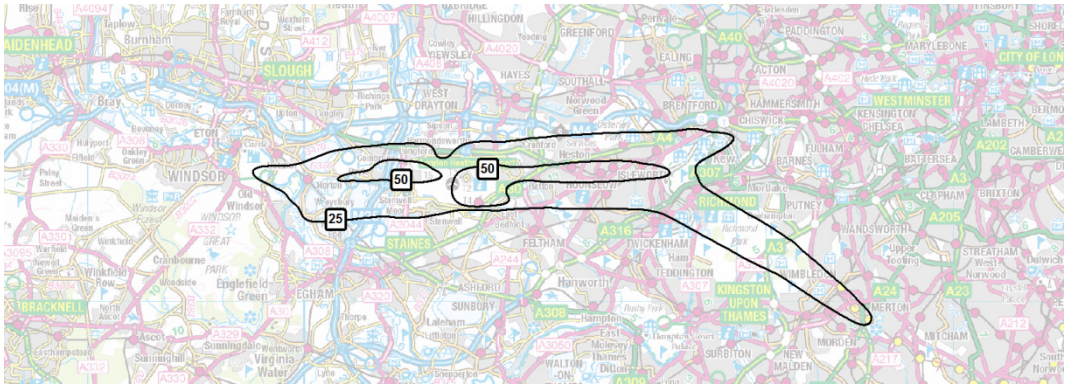


Figure 3.22 : 2040 DS Heathrow-ENR-O N60 Contours



The difference in N60 contour areas, population exposures and number of households included in each contour is summarised in Table 3.12 below.

Table 3.12 : 2040 DM Heathrow vs 2040 Heathrow-ENR-O, N60

Contour	Area (km2)	Population	Households
>25	32.8	7,100	(1,500)
>50	12.6	<50 to 47,900	<50 to 18,600

Note: Numbers in parentheses represent reductions

The area covered by the N60 >25 contour in the 2040 Heathrow-ENR-O scenario is predicted to be 32.8 km^2 greater than in the corresponding Do-Minimum scenario, and the N60 >50 contour in the Heathrow-ENR-O scenario is predicted to be 12.6 km^2 greater than in the Do-Minimum scenario. Although the N60 >25 contour for the Heathrow-ENR-O scenario includes the less populous area around Richmond Park, the overall increase in area causes more people to be included than in the Do-Minimum scenario. The corresponding increases in the populations within the Do-Something contours compared to the DM contours are:

- N60 >25: An increase of 7,100 (from 258,300 to 265,400)
- N60 >50: An increase from <50 to 47,900

Figure 3.23 : 2050 DM Heathrow N60 Contours

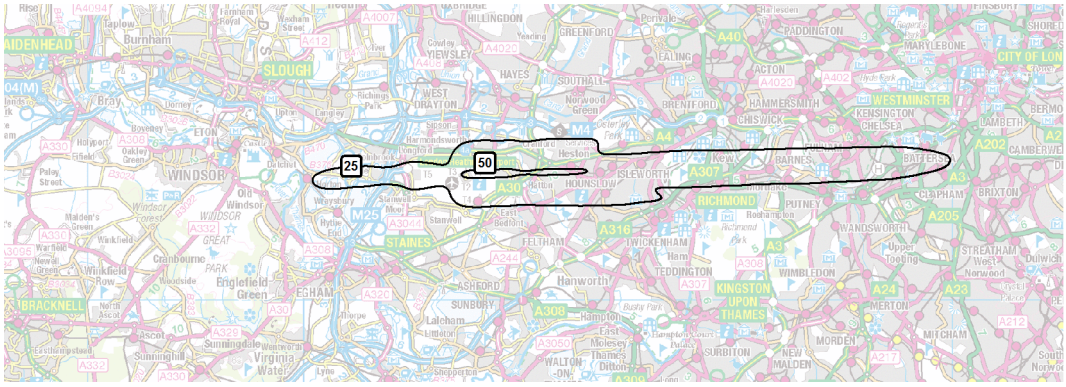
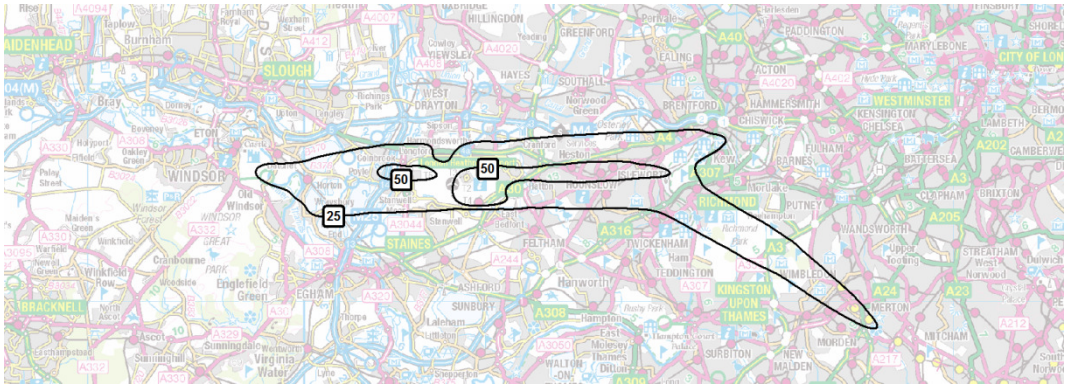


Figure 3.24 : 2050 DS Heathrow-ENR-O N60 Contours



The difference in N60 contour areas, population exposures and number of households included in each contour is summarised in Table 3.13 below.

Table 3.13 : 2050 DM Heathrow vs 2050 Heathrow-ENR-O, N60

Contour	Area (km2)	Population	Households
>25	23.5	(53,300)	(26,600)
>50	9.5	39,500	15,200

Note: Numbers in parentheses represent reductions

The area covered by the N60 >25 contour in the 2050 Heathrow-ENR-O scenario is predicted to be 23.5 km^2 greater than in the corresponding Do-Minimum scenario, and the N60 >50 contour in the Heathrow-ENR-O scenario is predicted to be 9.5 km^2 greater than in the Do-Minimum scenario. As a result of increased shoulder period movements in the Do-Minimum scenario over time, the 2050 N60 >25 contour is noticeably wider (in the north-south axis) than for the 2030 and 2040 Do-Minimum scenarios, and the number of people included in the 2050 Do-Minimum contour is increased. This causes the number of people in the 2050 N60 >25 Do-Minimum contour to exceed the number in the N60 >25 Heathrow-ENR-O scenario contour. In comparison to the DM scenario, the difference in populations contained in the Do-Something contour is as follows:

- N60 >25: A reduction of 53,300 (from 320,700 to 267,400)
- N60 >50: An increase of 39,500 (from 6,500 to 46,000)

3.3 24-hour Metric

This section considers predicted changes in terms of the L_{den} day-evening-night noise exposure metric, calculated as an annual average.

For convenience, extracts from the 2030, 2040 and 2050 DM and Do-Something scenario L_{den} contour plots are shown in Figure 3.25 to Figure 3.30 to provide visual context to the comparisons. The full contour plots are included in Appendix A.

The populations contained within the L_{den} contours are generally greater for the Heathrow-ENR-O scenarios than the Do-Minimum scenarios, with the exception of the >55 dB L_{den} contours for 2030 and 2050. These two contours show a 4% and 2% reduction in population respectively when compared the Do-Minimum contours.

Figure 3.25 : 2030 DM Heathrow L_{den} Contours

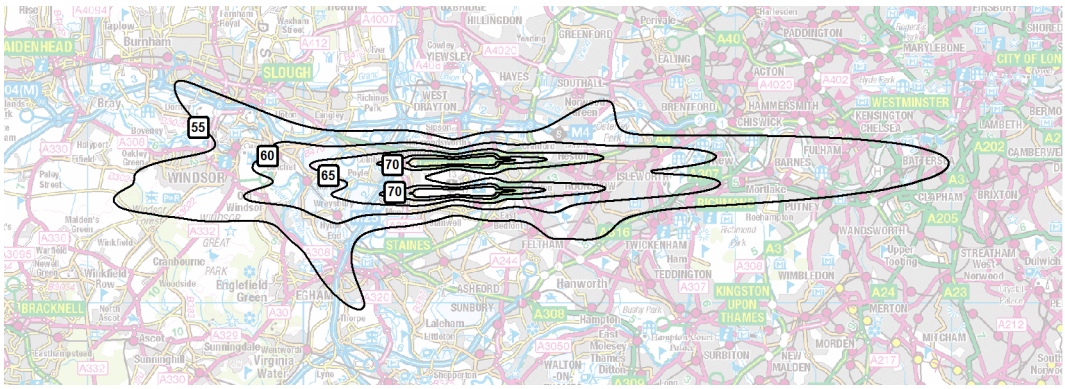
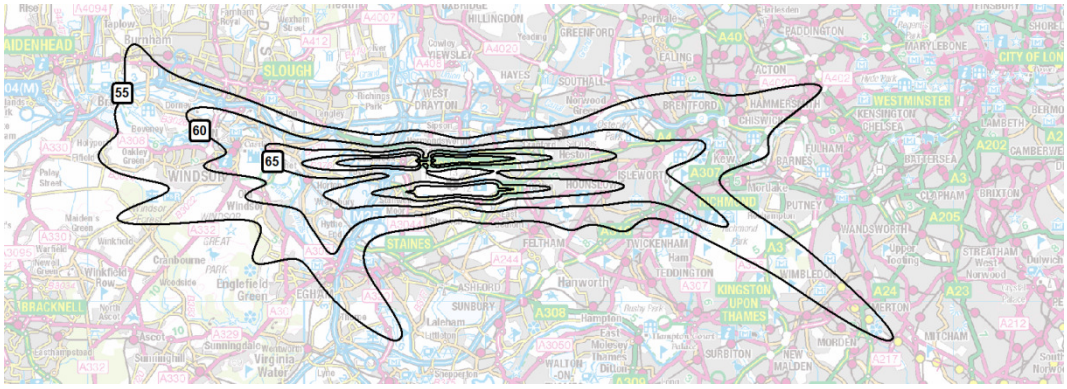


Figure 3.26 : 2030 DS Heathrow-ENR-O L_{den} Contours



The difference in L_{den} contour areas, population exposures and number of households included in each contour is summarised in Table 3.14 below.

Table 3.14 : 2030 DM Heathrow vs 2030 Heathrow-ENR-O, L_{den}

Contour	Area (km²)	Population	Households
>55	36.1	(21,900)	(16,400)
>60	16.5	42,700	16,600
>65	7.8	25,500	10,000
>70	3.7	1,700	700
>75	1.6	<50 to 400	<50 to 200

Note: Numbers in parentheses represent reductions

The shape of the 2030 Heathrow-ENR-O L_{den} contours differs substantially from the Do-Minimum contours, with the offset approach paths causing two spurs to the east of the airport, one orientated approximately north east and extending to Hammersmith, whilst the other is oriented south east over the less populated area of Richmond Park, extending over Wimbledon to Merton.

Due to the 35% greater number of ATMs in the Heathrow-ENR-O scenario, the areas covered by the Do-Something L_{den} contours are greater than the corresponding Do-Minimum contours. Generally this results in an increase in the population enclosed, apart from the >55 dB L_{den} contour where a 4% reduction is observed compared to the Do-Minimum situation due to the offset arrival route over Richmond. The changes in the populations within the Do-Something contours compared to the Do-Minimum contours are:

- >55 dB: A reduction of 21,900 (from 580,500 to 558,600)
- >60 dB: An increase of 42,700 (from 169,600 to 212,300)
- >65 dB: An increase of 25,500 (from 34,800 to 60,300)
- >70 dB: An increase of 1,700 (from 3,000 to 4,700)
- >75 dB: An increase from <50 to 400

For the Heathrow-ENR-O option, the number of people newly affected by noise levels over 55 dB L_{den} in the 2030 Do-Something scenario compared to the 2030 Do-Minimum scenario is 216,700, and the number of people newly removed is 238,500. This results in a net reduction in the number of people newly affected of 21,800.

Figure 3.27 : 2040 DM Heathrow L_{den} Contours

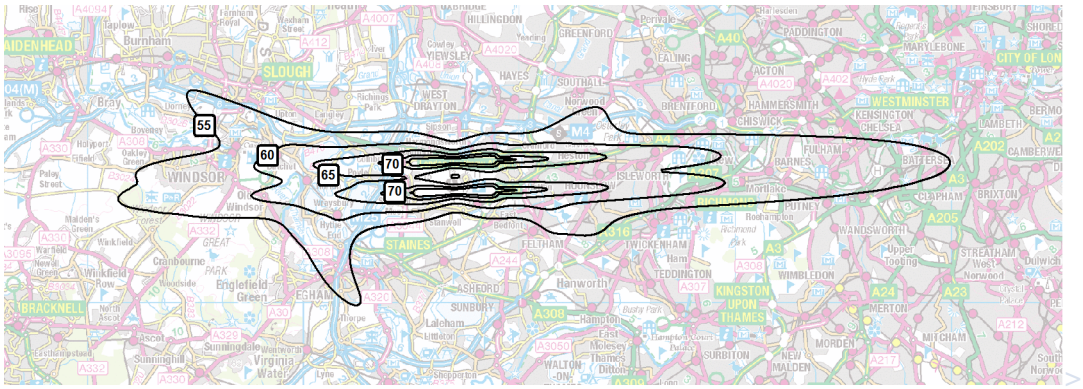
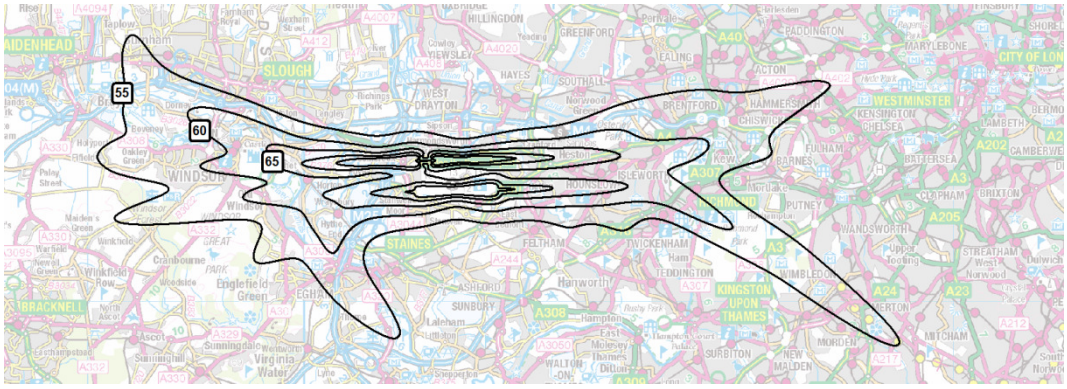


Figure 3.28 : 2040 DS Heathrow-ENR-O L_{den} Contours



The difference in L_{den} contour areas, population exposures and number of households included in each contour is summarised in Table 3.15 below.

Table 3.15 : 2040 DM Heathrow vs 2040 Heathrow-ENR-O, L_{den}

Contour	Area (km²)	Population	Households
>55	44.1	12,000	(3,100)
>60	18.7	44,000	17,200
>65	9.5	29,800	11,600
>70	4.1	2,000	800
>75	1.7	<50 to 400	<50 to 200

Note: Numbers in parentheses represent reductions

The shape of the 2040 Heathrow-ENR-O L_{den} contours differs substantially from the Do-Minimum contours, with the offset approach paths causing two spurs to the east of the airport, one orientated approximately north east and extending to Hammersmith, whilst the other is oriented south east over the less populated area of Richmond Park, extending over Wimbledon to Merton.

Due to the 44% greater number of ATMs in the Heathrow-ENR-O scenario, the areas covered by the Do-Something L_{den} contours are greater than the corresponding Do-Minimum contours. This results in an increase in the population enclosed in the Do-Something contours compared to the Do-Minimum contours:

- >55 dB: An increase of 12,000 (from 588,900 to 600,900)
- >60 dB: An increase of 44,000 (from 179,500 to 223,500)
- >65 dB: An increase of 29,800 (from 36,200 to 66,000)
- >70 dB: An increase of 2,000 (from 3,100 to 5,100)
- >75 dB: An increase from <50 to 400

For the Heathrow-ENR-O option, the number of people newly affected by noise levels over 55 dB L_{den} in the 2040 Do-Something scenario compared to the 2040 DM scenario is 256,400, and the number of people newly removed is 243,100. This results in a net increase in the number of people newly affected of 13,300.

Figure 3.29 : 2050 DM Heathrow Lden Contours

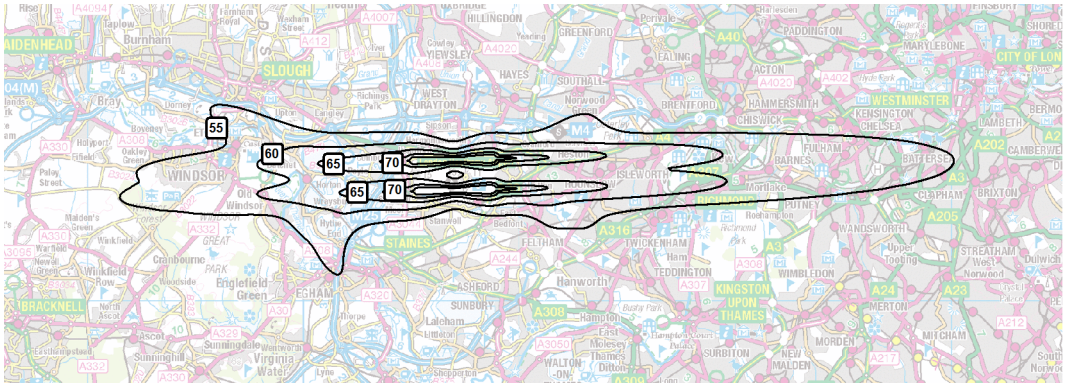
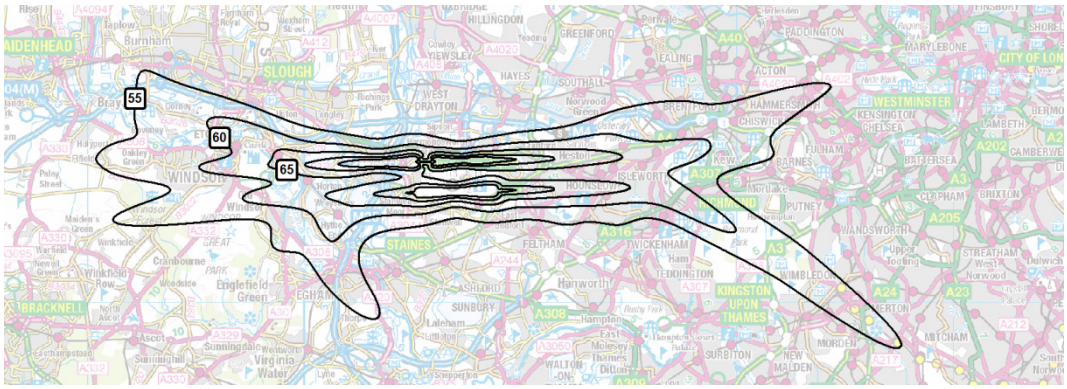


Figure 3.30 : 2050 DS Heathrow-ENR-O L_{den} Contours



The difference in L_{den} contour areas, population exposures and number of households included in each contour is summarised in Table 3.16 below.

Table 3.16 : 2050 DM Heathrow vs 2050 Heathrow-ENR-O, L_{den}

Contour	Area (km²)	Population	Households
>55	38.3	(13,400)	(13,100)
>60	16.4	41,500	16,100
>65	9.1	28,800	11,300
>70	3.7	1,800	700
>75	1.6	<50 to 400	<50 to 200

Note: Numbers in parentheses represent reductions

Due to the 49% greater number of ATMs in the Heathrow-ENR-O scenario, the areas covered by the Do-Something L_{den} contours are greater than the corresponding Do-Minimum contours. Generally this results in an increase in the population enclosed, apart from the >55 dB L_{den} contour where a 2% reduction is observed compared to the Do-Minimum situation due to the offset arrival route over Richmond Park. The changes in the populations within the Do-Something contours compared to the Do-Minimum contours are:

- >55 dB: A reduction of 13,400 (from 583,500 to 570,100)
- >60 dB: An increase of 41,500 (from 182,100 to 223,600)
- >65 dB: An increase of 28,800 (from 36,400 to 65,200)
- >70 dB: An increase of 1,800 (from 3,100 to 4,900)
- >75 dB: An increase from <50 to 400

For the Heathrow-ENR-O option, the number of people newly affected by noise levels over 55 dB L_{den} in the 2050 Do-Something scenario compared to the 2050 DM scenario is 243,000, and the number of people newly removed is 254,500. This results in a net decrease in the number of people newly affected of 11,500.

3.4 Sensitive Buildings

The change in number of sensitive buildings within each contour between the 2030 DM and 2030 Heathrow-ENR-O scenarios are set out in Table 3.17 below:

Table 3.17 : 2030 DM Heathrow vs 2030 Heathrow-ENR-O, Sensitive Buildings

Period	Metric	Schools	Hospitals	Places of Worship	Metric	Schools	Hospitals	Places of Worship
Day	>54 dB $L_{Aeq,16h}$	(22)	1	6	N70 >20	16	1	16
	>57 dB $L_{Aeq,16h}$	22	1	20	N70 >50	19	0	17
	>60 dB $L_{Aeq,16h}$	36	0	22	N70 >100	12	0	16
	>63 dB $L_{Aeq,16h}$	11	0	7	N70 >200	23	0	10
	>66 dB $L_{Aeq,16h}$	3	0	2	N70 >500	0	0	0
	>69 dB $L_{Aeq,16h}$	2	0	1		0	0	0
	>72 dB $L_{Aeq,16h}$	0	0	0		0	0	0
Night	>48 dB $L_{Aeq,8h}$	(7)	(1)	1	N60 >25	(11)	(2)	(14)
	>51 dB $L_{Aeq,8h}$	7	(1)	7	N60 >50	7	0	6
	>54 dB $L_{Aeq,8h}$	17	0	8	N60 >100	0	0	0
	>57 dB $L_{Aeq,8h}$	3	0	1	N60 >200	0	0	0
	>60 dB $L_{Aeq,8h}$	0	0	0	N60 >500	0	0	0
	>63 dB $L_{Aeq,8h}$	0	0	0				
	>66 dB $L_{Aeq,8h}$	0	0	0				
	>69 dB $L_{Aeq,8h}$	0	0	0				
	>72 dB $L_{Aeq,8h}$	0	0	0				
24-hour	>55 dB L_{DEN}	(29)	1	(4)				
	>60 dB L_{DEN}	33	(1)	27				
	>65 dB L_{DEN}	11	0	5				
	>70 dB L_{DEN}	1	0	0				
	>75 dB L_{DEN}	0	0	0				

The change in number of sensitive buildings within each contour between the 2040 DM and 2040 Heathrow-ENR-O scenarios are set out in Table 3.18 below:

Table 3.18 : 2040 DM Heathrow vs 2040 Heathrow-ENR-O, Sensitive Buildings

Period	Metric	Schools	Hospitals	Places of Worship	Metric	Schools	Hospitals	Places of Worship
Day	>54 dB $L_{Aeq,16h}$	25	0	16	N70 >20	29	1	19
	>57 dB $L_{Aeq,16h}$	34	1	27	N70 >50	25	1	21
	>60 dB $L_{Aeq,16h}$	40	0	21	N70 >100	17	0	19
	>63 dB $L_{Aeq,16h}$	12	0	6	N70 >200	27	0	10
	>66 dB $L_{Aeq,16h}$	2	0	3	N70 >500	0	0	0
	>69 dB $L_{Aeq,16h}$	2	0	1		0	0	0
	>72 dB $L_{Aeq,16h}$	0	0	0		0	0	0
Night	>48 dB $L_{Aeq,8h}$	(36)	0	(3)	N60 >25	(13)	1	(1)
	>51 dB $L_{Aeq,8h}$	(3)	(1)	(1)	N60 >50	29	0	16
	>54 dB $L_{Aeq,8h}$	12	0	3	N60 >100	0	0	0
	>57 dB $L_{Aeq,8h}$	3	0	1	N60 >200	0	0	0
	>60 dB $L_{Aeq,8h}$	0	0	(1)	N60 >500	0	0	0
	>63 dB $L_{Aeq,8h}$	0	0	0				
	>66 dB $L_{Aeq,8h}$	0	0	0				
	>69 dB $L_{Aeq,8h}$	0	0	0				
	>72 dB $L_{Aeq,8h}$	0	0	0				
24-hour	>55 dB L_{DEN}	(3)	1	7				
	>60 dB L_{DEN}	34	(1)	30				
	>65 dB L_{DEN}	11	0	4				
	>70 dB L_{DEN}	1	0	0				
	>75 dB L_{DEN}	0	0	0				

The change in number of sensitive buildings within each contour between the 2050 DM and 2050 Heathrow-ENR-O scenarios are set out in Table 3.19 below:

Table 3.19 : 2050 DM Heathrow vs 2050 Heathrow-ENR-O, Sensitive Buildings

Period	Metric	Schools	Hospitals	Places of Worship	Metric	Schools	Hospitals	Places of Worship
Day	>54 dB $L_{Aeq,16h}$	13	0	19	N70 >20	19	1	10
	>57 dB $L_{Aeq,16h}$	32	1	27	N70 >50	24	1	20
	>60 dB $L_{Aeq,16h}$	39	0	21	N70 >100	19	(1)	19
	>63 dB $L_{Aeq,16h}$	12	0	6	N70 >200	27	0	10
	>66 dB $L_{Aeq,16h}$	3	0	2	N70 >500	0	0	0
	>69 dB $L_{Aeq,16h}$	2	0	1		0	0	0
	>72 dB $L_{Aeq,16h}$	0	0	0		0	0	0
Night	>48 dB $L_{Aeq,8h}$	(55)	1	(14)	N60 >25	(39)	0	(17)
	>51 dB $L_{Aeq,8h}$	(12)	(1)	(4)	N60 >50	22	0	16
	>54 dB $L_{Aeq,8h}$	9	0	4	N60 >100	0	0	0
	>57 dB $L_{Aeq,8h}$	1	0	1	N60 >200	0	0	0
	>60 dB $L_{Aeq,8h}$	0	0	(1)	N60 >500	0	0	0
	>63 dB $L_{Aeq,8h}$	(1)	0	(1)				
	>66 dB $L_{Aeq,8h}$	0	0	0				
	>69 dB $L_{Aeq,8h}$	0	0	0				
	>72 dB $L_{Aeq,8h}$	0	0	0				
24-hour	>55 dB L_{DEN}	(13)	1	(1)				
	>60 dB L_{DEN}	31	(1)	27				
	>65 dB L_{DEN}	13	0	6				
	>70 dB L_{DEN}	1	0	0				
	>75 dB L_{DEN}	0	0	0				

4 A380 SEL Footprints

Displaced landing thresholds can be employed to reduce noise exposure. A displaced landing threshold is where aircraft land further along the runway than normal, thus overflying the surrounding properties at greater heights than if landing at the normal position. The extent to which landing thresholds can be displaced depends on the length of the runway, safety considerations and the mode of operation.

The 90 dB(A) Sound Exposure Level (SEL) contours have been calculated for an arriving Airbus A380 aircraft for the Heathrow NWR and ENR scenarios. In this context the SEL is the total sound energy of an aircraft over-flying an assessment position compressed into one second 'burst' of noise, and is designated using the nomenclature 'L_{AE}'. It is therefore similar to L_{Aeq} in that the total sound energy over the measurement period is integrated, but instead of averaging it over the entire measurement, a reference duration of 1s is used.

As most aircraft noise events have durations significantly greater than the reference time of one second, their L_{AE} values are invariably numerically greater than L_{Amax}, typically by around 10 dB [2]. The outdoor 90 dB L_{AE} contour is relevant because research shows that below outdoor event levels of 90 dBA L_{AE}, aircraft noise events are most unlikely to cause any increase in measured sleep disturbance from that which occurs naturally during normal sleep.

There is no variation in the shape or dimensions of the 90 dB L_{AE} footprints regardless of which approach path is selected; the only difference is how far along the runway the footprint is situated. This is because the same type of aircraft and approach slope has been considered in all scenarios, and the 90 dB L_{AE} footprint is entirely contained with a distance of 3 nautical miles from the threshold of the runway. At such distances the aircraft approaching Heathrow are already on a straight path aligned with the chosen runway centreline.

For both the NWR and ENR proposals, the effects with and without displaced landing thresholds have been considered.

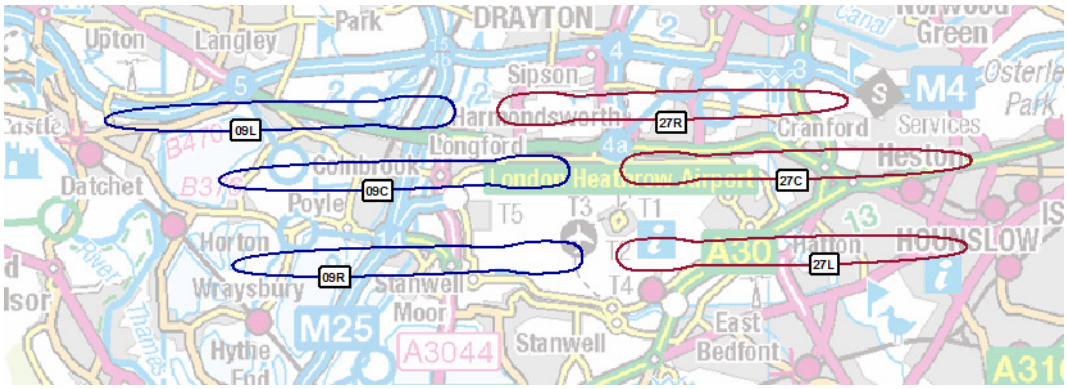
4.1 Heathrow NWR

As explained above, the dimensions of the 90 dB L_{AE} contours for each runway are consistent (2.4km^2) as the same 3.2° approach slope is assumed on a straight approach to each runway. However, the population and number of households within each contour differ depending on the proximity and density of residential development to each runway.

Figure 4.1 below shows the predicted A380 90 dB L_{AE} landing footprints without displaced landings, apart from runways 09C and 09R which already operate with displaced thresholds.

[2] ERCD Report 0904, Metrics for Aircraft Noise, K Jones & R Cadoux, Civil Aviation Authority, 2009.

Figure 4.1 Heathrow-NWR A380 90 dB L_{AE} Landing Footprints Without Displaced Landings (Apart from 09C and 09R)

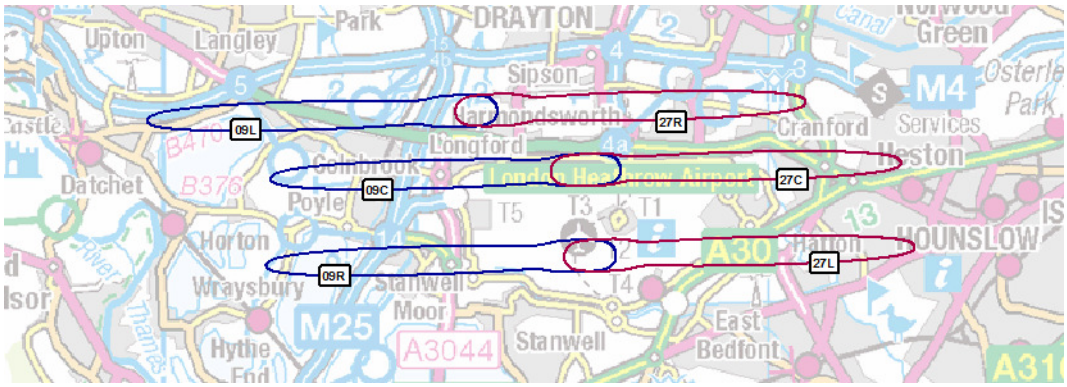


It can be seen that the westerly approaches (to runways 27L, 27C and 27R) overfly populous areas, and as a result affect the greatest number of residents. Table 4.1 below shows the areas, populations and households within the predicted 90 dB L_{AE} contour without displaced landing thresholds:

Table 4.1 : Heathrow-NWR A380 90 dB L_{AE} Landing Footprints Without Displaced Landings

Runway	Area (km²)	Population	Households
27R	2.4	3,800	1,400
27C	2.4	11,500	4,300
27L	2.4	9,000	3,400
09R	2.4	600	300
09C	2.4	600	300
09L	2.4	1,800	700

Figure 4.2 Heathrow-NWR A380 90 dB L_{AE} Landing Footprints With Displaced Landings



Comparing Figure 4.1 and Figure 4.2, it can be seen that the displaced thresholds significantly reduce the number of properties included in the 90 dBA L_{AE} contours to the east of the airport. Table 4.2 below shows the areas, populations and households within the predicted 90 dB L_{AE} contour with displaced landing thresholds.

Table 4.2 : Heathrow-NWR A380 90 dB L_{AE} Landing Footprints With Displaced Landings

Runway	Area (km²)	Population	Households
27R	2.4	3,000	1,100
27C	2.4	6,400	2,500
27L	2.4	3,800	1,500
09R	2.4	600	300
09C	2.4	600	300
09L	2.4	1,500	600

Landings on runways 09R and 09C which overfly less populous areas are shown to affect the fewest people (600 within the 90 dB SEL contour), whilst landings on 27C affect the greatest number of people (6,400 within the 90 dB L_{AE} contour) as this approach overflies the settlement of Cranford which is close to the airport.

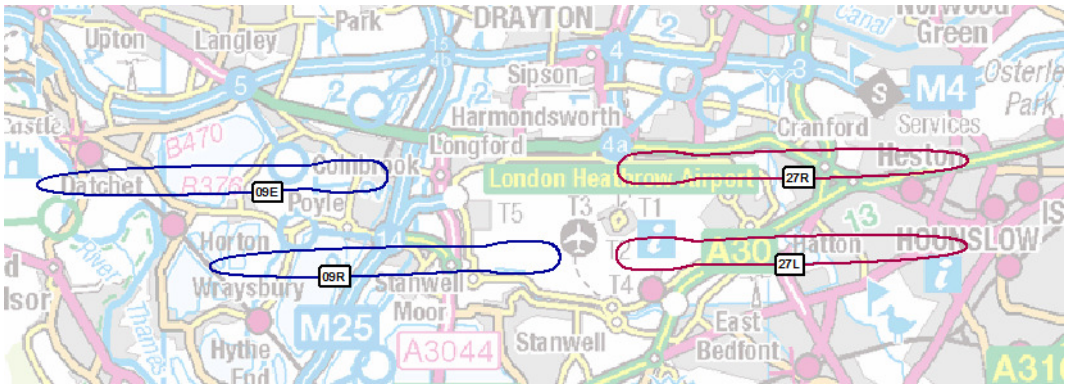
Compared to the current situation, increased use of displaced thresholds would reduce the number of people within the 90 dB L_{AE} contours as follows:

- 27R: a reduction of 800 people (from 3,800 to 3,000)
- 27C: a reduction of 5,100 people (from 11,500 to 6,400)
- 27L: a reduction of 5,200 people (from 9,000 to 3,800)
- 09R: no change (runway already operating with displaced threshold)
- 09C: no change (runway already operating with displaced threshold)
- 09L: a reduction of 300 people (from 1,800 to 1,500)

4.2 Heathrow ENR

The 90 dB L_{AE} footprint has been calculated for an arriving Airbus A380 aircraft on each of the arrival routes for the Heathrow ENR scheme without displaced thresholds, and are shown in Table 4.4 below.

Figure 4.3 Heathrow-ENR A380 90 dB L_{AE} Landing Footprints Without Displaced Landings



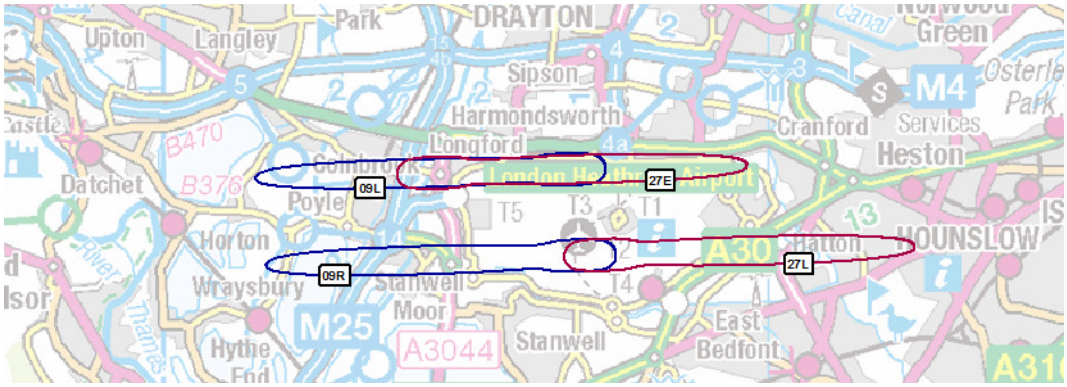
It can be seen that without displaced thresholds both the easterly and westerly approaches will overfly populous areas. Table 4.1 below shows the areas, populations and households within the predicted 90 dB L_{AE} contour without displaced landing thresholds (apart from 09R which already operates with a displaced threshold):

Table 4.3 : Heathrow-ENR A380 90 dB L_{AE} Landing Footprints Without Displaced Landings

Runway	Area (km²)	Population	Households
27R	2.4	11,500	4,300
27L	2.4	9,000	3,400
09R	2.4	600	300
09E	2.4	1,000	400

Figure 4.4 below shows the predicted A380 90 dB L_{AE} landing footprints with displaced landings. In particular, it is proposed to use 'deep landings' on the proposed extended runway, which is an extreme form of displaced threshold landing on the extended runway.

Figure 4.4 Heathrow-ENR A380 90 dB L_{AE} Landing Footprints With Displaced Landings



Comparing Figure 4.3 and Figure 4.4, it can be seen that the 'deep landings' on 09L and 27E draw the 90 dB L_{AE} contours in towards the airport dramatically, reducing the number of people included within these contours significantly. Table 4.4 below shows the areas, populations and households within the predicted 90 dB L_{AE} contour with displaced landing thresholds:

Table 4.4 : Heathrow-ENR A380 90 dB L_{AE} Landing Footprints With Displaced Landings

Runway	Area (km²)	Population	Households
27L	2.4	3,800	1,500
27E	2.4	<50	<50
09R	2.4	600	300
09L	2.4	600	300

The fewest people are affected by approaches to 27E, 09E and 09R. In the case of 27E much of the 90 SEL dB contour is contained within the airport boundary, and the population enclosed is <50, which compares to 11,600 for 27R without deep landings. Displaced threshold landings on 09R and 09L will also include smaller numbers of people in the 90 dB SEL contours than without displaced threshold landings, as the area between the M25 and Heathrow Airport is not densely populated.

A greater number of people will be included in the displaced threshold landings to 27L (3,800). Compared to the current situation, increased use of displaced thresholds would reduce the number of people within the contours as follows:

- 27R: a reduction of 7,800 people (from 11,600 to 3,800)

- 27C: a reduction of 8,950 (from 9,000 to 50)
- 27L: no change (runway already operating with displaced threshold)
- 09R: a reduction of 400 (from 1,000 to 600)

It should be noted that the above results apply only to the example case of an A380 landing, which is provided as an illustration of how displaced and 'deep' landings can reduce noise exposure. These numbers should not be extrapolated to other situations.

Appendix A Noise Contour Plots