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5. Noise: National Assessment

Prepared for the Airports Commission

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Executive Summary

This report considers the aviation noise implications of potential airport expansion in accordance with Airports Commission Appraisal Framework at a national level. The national noise impacts have been determined and are presented for the three shortlisted schemes which are:

- *Gatwick Airport Second Runway (Gatwick 2R) promoted by Gatwick Airport Ltd (GAL);*
- *Heathrow Airport Northwest Runway (Heathrow NWR) promoted by Heathrow Airport Ltd (HAL); and,*
- *Heathrow Airport Extended Northern Runway (Heathrow ENR) promoted by Heathrow Hub Ltd (HH).*

The impacts for each scheme have been determined at thirteen UK airports, which are: Aberdeen, Birmingham, Bristol, East Midlands, Edinburgh, Glasgow, London City, London Gatwick, London Heathrow, London Luton, London Southend, London Stansted, and Manchester.

In this report the combined statistics from the 13 airports are taken to represent the National impacts, and the report sets out the airborne aircraft noise levels expected on a national basis for each scheme in 2030, 2040 and 2050. It also undertakes a comparison of these noise levels with the Do-Minimum case, which is described in more detail in the Noise: Baseline report (Jacobs, 2014).

In respect of aviation noise, for the national picture a reduced set of noise metrics identified for the Appraisal Framework local 'noise scorecard' is reported for each case. This includes the 'average measures' of $L_{Aeq,16h}$ (summer daytime), $L_{Aeq,8h}$ (summer night time) and L_{DEN} (24 hour). The reported metrics are examined in detail to identify trends and probable contributory factors.

The following sections summarise the differences between each of the three short-listed schemes and the Do-Minimum case.

The significance of the change in the National cumulative exposure at the 13 airports with one of the shortlisted schemes: the 'Do Something' scenario, is evaluated in the context of the current exposure and against the future exposure assuming none of the shortlisted schemes are implemented: the 'Do Minimum scenario'. The current summer daytime noise is incident on approximately 363,000 people, and it is forecast that in the future Do-Minimum scenario it will be incident on slightly less people, in the range 341,000 to 357,000 depending on the year. With regard to summer night-time noise the corresponding figures are 579,000 now, and a future Do-Minimum range from 449,000 to 595,000. As for the EU metric, L_{den}, the corresponding figures are 1,006,000 people now, and a future Do-Minimum range of 879,000 to 946,000.

Gatwick Airport Second Runway

Tables 0.1, 0.2 and 0.3 and associated commentary provide an overview of the changes in the national situation in the event of the Gatwick 2R scheme being developed, compared to the Do-Minimum case for the period 2030 to 2050.

Table 0.1: 2030 Gatwick 2R vs 2030 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	(3,200)		
Night	>48 dB $L_{Aeq,8h}$	7,350		
24-hour			>55 dB L_{DEN}	2,200

Values in brackets show reductions in populations relative to the 'Do-Minimum' values.

Table 0.2: 2040 Gatwick 2R vs 2040 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	(4,600)		
Night	>48 dB $L_{Aeq,8h}$	(4,350)		
24-hour			>55 dB L_{DEN}	(3,400)

Values in brackets show reductions in populations relative to the 'Do-Minimum' values.

Table 0.3: 2050 Gatwick 2R vs 2050 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	(1,950)		
Night	>48 dB $L_{Aeq,8h}$	(8,000)		
24-hour			>55 dB L_{DEN}	3,750

Values in brackets show reductions in populations relative to the 'Do-Minimum' values.

If the Gatwick 2R scheme were to be developed, the national situation would be largely similar to the Do-Minimum case, with relatively small decreases in some metrics and small increases in others. This is due to the fact that the forecast increase in exposed population at the developed Gatwick airport, compared to the Do-Minimum case, is approximately equal to the reduction in exposed population at other airports.

Heathrow Airport Northwest Runway

Tables 0.4, 0.5 and 0.6 and associated commentary below provide an overview of the changes in the national situation in the event of the Heathrow NWR scheme being developed, compared to the Do-Minimum case for the period 2030 to 2050.

Table 0.4: 2030 Heathrow NWR vs 2030 Do-Minimum vs national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	(7,700)		
Night	>48 dB $L_{Aeq,8h}$	(25,750)		
24-hour			>55 dB L_{DEN}	(71,650)

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

Table 0.5: 2040 Heathrow NWR vs 2040 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	1,000		
Night	>48 dB $L_{Aeq,8h}$	(68,200)		
24-hour			>55 dB L_{DEN}	(36,550)

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

Table 0.6: 2050 Heathrow NWR vs 2050 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	500		
Night	>48 dB $L_{Aeq,8h}$	(125,050)		
24-hour			>55 dB L_{DEN}	(12,000)

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

If the Heathrow NWR scheme were to be developed, the national daytime situation would be largely similar to the Do-Minimum case, due to the forecast increase in exposed population at the developed Heathrow NWR airport, compared to the Do-Minimum case, being largely offset by a reduction in exposed population at other airports. At night-time, significant decreases in national population exposure would occur compared to the Do-Minimum case, due to decreased exposure at Heathrow as well as other airports. This leads to generally smaller, but still significant, decreases in national population exposure compared to the Do-Minimum case when using the 24-hour metric.

Heathrow Airport Extended Northern Runway

Tables 0.7, 0.8 and 0.9 and associated commentary below provide an overview of the changes in the national situation in the event of the Heathrow ENR scheme being developed, compared to the Do-Minimum case for the period 2030 to 2050.

Table 0.7: 2030 Heathrow ENR vs 2030 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	54,100		
Night	>48 dB $L_{Aeq,8h}$	102,350		
24-hour			>55 dB L_{DEN}	182,800

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

Table 0.8: 2040 Heathrow ENR vs 2040 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	62,650		
Night	>48 dB $L_{Aeq,8h}$	106,050		
24-hour			>55 dB L_{DEN}	214,200

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

Table 0.9: 2050 Heathrow ENR vs 2050 Do-Minimum national aviation noise levels

Period	Change in Population Noise Exposure			
	UK measure		EU measure	
Day	>57 dB $L_{Aeq,16h}$	58,400		
Night	>48 dB $L_{Aeq,8h}$	99,900		
24-hour			>55 dB L_{DEN}	211,350

Values in brackets show reductions in populations relative to the "Do-Minimum" values.

If the Heathrow ENR scheme were to be developed, significant increases in national population exposure would occur compared to the Do-Minimum case for all metrics, due to increased population exposure at Heathrow of significantly greater magnitude than decreases in exposure at other airports.

1. Introduction

This report considers the national noise impact of each of the three shortlisted schemes:

- *Gatwick Airport Second Runway (Gatwick 2R) promoted by Gatwick Airport Ltd (GAL);*
- *Heathrow Airport Northwest Runway (Heathrow NWR) promoted by Heathrow Airport Ltd (HAL); and,*
- *Heathrow Airport Extended Northern Runway (Heathrow ENR) promoted by Heathrow Hub (HH).*

Potential environmental impacts from the three schemes are appraised in accordance with the Appraisal Framework (Section A.5): *"Noise".* The objective for this module is *"To minimise and where possible reduce noise impacts".*

This appraisal module provides a consistent approach to evaluating the airport expansion schemes and assessing thier impacts on minimising or reducing the population that would be exposed to aircraft noise.

The appraisal module considers the noise implications of a scheme at both the national and local level. Both are based on comparisons of the development scenarios to Do-Minimum situations. The baseline assessment considers the Do-Minimum cases, while the local assessment considers the "*statistics and changes to noise environments in and around short-listed airports*".

This report sets out the national noise impact due to aviation noise, which would exist in the event that any one of the three shortlisted schemes is developed, and compares this with the impact in the Do-Minimum cases for the years 2030, 2040 and 2050. For each of these years, the airports have been assessed for the development cases on the same basis as the Do-Minimum case, other than accounting for changes to aircraft movements and the specific features of the developments themselves, both physical and operational.

The national noise assessment requirements are listed in Section 5 of the Appraisal Framework: *"Noise".* For the national assessment, the average noise metrics identified for the 'noise scorecard' are reported for each case. These include the UK DfT metric for annoyance of 57dB $L_{Aeq,16h}$ to create an indicative national noise picture. This report is structured to address each of these metrics in turn for each of the three shortlisted schemes.

The national noise analysis approach was developed by Jacobs and Bickerdike Allen Partners, with noise modelling undertaken by BAP and ERCD

2. Methodology and Legislation

This section covers:

- An outline of the methodology used to inform this National assessment.
- Key legislation and relevant guidance applicable to inform the National conditions.
- An outline of the assumptions made in this National assessment and the limitations of it.

The evaluation of national aviation noise has involved a consideration of 13 airports in the UK. These airports have been selected to reflect the major provision of aviation infrastructure in the UK based on the definition in the European Noise Directive (interpreted here as >50,000 Air Transport Movements) and the London Terminal Manoeuvring Area (LTMA). Consideration of LTMA airports includes Southend: this is considered of value for two key reasons: it is the fastest growing of the south east England airports, and has the potential to be affected significantly by airport expansion.

The Airports included in this study are the Scottish airports, Aberdeen, Edinburgh and Glasgow; the English regional airports, Birmingham, Bristol, East Midlands and Manchester; the LTMA Airports (including airports where schemes have been shortlisted), Gatwick, Heathrow, London City, Luton, Southend and Stansted.

For each of the proposed schemes a set of comparisons has been made comparing the baseline 'do minimum' against the situation with the proposed scheme in operation:

- *2030 Developed vs 2030 Do-Minimum*
- *2040 Developed vs 2040 Do-Minimum*
- *2050 Developed vs 2050 Do-Minimum*

For each comparison, the following aviation noise metrics are considered on a national level:

- *Daytime noise metric, $L_{Aeq,16h}$ which is the A-weighted equivalent continuous noise level, assessed over an average summertime daytime / evening period (07.00-23.00), at 57 dB.*
- *Night-time noise metric, $L_{Aeq,8h}$ which is the A-weighted equivalent continuous noise level, assessed over an average summertime night period (23.00-07.00), at 48 dB.*
- *24-hour noise metric, L_{DEN} which is the A-weighted equivalent continuous noise level, evaluated over an annual average 24 hour period, with a 10 dB penalty added to the levels at night (23.00-07.00) and a 5 dB penalty added to the levels in the evening (19.00-23.00) to reflect people's increased sensitivity to noise during these periods, at 55 dB.*

The areas and populations associated with contours for each of these are presented at an airport level, along with results for the daytime metric at values of 63 and 69 dB $L_{Aeq,16h}$, in Appendix A. These additional levels of noise exposure are given in the Aviation Policy Framework (DfT, 2013) in relation to where the

Government expects airport operators to offer acoustic insulation to noise-sensitive buildings, or assistance to households with the costs of moving.

Contour maps showing the daytime noise metric, $L_{Aeq,16h}$, at a value of 57 dB for each airport in 2030 with each of the shortlisted schemes and the Do-Minimum situation are contained within the Noise: Figures report (Jacobs, 2014). The contours shown on this mapping have been derived from modelling undertaken to prepare ERCD Report 1205 Strategic Noise Maps for Gatwick Airport 2011, (ERCD, 2011), Draft ERCD Report 1402 Noise Exposure Contours for Gatwick Airport 2013, (ERCD, 2013a) for Gatwick, and ERCD report 1204 Strategic Noise Maps for Heathrow Airport 2011, (ERCD, 2011) and the Draft ERCD Report 1401 Noise Exposure Contours for Heathrow Airport 2013 (ERCD Report, 2013b) for Heathrow. In the Aviation Policy Framework the Government states that it will continue to ensure that noise exposure maps are produced for the noise-designated airports on an annual basis using this metric down to this value.

The methodology and assumptions used for this assessment are described in Appendix B.

2.2 Legislation

The noise effects are considered with respect to the policy delineated in the Aviation Policy Framework; there are no legal limits on the airborne aircraft noise exposure in the UK. A key Government objective on noise is to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise.

EU Directive 2002/30/EC, commonly referred to as the European Noise Directive (END) sets out requirements and procedures for introducing noise related operating restrictions at Community Airports. In the UK, the provisions of the END are enacted in Environmental Noise (England) Regulations 2006, as amended.

The Environmental Noise (England) Regulations 2006 apply to airports that have more than 50,000 movements of civil subsonic jet aircraft per calendar year. Qualifying airports must implement or update noise action plans every five years or whenever a major development which affects the existing noise situation occurs. The noise action plans should be based on noise maps and designed to manage noise issues and effects, including noise reduction if necessary.

2.3 Technical Standards

The International Civil Aviation Organisation (ICAO) recommends technical standards to limit noise.

The International Civil Aviation Organization (ICAO) Resolution A33/7 (ICAO, 2004), is titled 'Balanced Approach to Aircraft Noise Management'. The balanced approach involves identifying the noise issues relevant to an airport, then analysing the various measures available to reduce noise through the exploration of the following four principal elements:

- *reduction at source (quieter aircraft);*
- *land-use planning and management;*
- *noise abatement operations procedures; and*

- *operating restrictions (e.g. enforced Chapter withdrawal (not allowing older, noisier planes) and time restricted flights).*

The recommended practices for implementing this balanced approach are contained in ICAO Doc 9829 – '*Guidance on the balanced approach to aircraft noise management*'. In respect of reducing noise at source, ICAO recommends technical standards to limit noise. Aircraft and engines are independently assessed and certified against these standards before entering service. ICAO noise standards are referred to by 'Chapter', which refers to the chapter in the proceedings of meetings where the noise standard is agreed:

- *Chapter 2, Committee on Aircraft Noise (CAN), 1973*
- *Chapter 3, Committee on Aircraft Noise (CAN), 1977*
- *Chapter 4, Committee on Aviation Environmental Protection 5, 2001 (CAEP/5-2001)*
- *Chapter 14, Committee on Aviation Environmental Protection 9, 2013 (CAEP/9-2013)*

The technical standards for noise have become progressively more stringent with each Chapter.

2.4 Assumptions and Limitations

This assessment has considered 13 of the 26 or so UK airports, as it was not feasible to assess all UK airports within the timescale. It is considered that the overall effects found with this limited study would not be significantly different if all UK airports had been included.

Population data has been provided by CACI Ltd, comprising a 2013 postcode database which is an update of the latest 2011 Census, and forecasts for 2030, 2040 and 2050. Each postcode in the database is described by a single geographical point, and if this point is within a contour then all of the population assigned to the postcode are counted.

Due to the nature of the postcode database, similar contours may have different population counts when the geographical point representing a postcode lies just inside one contour and just outside another. This can lead to large relative changes in assessed population despite the change in contour area and/or shape being small. This is because if the population is only within a few postcodes the inclusion of one more, or exclusion of one already included, is more significant than if there were many postcodes contributing to the total.

These population forecasts include growth at locations in close proximity to the shortlisted airports. However, in practice it is unlikely that the planning authority will permit any new dwellings in locations already subject to aircraft noise levels at or above the Significant Observed Adverse Effect Level[1] (SOAEL) adopted by the local planning authority. This report is based on the noise modelling undertaken by ERCD and BAP, which in turn is based on detailed aircraft

[1] The National Planning Policy Framework (NPPF) states that planning policies and decisions should aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development. The Noise Policy Statement for England 2010 (NPSE) expands on the term 'significant adverse impact' and defines the Significant Observed Adverse Effect Level (SOAEL) as the level above which significant adverse effects on health and quality of life occur.

movement data. This is based on the Assessment of Need carbon capped scenario of the Airport Commission Demand Forecast 2014, which provides annual passenger and ATM numbers. No alternative scenarios have been assessed.

For Gatwick and Heathrow airports, the annual aircraft movement data in the Demand Forecast has been processed by LeighFisher into movements for the summer period, as well as movements for the day, evening and night periods, by aircraft type. The methodology undertaken by LeighFisher is contained in an appendix to Aviation Noise Local report (Jacobs, 2014).

For the other 11 airports assessed, the average ratio between summer and annual movements over the last 10 years has been calculated at each airport based on the CAA's published statistics, and this has been applied equally to each aircraft type. Assumptions have been made by BAP about the relative number of flights in the day, evening and night periods at each airport, and these were applied equally to each aircraft type.

The forecasts only include Air Transport Movements (ATMs) which are defined as landings or take-offs of aircraft engaged on the transport of passengers, freight or mail on commercial terms. All scheduled movements, including those operated empty, loaded charter and air taxi movements are included. The forecasts therefore represent an underestimation of the total air traffic in the future as some movements such as those for training purposes are excluded. This is not expected to significantly affect the national exposure, as at the busiest airports, including Gatwick and Heathrow, which generally contribute most to the national totals, almost all the movements are ATMs. Where this will have a more significant effect is at some of the smaller airports where a large proportion of the movements are made up of general aviation or business aviation aircraft. There the effect will be however be moderated as the aircraft types undertaking ATMs are generally larger and noisier than general aviation and business aircraft.

ANCON and INM both estimate long-term average impacts using average input conditions. Differences between predicted and actual noise levels will also occur because some complex noise propagation phenomena, such as the variation in wind speeds, wind directions, and air temperatures with altitude, will have comparatively small effects but are not explicitly modelled by either ANCON or INM.

For the modelling carried out using ANCON, the following assumptions have been made:

- Aircraft routes for the Gatwick 2R and Heathrow ENR schemes prepared as a result of a workshop between the Commission, the CAA, NATS and the promoters. For the Heathrow NWR scheme the indicative flight path designs supplied by the airport operator. All these routes must be considered indicative only. They should not be considered definitive route indications.
- Aircraft profiles based on actual measured data in 2013 at Gatwick and Heathrow airports.
- Runway usage based on the average of the previous 20 years as per **Error! Reference source not found. Error! Reference source not found.**.

- Traffic distribution between time period and route provided by LeighFisher.

Table 2.1: Runway Usage for ANCON model

Time Period	Runway Usage (% westerly)	
	Gatwick	Heathrow
Summer day	74	77
Summer night	78	83
Annual 12-hr day (L_{DEN} component)	67	70
Annual 4-hr evening (L_{DEN} component)	68	70
Annual 8-hr night (L_{DEN} component)	68	72

For the modelling carried out using INM, the following assumptions have been made:

- Stage lengths (affecting departure weight) based on destination information provided with traffic forecasts.
- Runway usage percentages obtained from individual airport publications such as annual reports, action plans, etc. If available, average of 2004-13 has been used. Otherwise it has been assumed that 75% of annual movements operate in a westerly direction.
- Departure routes assumed to remain as currently published in AIP entries. Arrival routes assumed to be straight in the area being considered.

3. Do-Minimum Scenarios

This section presents the National aviation noise assessment results of the Do-Minimum scenarios for the noise metrics considered in this report. These are described in more detail in the Aviation Noise Baseline report (Jacobs, 2014). The Do-Minimum results for individual airports are given in Appendix A.

The noise models are based on the ATMs arising from the Airports Commission Assessment of Need Forecast (carbon capped). The total annual ATMs at the thirteen airports used to inform the different noise models are 1,980,000 in 2030, 2,134,000 in 2040 and 2,311,000 in 2050. The split of these movements across the national airports is summarised in Table 3.1.

Table 3.1 : Approximate National ATMs for 2030, 2040 & 2050 – Do-Minimum

Airports	Annual Aircraft Movement Numbers		
	2030	2040	2050
Scottish Airports	323,000	356,000	404,000
English Regional Airports	460,000	546,000	679,000
LTMA Airports	1,197,000	1,232,000	1,228,000
National Total	1,980,000	2,134,000	2,311,000

The national situation has movement growth of 8% from 2030 to 2040, and further growth of 8% from 2040 to 2050. For the Scottish Airports higher growth is forecast, 10% from 2030 to 2040 and 13% from 2040 to 2050, and for the English Regional Airports even higher growth is forecast, 19% from 2030 to 2040 and 24% from 2040 to 2050. For the LTMA Airport the growth is less, 3% from 2030 to 2040 and a slight reduction from 2040 to 2050.

How the individual airports are affected depends on which scheme is implemented, and in particular how this affects their numbers of aircraft movements. These are detailed in the Strategic Fit module technical report. In the Do-Minimum case, all the airports other than Heathrow are predicted to grow from their 2013 level of ATMs to 2030, and all the airports other than Gatwick and Heathrow are predicted to grow between 2030 and 2050.

As a result of technological advances, aircraft produced today are considerably quieter than those of 50 years ago (ICAO, 2010), and this trend is expected to continue. The Sustainable Aviation Noise Road-Map (2013) defines three generations of aircraft and sets out assumptions concerning the noise emissions of each generation:

- *'**Current**' Aircraft represent the Chapter 3/4 aircraft which are already established in service. The noise characteristics of these aircraft are well defined.*
- *'**Imminent**' Aircraft (Generation 1 Aircraft) are already entering service or are currently offered for sale to the market (including all-new aircraft as well as re-engined aircraft). The noise characteristics of these aircraft are well defined.*
- *'**Future**' Aircraft (Generation 2 Aircraft) are currently being developed. The technology and design of these aircraft is yet to be realised, and their noise characteristics are subject to significant uncertainty. However, a*

baseline forecast of -0.1dB per annum improvement in noise emissions for these aircraft is adopted in the Sustainable Aviation Noise Road-Map.

The assumed transitions from the existing aircraft fleet mixes, which are predominantly 'current' generation, to higher proportions of Generation 1 and Generation 2 aircraft, occur at varying rates across the airports. For the Do-Minimum noise models the combined splits for all the airports considered are set out in Table 3.2.

Table 3.2 : Overall Aircraft fleet mix used in Do-Minimum noise models

Aircraft Generation	Year		
	2030	2040	2050
Current	35%	17%	13%
Generation 1	65%	75%	43%
Generation 2	0%	8%	44%

3.1 2030 Do-Minimum Case

Table 3.3 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for the 2030 Do-Minimum case, predicted by ERCD and BAP on behalf of the Airports Commission.

Table 3.3 : National aviation noise levels for 2030 – Do-Minimum

Period	Airports	Population Noise Exposure			
		UK measure		EU measure	
Day	Scottish Airports	>57 dB $L_{Aeq,16h}$	14,250		
	English Regional Airports		57,500		
	LTMA Airports		269,000		
	National Total		**340,750**		
Night	Scottish Airports	>48 dB $L_{Aeq,8h}$	26,850		
	English Regional Airports		115,750		
	LTMA Airports		306,500		
	National Total		**449,100**		
24-hour	Scottish Airports			>55 dB L_{DEN}	52,400
	English Regional Airports				142,450
	LTMA Airports				683,900
	National Total				**878,750**

Full details of the current population impacts are given in the Aviation Noise Baseline report (Jacobs, 2014). Table 3.4 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for the current situation, predicted by ERCD and BAP on behalf of the Airports Commission.

Table 3.4 : National aviation noise levels for Baseline

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	13,000	
	English Regional Airports	51,400	
	LTMA Airports	299,050	
	National Total	**363,450**	
Night	Scottish Airports	27,150	
	English Regional Airports	105,100	
	LTMA Airports	446,700	
	National Total	**578,950**	
24-hour	Scottish Airports		47,100
	English Regional Airports		132,700
	LTMA Airports		826,200
	National Total		**1,006,000**

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2030 is 22,700 less in the 2030 Do-Minimum scenario than currently. The number of people exposed to night-time noise levels of at least 48 dB $L_{Aeq,8h}$ is forecast to decrease by 129,850, while a decrease of 127,250 people exposed to noise levels of at least 55 dB L_{DEN} is expected. These decreases are related to improvements in the noise performance of aircraft more than countering an increase in ATMs.

3.2 2040 Do-Minimum Case

Table 3.5 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for the 2040 Do-Minimum case, predicted by ERCD and BAP on behalf of the Airports Commission.

Table 3.5 : National aviation noise levels for 2040 – Do-Minimum

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	15,700	
	English Regional Airports	67,000	
	LTMA Airports	263,700	
	National Total	**346,400**	
Night	Scottish Airports	29,250	
	English Regional Airports	132,450	
	LTMA Airports	371,950	
	National Total	**533,650**	
24-hour	Scottish Airports		63,300
	English Regional Airports		163,150
	LTMA Airports		692,650
	National Total		**919,100**

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2040 is 5,650 more than in the 2030 Do-Minimum scenario. The number of people exposed to night-time noise levels of at least 48 dB $L_{Aeq,8h}$ is forecast to increase by 84,550, while an increase of 40,350 people exposed to noise levels of at least 55 dB L_{DEN} is expected. These increases are related to an increase of 154,000 ATMs.

3.3 2050 Do-Minimum Case

Table 3.6 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for the 2050 Do-Minimum case, predicted by ERCD and BAP on behalf of the Airports Commission.

Table 3.6 : National aviation noise levels for 2050 – Do-Minimum

Period	Airports	Population Noise Exposure			
		UK measure		EU measure	
Day	Scottish Airports	>57 dB $L_{Aeq,16h}$	17,700		
	English Regional Airports		82,400		
	LTMA Airports		256,950		
	National Total		**357,050**		
Night	Scottish Airports	>48 dB $L_{Aeq,8h}$	31,050		
	English Regional Airports		158,000		
	LTMA Airports		405,450		
	National Total		**594,500**		
24-hour	Scottish Airports			>55 dB L_{DEN}	69,650
	English Regional Airports				197,600
	LTMA Airports				678,450
	National Total				**945,700**

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2050 is 10,650 more than in the 2040 Do-Minimum scenario. The number of people exposed to night-time noise levels of at least 48 dB $L_{Aeq,8h}$ is forecast to increase by 60,850, while an increase of 26,600 people exposed to noise levels of at least 55 dB L_{DEN} is expected. These increases are related to an increase of 177,000 ATMs.

4. Gatwick Airport Second Runway

The Gatwick Airport Second Runway scheme is based around a new, wide spaced runway parallel to and to the south of the existing runway, and a new terminal building located between the runways. The basic proposal will require some aircraft using the new runway to taxi across the existing runway, although a possible alternative has been put forward which involves aircraft taxing around the ends of the existing runway.

The noise models are based on the ATMs arising from the Airports Commission Assessment of Need Forecast (carbon capped). The total annual ATMs at the thirteen airports used to inform the different noise models are 1,985,000 in 2030, 2,177,000 in 2040 and 2,425,000 in 2050. The split of these movements across the national airports is summarised in Table 4.1.

Table 4.1 : Approximate National ATMs for 2030, 2040 & 2050 – Gatwick 2R Scheme

Airports	Annual Aircraft Movement Numbers		
	2030	2040	2050
Scottish Airports	320,000	354,000	399,000
English Regional Airports	456,000	520,000	611,000
LTMA Airports	1,209,000	1,303,000	1,415,000
National Total	1,985,000	2,177,000	2,425,000

The national situation, with the Gatwick scheme, has movement growth of 10% from 2030 to 2040, and further growth of 11% from 2040 to 2050. For the Scottish Airports slightly higher growth is forecast, 11% from 2030 to 2040 and 13% from 2040 to 2050, and for the English Regional Airports even higher growth is forecast, 14% from 2030 to 2040 and 18% from 2040 to 2050. For the LTMA Airport the growth is similar to the national total, 8% from 2030 to 2040 and 9% 2040 to 2050.

Compared to the Do-Minimum cases, see Table 3.1, the movements there is no significant change to the movement numbers in 2030, or to the movement numbers at the Scottish Airports in 2040 and 2050. For the English Regional Airports there is a reduction in movements of 5% in 2040 and 10% in 2050 whereas for the LTMA Airports there is an increase of 6% in 2040 and 15% in 2050. This leads to a national increase of 2% in 2040 and 5% in 2050.

The assumed transitions from the existing aircraft fleet mixes, which are predominantly 'current' generation, to higher proportions of Generation 1 and Generation 2 aircraft, vary by no more than 2% from those set out in Table 3.2 as combined totals for all the airports considered, although there is some variation between different airports.

4.1 2030 Gatwick 2R Scheme vs Do-Minimum

This section considers the predicted national noise exposure in 2030 with the Gatwick 2R scheme developed and compares it with the Do-Minimum situation.

Table 4.2 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2030. This is with the Gatwick 2R scheme developed predicted by ERCD and BAP on behalf of the Airports Commission. The results for

individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 4.2 : National aviation noise levels for 2030 – Gatwick 2R Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	14,200	
	English Regional Airports	56,800	
	LTMA Airports	>57 dB $L_{Aeq,16h}$ 266,550	
	National Total	**337,550**	
Night	Scottish Airports	26,350	
	English Regional Airports	115,050	
	LTMA Airports	>48 dB $L_{Aeq,8h}$ 315,050	
	National Total	**456,450**	
24-hour	Scottish Airports		52,200
	English Regional Airports		141,250
	LTMA Airports		>55 dB L_{DEN} 687,500
	National Total		**880,950**

The expected change in the national population by 2030 within each noise metric contour, with the Gatwick 2R scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ a reduction of 3,200 with Gatwick 2R (from 340,750 to 337,550)*
- *>48 dB $L_{Aeq,8h}$ an increase of 7,350 with Gatwick 2R (from 449,100 to 456,450)*
- *>55 dB L_{DEN} an increase of 2,200 with Gatwick 2R (from 878,750 to 880,950)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2030 is lower by 1% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is largely due to an overall decrease in exposure at the LTMA airports despite an increase at Gatwick airport. The change in the LTMA exposure is mainly due to the redistribution of the LTMA traffic with a greater proportion using Gatwick airport which has a lower population in its local area than some of the other LTMA airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2030 is higher by 2% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is largely due to an increase in exposure at Gatwick airport which is only partially offset by decreases at other airports.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2030 is higher by 0.3% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to an increase at Gatwick airport which is only partially offset by decreases at other airports.

4.2 2040 Gatwick 2R Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2040 with the Gatwick 2R scheme developed and compares it with the Do-Minimum situation.

Table 4.3 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2040. This is with the Gatwick 2R scheme developed predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 4.3 : National aviation noise levels for 2040 – Gatwick 2R Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	14,750	
	English Regional Airports	63,150	
	LTMA Airports	>57 dB $L_{Aeq,16h}$ 263,900	
	National Total	**341,800**	
Night	Scottish Airports	27,200	
	English Regional Airports	127,350	
	LTMA Airports	>48 dB $L_{Aeq,8h}$ 374,750	
	National Total	**529,300**	
24-hour	Scottish Airports		61,300
	English Regional Airports		157,950
	LTMA Airports		>55 dB L_{DEN} 696,450
	National Total		**915,700**

The expected change in the national population by 2040 within each noise metric contour, with the Gatwick 2R scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ a reduction of 4,600 with Gatwick 2R (from 346,400 to 341,800)*
- *>48 dB $L_{Aeq,8h}$ a reduction of 4,350 with Gatwick 2R (from 533,650 to 529,300)*
- *>55 dB L_{DEN} a reduction of 3,400 with Gatwick 2R (from 919,100 to 915,700)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2040 is lower by 1% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of other airports which more than offsets an increase at Gatwick airport.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2040 is lower by 1% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of other airports which more than offsets an increase at Gatwick airport.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2040 is lower by 0.4% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of other airports which more than offsets an increase at Gatwick airport.

4.3 2050 Gatwick 2R Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2050 with the Gatwick 2R scheme developed and compares it with the Do-Minimum situation.

Table 4.4 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2050. This is with the Gatwick 2R scheme developed predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 4.4 : National aviation noise levels for 2050 – Gatwick 2R Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	16,900 (>57 dB $L_{Aeq,16h}$)	
	English Regional Airports	72,300	
	LTMA Airports	265,900	
	National Total	**355,100**	
Night	Scottish Airports	29,950 (>48 dB $L_{Aeq,8h}$)	
	English Regional Airports	143,150	
	LTMA Airports	413,400	
	National Total	**586,500**	
24-hour	Scottish Airports		68,550 (>55 dB L_{DEN})
	English Regional Airports		180,200
	LTMA Airports		700,700
	National Total		**949,450**

The expected change in the national population by 2050 within each noise metric contour, with the Gatwick scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ a reduction of 1,950 with GATWICK 2R (from 357,050 to 355,100)*
- *>48 dB $L_{Aeq,8h}$ a reduction of 8,000 with GATWICK 2R (from 594,500 to 586,500)*
- *>55 dB L_{DEN} an increase of 3,750 with GATWICK 2R (from 945,700 to 949,450)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2050 is lower by 0.5% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is largely due to a decrease in overall exposure at the English regional airports which more than offsets the increase predicted at the LTMA airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2050 is lower by 1% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to a decrease in overall exposure at the English regional airports, which more than offsets the increase predicted at the LTMA airports.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2050 is higher by 0.4% with the Gatwick 2R scheme developed than in the Do-Minimum case. This is due to an increase at the LTMA airports, which is only partially offset by the decrease at the English regional airports.

4.4 Gatwick 2R Scheme Summary

If the Gatwick 2R scheme were to be developed, the national situation would be largely similar to the Do-Minimum case, with relatively small decreases in some metrics and small increases in others. This follows from the changes in the total movements which are at most an increase of 5% in 2050 compared to the Do-Minimum case. With regard to Gatwick there is an increase in movements with the development, which results in a forecast increase in exposed population there, compared to the Do-Minimum case, but this is approximately equal to the reduction in exposed population at other airports.

5. Heathrow Airport Northwest Runway

The Heathrow NWR scheme is based around:

- *A new 3,500m runway situated to the north-west of the existing Airport, approximately parallel to the M4 and extending over the existing alignment of the M25 which would be re-routed under the runway in a tunnel.*
- *Two new terminal buildings;*
- *Additional Aircraft movement areas and taxiways;*
- *Various additional aircraft stands (pier serviced stands and remote stands);*
- *Additional Car parking; and*
- *Ancillary uses.*

The noise models are based on the ATMs arising from the Airports Commission Assessment of Need Forecast (carbon capped). The total annual ATMs at the thirteen airports used to inform the different noise models are 1,949,000 in 2030, 2,126,000 in 2040 and 2,323,000 in 2050. The split of these movements across the national airports is summarised in Table 5.1.

Table 5.1 : Approximate National ATMs for 2030, 2040 & 2050 – Heathrow NWR Scheme

Airports	Annual Aircraft Movement Numbers		
	2030	2040	2050
Scottish Airports	305,000	339,000	387,000
English Regional Airports	418,000	441,000	510,000
LTMA Airports	1,226,000	1,345,000	1,426,000
National Total	1,949,000	2,126,000	2,323,000

The national situation, with the Heathrow NWR scheme, has movement growth of 9% from 2030 to 2040, and further growth of 9% from 2040 to 2050. For the Scottish Airports higher growth is forecast, 11% from 2030 to 2040 and 14% from 2040 to 2050. For the English Regional Airports the forecast is lower growth of 6% from 2030 to 2040 but higher growth of 16% from 2040 to 2050. For the LTMA Airport the growth is broadly similar to the national total, 10% from 2030 to 2040 and 6% 2040 to 2050.

Compared to the Do-Minimum cases, see Table 3.1, there is a forecast reduction in the movements of around 5% at the Scottish Airports at each year. For the English Regional Airports the reduction in movements increases with time from 9% in 2030 to 19% in 2040 and 25% in 2050. Conversely for the LTMA Airports the increase in movements increases with time from 2% in 2030 to 9% in 2040 and 16% in 2050. This leads to a national decrease of 2% in 2030 and 0.4% in 2040 but an increase of 0.5% in 2050.

The assumed transitions from the existing aircraft fleet mixes, which are predominantly 'current' generation, to higher proportions of Generation 1 and Generation 2 aircraft, vary by no more than 2% from those set out in Table 3.2 as combined totals for all the airports considered, although there is some variation between different airports.

5.1 2030 Heathrow NWR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2030 with the Heathrow NWR scheme developed and compares it with the Do-Minimum situation.
Table 5.2 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2030. This is with the Heathrow NWR scheme developed predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 5.2 : National aviation noise levels for 2030 – Heathrow NWR Scheme

Period	Airports	Population Noise Exposure			
		UK measure		EU measure	
Day	Scottish Airports	>57 dB $L_{Aeq,16h}$	12,850		
	English Regional Airports		51,150		
	LTMA Airports		269,050		
	National Total		**333,050**		
Night	Scottish Airports	>48 dB $L_{Aeq,8h}$	23,900		
	English Regional Airports		106,350		
	LTMA Airports		293,100		
	National Total		**423,350**		
24-hour	Scottish Airports			>55 dB L_{DEN}	45,750
	English Regional Airports				129,200
	LTMA Airports				632,150
	National Total				**807,100**

The expected change in the national population by 2030 within each noise metric contour, with the HAL scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ a reduction of 7,700 with HEATHROW NWR (from 340,750 to 333,050)*
- *>48 dB $L_{Aeq,8h}$ a reduction of 25,750 with HEATHROW NWR (from 449,100 to 423,350)*
- *>55 dB L_{DEN} a reduction of 71,650 with HEATHROW NWR (from 878,750 to 807,100)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2030 is lower by 2% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of other airports, in particular the other LTMA airports, which more than offsets an increase predicted at Heathrow.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2030 is lower by 6% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of airports, including Heathrow.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2030 is lower by 8% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of airports, including Heathrow.

5.2 2040 Heathrow NWR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2040 with the Heathrow NWR scheme developed and compares it with the Do-Minimum situation.

Table 5.3 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2040. This is with the Heathrow NWR scheme developed predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 5.3 : National aviation noise levels for 2040 – Heathrow NWR Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	13,150	
	English Regional Airports	53,150	
	LTMA Airports	281,100	
	National Total	**347,400**	
Night	Scottish Airports	22,400	
	English Regional Airports	110,200	
	LTMA Airports	332,850	
	National Total	**465,450**	
24-hour	Scottish Airports		53,150
	English Regional Airports		134,950
	LTMA Airports		694,450
	National Total		**882,550**

The expected change in the national population by 2040 within each noise metric contour, with the HAL scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ an increase of 1,000 with Heathrow NWR (from 346,400 to 347,400)*
- *>48 dB $L_{Aeq,8h}$ a reduction of 68,200 with Heathrow NWR (from 533,650 to 465,450)*
- *>55 dB L_{DEN} a reduction of 36,550 with Heathrow NWR (from 919,100 to 882,550)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2040 is higher by 0.3% with the Heathrow NWR scheme developed than in the Do-Minimum case. This small increase is due to an increase in exposure at Heathrow, which is of greater magnitude than the decreases at a number of other airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2040 is lower by 13% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of airports, including Heathrow.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2040 is lower by 4% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of other airports, which more than offsets the increase predicted at Heathrow.

5.3 2050 Heathrow NWR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2050 with the Heathrow NWR scheme developed and compares it with the Do-Minimum situation.

Table 5.4 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2050. This is with the Heathrow NWR scheme developed, predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 5.4 : National aviation noise levels for 2050 – Heathrow NWR Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	14,900	
	English Regional Airports	59,000	
	LTMA Airports	283,650	
	National Total	**357,550**	
Night	Scottish Airports	25,100	
	English Regional Airports	121,400	
	LTMA Airports	322,950	
	National Total	**469,450**	
24-hour	Scottish Airports		61,250
	English Regional Airports		150,350
	LTMA Airports		722,100
	National Total		**933,700**

The expected change in the national population by 2050 within each noise metric contour, with the HAL scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ an increase of 500 with Heathrow NWR (from 357,050 to 357,550)*
- *>48 dB $L_{Aeq,8h}$ a reduction of 125,050 with Heathrow NWR (from 594,500 to 469,450)*
- *>55 dB L_{DEN} a reduction of 12,000 with Heathrow NWR (from 945,700 to 933,700)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2050 is higher by 0.1% with the Heathrow NWR scheme developed than in the Do-Minimum case. This small increase is due to an increase in exposure at Heathrow, which is of greater magnitude than the decreases at a number of other airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2050 is significantly lower by 21% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at a number of airports, and in particular at Heathrow which contributes over 60% of the decrease. This is discussed further in the Aviation Noise Local report (Jacobs, 2014).

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2050 is lower by 1% with the Heathrow NWR scheme developed than in the Do-Minimum case. This is due to a decrease in exposure at other airports which more than offsets an increase predicted at Heathrow.

5.4 Heathrow NWR Scheme Summary

If the Heathrow NWR scheme were to be developed, the national daytime situation would be largely similar to the Do-Minimum case. This follows from the differences in the total movements which are at most 2%. With regard to Heathrow there is an increase in movements with the development, which results in a forecast increase in exposed population there, compared to the Do-Minimum case, but this is largely offset by a reduction in exposed population at other airports. At night-time, significant decreases in national population exposure would occur compared to the Do-Minimum case, due to decreased exposure at Heathrow as well as at other airports (21% by 2050). This leads to smaller decreases (1% by 2050) in National population exposure compared to the Do-Minimum case when using the 24-hour metric.

6. Heathrow Airport Extended Northern Runway

The basic premise of the proposed Heathrow ENR scheme is the extension to the west 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.

The noise models are based on the ATMs arising from the Airports Commission Assessment of Need Forecast (carbon capped). The total annual ATMs at the thirteen airports used to inform the different noise models are 1,966,000 in 2030, 2,133,000 in 2040 and 2,327,000 in 2050. The split of these movements across the national airports is summarised in Table 6.1.

Table 6.1 : Approximate National ATMs for 2030, 2040 & 2050 – Heathrow ENR Scheme

Airports	Annual Aircraft Movement Numbers		
	2030	2040	2050
Scottish Airports	306,000	343,000	389,000
English Regional Airports	421,000	457,000	530,000
LTMA Airports	1,238,000	1,333,000	1,407,000
National Total	1,966,000	2,133,000	2,327,000

The national situation, with the Heathrow ENR scheme, has movement growth of 8% from 2030 to 2040, and further growth of 9% from 2040 to 2050. For the Scottish Airports higher growth is forecast, 12% from 2030 to 2040 and 13% from 2040 to 2050. For the English Regional Airports the forecast is growth of 9% from 2030 to 2040, similar to the national figure, and higher growth of 16% from 2040 to 2050. For the LTMA Airport the growth is slightly less than the national total, 8% from 2030 to 2040 and 6% 2040 to 2050.

Compared to the Do-Minimum cases, Table 3.1, there is a forecast reduction in the movements of around 4% at the Scottish Airports at each year. For the English Regional Airports the reduction in movements increases with time from 8% in 2030 to 16% in 2040 and 22% in 2050. Conversely for the LTMA Airports the increase in movements increases with time from 3% in 2030 to 8% in 2040 and 15% in 2050. This leads to a national decrease of 0.7% in 2030, no change in 2040, and an increase of 0.7% in 2050.

The assumed transitions from the existing aircraft fleet mixes, which are predominantly 'current' generation, to higher proportions of Generation 1 and Generation 2 aircraft, vary by no more than 2% from those set out in Table 3.2 as combined totals for all the airports considered, although there is some variation between different airports.

6.1 2030 Heathrow ENR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2030 with the Heathrow ENR scheme developed and compares it with the Do-Minimum situation.

Table 6.2 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2030. This is with the Heathrow ENR scheme developed, predicted by ERCD and BAP on behalf of the Airports Commission. The results for

individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 6.2 : National aviation noise levels for 2030 – Heathrow ENR Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	>57 dB $L_{Aeq,16h}$ 12,900	
	English Regional Airports	51,800	
	LTMA Airports	330,150	
	National Total	**394,850**	
Night	Scottish Airports	>48 dB $L_{Aeq,8h}$ 24,150	
	English Regional Airports	107,100	
	LTMA Airports	420,200	
	National Total	**551,450**	
24-hour	Scottish Airports		>55 dB L_{DEN} 46,500
	English Regional Airports		130,800
	LTMA Airports		884,250
	National Total		**1,061,550**

The expected change in the national population by 2030 within each noise metric contour, with the Heathrow ENR scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ an increase of 54,100 with Heathrow ENR (from 340,750 to 394,850)*
- *>48 dB $L_{Aeq,8h}$ an increase of 102,350 with Heathrow ENR (from 449,100 to 551,450)*
- *>55 dB L_{DEN} an increase of 182,800 with Heathrow ENR (from 878,750 to 1,061,550)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2030 is higher by 16% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase of 76,200 at Heathrow airport, which is of greater magnitude than predicted decreases at other airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2030 is higher by 23% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport of 121,500, which is of greater magnitude than predicted decreases at other airports.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2030 is higher by 21% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport of 226,300, which is of greater magnitude than predicted decreases at other airports. This is discussed further in the Aviation Noise Local report (Jacobs, 2014).

6.2 2040 Heathrow ENR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2040 with the Heathrow ENR scheme developed and compares it with the Do-Minimum situation.

Table 6.3 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2040. This is with the Heathrow ENR scheme developed, predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 6.3 : National aviation noise levels for 2040 – Heathrow ENR Scheme

Period	Airports	Population Noise Exposure	
		UK measure	EU measure
Day	Scottish Airports	13,150	
	English Regional Airports	55,200	
	LTMA Airports	>57 dB $L_{Aeq,16h}$ 340,700	
	National Total	**409,050**	
Night	Scottish Airports	23,000	
	English Regional Airports	114,000	
	LTMA Airports	>48 dB $L_{Aeq,8h}$ 502,700	
	National Total	**639,700**	
24-hour	Scottish Airports		54,350
	English Regional Airports		139,400
	LTMA Airports		>55 dB L_{DEN} 939,550
	National Total		**1,133,300**

The expected change in the national population by 2040 within each noise metric contour, with the Heathrow ENR scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ an increase of 62,650 with Heathrow ENR (from 346,400 to 409,050)*
- *>48 dB $L_{Aeq,8h}$ an increase of 106,050 with Heathrow ENR (from 533,650 to 639,700)*
- *>55 dB L_{DEN} an increase of 214,200 with Heathrow ENR (from 919,100 to 1,133,300)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2040 is higher by 18% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than the decreases at other airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2040 is higher by 20% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than predicted decreases at other airports.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2040 is higher by 23% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than predicted decreases at other airports.

6.3 2050 Heathrow ENR Scheme vs Do-Minimum

This section considers the predicted noise exposure in 2050 with the Heathrow ENR scheme developed and compares it with the Do-Minimum situation.

Table 6.4 below sets out the population impacts using a sample of the average measure metrics advocated by the 'scorecard' approach articulated within the Appraisal Framework for 2050. This is with the Heathrow ENR scheme developed, predicted by ERCD and BAP on behalf of the Airports Commission. The results for individual airports are given in Appendix A. A commentary on how each of these metrics differs from the Do-Minimum situation is provided below.

Table 6.4 : National aviation noise levels for 2050 – Heathrow ENR Scheme

Period	Airports	Population Noise Exposure			
		UK measure		EU measure	
Day	Scottish Airports	>57 dB $L_{Aeq,16h}$	15,100		
	English Regional Airports		61,850		
	LTMA Airports		338,500		
	National Total		**415,450**		
Night	Scottish Airports	>48 dB $L_{Aeq,8h}$	25,650		
	English Regional Airports		125,400		
	LTMA Airports		543,350		
	National Total		**694,400**		
24-hour	Scottish Airports			>55 dB L_{DEN}	62,200
	English Regional Airports				156,100
	LTMA Airports				938,750
	National Total				**1,157,050**

The expected change in the national population by 2050 within each noise metric contour, with the Heathrow ENR scheme developed as compared to the Do-Minimum case is set out below.

- *>57 dB $L_{Aeq,16h}$ an increase of 58,400 with Heathrow ENR (from 357,050 to 415,450)*
- *>48 dB $L_{Aeq,8h}$ an increase of 99,900 with Heathrow ENR (from 594,500 to 694,400)*
- *>55 dB L_{DEN} an increase of 211,350 with Heathrow ENR (from 945,700 to 1,157,050)*

The national population predicted to be exposed to average summer daytime noise levels of at least 57 dB $L_{Aeq,16h}$ in 2050 is higher by 16% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than predicted decreases at other airports.

The national population predicted to be exposed to average summer night time noise levels of at least 48 dB $L_{Aeq,8h}$ in 2050 is higher by 17% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than predicted decreases at other airports, in particular the English regional ones.

The national population predicted to be exposed to average annual noise levels of at least 55 dB L_{DEN} in 2050 is higher by 22% with the Heathrow ENR scheme developed than in the Do-Minimum case. This is due to a predicted increase at Heathrow airport, which is of greater magnitude than predicted decreases at other airports.

6.4 Heathrow ENR Scheme Summary

If the Heathrow ENR scheme were to be developed, significant increases in national population exposure would occur compared to the Do-Minimum case for all metrics. This is despite the differences in the total movements being under 1% in each year. The increases in national population are due to the increased activity at Heathrow with the development leading to increased population exposure there of significantly greater magnitude than the decreases in exposure that occur at other airports.

Glossary

The following table lists and explains key technical terms used in this report.

A-Weighting	The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allowed sound levels to be expressed as an overall single figure, dB(A).
ATM	Air Transport Movement. Landings or take-offs of aircraft engaged in the transport of passengers, freight or mail on commercial terms, including empty flights, charter and air taxi movements.
Airborne Aircraft Noise	This refers to the airborne noise created by aircraft. It includes noise due to start of roll or reverse thrust, but does not include noise due to taxiing or maintenance.
CAA	Civil Aviation Authority
Decibel (dB)	The unit used to describe the magnitude of sound. The decibel scale is logarithmic and it ascribes equal value to proportional changes in sound pressure, which is a characteristic of the ear. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10-5 pascals) and the threshold of pain is around 120 dB.
ERCD	Environmental Research and Consultancy Department of the Civil Aviation Authority.
$L_{Aeq,T}$	Equivalent continuous A-weighted sound pressure level. This is the most widely applicable unit in noise measurement It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound.
L_{DEN}	The day-evening-night indicator is defined by the following formula: $L_{DEN} = 10log\frac{1}{24}\left(12 \times 10^{\frac{L_{day}}{10}} + 4 \times 10^{\frac{L_{evening}}{10}} + 8 \times 10^{\frac{L_{night}}{10}}\right)$ in which: L_{day} is the $L_{Aeq,12h}$ for the daytime period (0700 to 1900) $L_{evening}$ is the $L_{Aeq,4h}$ for the evening period (1900 to 2300) L_{night} is the $L_{Aeq,8h}$ for the evening period (2300 to 0700)
Significant Observed Adverse Effect Level (SOAEL)	This is the level above which significant adverse effects on health and quality of life occur.

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Appendix A Airborne Aircraft Noise Results

Contour areas rounded to the nearest 0.1km. Totals may not sum due to rounding.

Population values rounded to the nearest 50. Where values are non-zero and less than 50 they are displayed as <50, but counted as 50 in totals.

Table A.1 : Do-Minimum Contour Results, 57 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	8.2	8.9	9.4	6100	7250	8600
Edinburgh	14.3	13.8	14.4	4100	4000	4150
Glasgow	8.8	8.7	8.6	4050	4450	4950
Sub-total	**31.3**	**31.4**	**32.4**	**14250**	**15700**	**17700**
Birmingham	10.8	12.0	15.7	13000	16550	25200
Bristol	8.4	8.8	10.0	900	1000	1250
East Midlands	10.2	11.1	11.9	2050	2400	2600
Manchester	29.8	32.2	34.9	41550	47050	53350
Sub-total	**59.2**	**64.1**	**72.5**	**57500**	**67000**	**82400**
London City	7.8	7.0	5.9	35100	30750	22850
London Luton	12.4	14.4	13.2	5100	5750	5100
London Southend	2.5	2.5	3.0	1850	1900	2850
London Stansted	27.4	26.4	24.9	3550	3700	3750
Sub-total	**50.1**	**50.3**	**47.0**	**45600**	**42100**	**34550**
London Gatwick	31.8	29.7	30.7	2200	2200	2800
London Heathrow	79.5	73.4	68.3	221200	219400	219600
Total	**251.9**	**248.9**	**250.9**	**340750**	**346400**	**357050**

Table A.2 : Gatwick 2R Contour Results, 57 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	8.2	8.9	9.6	6100	7300	8600
Edinburgh	14.2	14.0	14.5	4100	4050	4150
Glasgow	8.8	8.2	8.1	4000	3400	4150
Sub-total	**31.2**	**31.1**	**32.2**	**14200**	**14750**	**16900**
Birmingham	10.7	11.2	12.3	12700	14150	17100
Bristol	8.2	8.2	9.3	900	950	1100
East Midlands	10.2	10.4	10.3	2000	2100	2150
Manchester	29.5	31.7	34.3	41200	45950	51950
Sub-total	**58.6**	**61.5**	**66.2**	**56800**	**63150**	**72300**
London City	7.1	6.7	6.6	30700	28800	27450
London Luton	11.8	12.5	13.2	4600	4900	5100
London Southend	2.5	2.5	2.9	1800	1800	2750
London Stansted	26.1	26.2	25.6	3350	3700	3800
Sub-total	**47.5**	**47.9**	**48.3**	**40450**	**39200**	**39100**
London Gatwick	43.3	45.0	54.3	4900	5300	7200
London Heathrow	79.5	73.4	68.3	221200	219400	219600
Total	**260.1**	**258.9**	**269.3**	**337550**	**341800**	**355100**

Table A.3 : Heathrow NWR Contour Results, 57 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	8.0	8.7	9.3	6000	6900	8400
Edinburgh	13.3	14.0	14.4	3800	4100	4150
Glasgow	8.0	6.6	6.6	3050	2150	2350
Sub-total	**29.3**	**29.3**	**30.3**	**12850**	**13150**	**14900**
Birmingham	9.2	7.8	8.2	9600	7350	8050
Bristol	7.5	7.2	7.8	800	800	950
East Midlands	9.7	9.9	9.9	2000	2050	2100
Manchester	28.2	29.1	31.1	38750	42950	47900
Sub-total	**54.6**	**54.0**	**57.0**	**51150**	**53150**	**59000**
London City	5.9	5.8	6.1	22300	21850	24000
London Luton	10.2	9.0	9.1	3200	2750	2800
London Southend	2.3	2.2	2.6	1700	1600	1950
London Stansted	22.7	23.3	24.1	2850	3400	3600
Sub-total	**41.1**	**40.3**	**41.9**	**30050**	**29600**	**32350**
London Gatwick	26.1	23.5	25.2	1900	1600	2000
London Heathrow	104.0	101.5	96.0	237100	249900	249300
Total	**255.1**	**248.6**	**250.4**	**333050**	**347400**	**357550**

Table A.4 : Heathrow ENR Contour Results, 57 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	8.0	8.7	9.3	6000	6900	8400
Edinburgh	13.4	14.1	14.4	3800	4100	4150
Glasgow	8.1	6.8	6.9	3100	2150	2550
Sub-total	**29.5**	**29.6**	**30.6**	**12900**	**13150**	**15100**
Birmingham	9.5	8.6	8.9	10400	9100	9650
Bristol	7.6	7.3	7.9	800	850	950
East Midlands	9.8	10.1	10.1	2000	2100	2100
Manchester	28.1	29.5	31.9	38600	43150	49150
Sub-total	**55.0**	**55.5**	**58.8**	**51800**	**55200**	**61850**
London City	6.0	6.4	6.1	22850	25200	24000
London Luton	10.5	9.5	9.6	3450	2900	2850
London Southend	2.4	2.3	2.7	1700	1600	2150
London Stansted	22.9	23.7	24.7	2850	3400	3600
Sub-total	**41.8**	**41.9**	**43.1**	**30850**	**33100**	**32600**
London Gatwick	26.6	24.5	26.6	1900	1900	2000
London Heathrow	104.1	100.9	93.6	297400	305700	303900
Total	**257.0**	**252.4**	**252.7**	**394850**	**409050**	**415450**

Table A.5 : Do-Minimum Contour Results, 48 dB $L_{Aeq,8h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	9.9	10.8	11.6	8700	10550	11400
Edinburgh	23.2	22.7	23.9	5100	5200	5700
Glasgow	14.2	14.3	14.2	13050	13500	13950
Sub-total	**47.3**	**47.8**	**49.7**	**26850**	**29250**	**31050**
Birmingham	17.3	19.4	25.4	26600	32450	46750
Bristol	13.4	14.2	16.5	1650	1800	2050
East Midlands	53.8	56.5	59.2	23050	24500	25550
Manchester	46.5	50.2	53.9	64450	73700	83650
Sub-total	**131.0**	**140.3**	**155.0**	**115750**	**132450**	**158000**
London City	2.9	2.4	1.9	6250	3450	1500
London Luton	19.6	23.1	21.5	8500	11500	9550
London Southend	4.3	4.3	5.1	3600	3650	4750
London Stansted	42.9	41.6	39.4	5250	5250	5350
Sub-total	**69.7**	**71.4**	**67.9**	**23600**	**23850**	**21150**
London Gatwick	83.1	76.4	76.4	11700	11100	11200
London Heathrow	71.9	76.5	79.5	271200	337000	373100
Total	**403.0**	**412.4**	**428.5**	**449100**	**533650**	**594500**

Table A.6 : Gatwick 2R Contour Results, 48 dB $L_{Aeq,8h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	9.8	10.9	11.9	8500	10550	11700
Edinburgh	23.1	23.0	23.9	5050	5200	5400
Glasgow	14.2	13.3	13.4	12800	11450	12850
Sub-total	**47.1**	**47.2**	**49.2**	**26350**	**27200**	**29950**
Birmingham	17.1	18.2	20.0	26550	28650	34150
Bristol	13.1	13.2	15.2	1650	1700	1950
East Midlands	53.8	55.9	57.6	23050	24450	25050
Manchester	46.1	49.4	53.0	63800	72550	82000
Sub-total	**130.1**	**136.7**	**145.8**	**115050**	**127350**	**143150**
London City	2.5	2.3	2.2	5000	2800	2600
London Luton	18.6	19.9	21.5	8000	9000	9200
London Southend	4.3	4.2	5.0	3600	3300	4550
London Stansted	41.1	41.3	40.4	4950	5250	5350
Sub-total	**66.5**	**67.7**	**69.1**	**21550**	**20350**	**21700**
London Gatwick	84.2	74.6	75.8	22300	17400	18600
London Heathrow	71.9	76.5	79.5	271200	337000	373100
Total	**399.8**	**402.7**	**419.4**	**456450**	**529300**	**586500**

Table A.7 : Heathrow NWR Contour Results, 48 dB $L_{Aeq,8h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	9.6	10.5	11.5	8250	10100	11150
Edinburgh	21.6	23.0	23.8	4900	5250	5400
Glasgow	12.9	10.7	11.0	10750	7050	8550
Sub-total	**44.1**	**44.2**	**46.3**	**23900**	**22400**	**25100**
Birmingham	14.9	12.9	13.6	21300	18000	19500
Bristol	12.0	11.5	12.7	1450	1450	1700
East Midlands	53.4	55.4	57.2	22850	24300	25050
Manchester	44.1	45.6	48.5	60750	66450	75150
Sub-total	**124.4**	**125.4**	**132.0**	**106350**	**110200**	**121400**
London City	2.1	1.9	2.0	2550	1750	2000
London Luton	16.0	14.3	14.7	6450	5750	5650
London Southend	4.0	3.9	4.4	3000	2750	3750
London Stansted	36.2	37.2	38.3	4700	5200	5350
Sub-total	**58.3**	**57.3**	**59.4**	**16700**	**15450**	**16750**
London Gatwick	70.9	63.2	68.8	9600	8900	10400
London Heathrow	102.3	105.1	97.3	266800	308500	295800
Total	**400.0**	**395.2**	**403.8**	**423350**	**465450**	**469450**

Table A.8 : Heathrow ENR Contour Results, 48 dB $L_{Aeq,8h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	9.6	10.6	11.5	8250	10100	11150
Edinburgh	21.8	23.2	23.8	4900	5250	5400
Glasgow	13.1	11.0	11.4	11000	7650	9100
Sub-total	**44.5**	**44.8**	**46.7**	**24150**	**23000**	**25650**
Birmingham	15.4	14.2	14.7	22200	20750	21650
Bristol	12.1	11.8	12.8	1450	1450	1700
East Midlands	53.5	55.5	57.4	22850	24300	25050
Manchester	43.9	46.3	49.6	60600	67500	77000
Sub-total	**124.9**	**127.8**	**134.5**	**107100**	**114000**	**125400**
London City	2.1	2.1	2.0	2550	2650	2000
London Luton	16.5	15.0	15.4	7100	6050	5900
London Southend	4.1	3.9	4.5	3000	2900	3900
London Stansted	36.4	37.7	39.2	4750	5200	5350
Sub-total	**59.1**	**58.7**	**61.1**	**17400**	**16800**	**17150**
London Gatwick	72.9	64.6	67.4	10100	9200	9900
London Heathrow	102.8	112.6	110.0	392700	476700	516300
Total	**404.2**	**408.5**	**419.7**	**551450**	**639700**	**694400**

Table A.9 : Do-Minimum Contour Results, 55 dB L_{DEN}

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	33.8	48.0	59.3	22300	33350	38850
Edinburgh	30.9	30.4	32.0	7500	7750	8600
Glasgow	18.7	18.8	18.8	22600	22200	22200
Sub-total	**83.4**	**97.2**	**110.1**	**52400**	**63300**	**69650**
Birmingham	22.9	25.9	33.8	39500	46200	63400
Bristol	17.4	18.4	21.6	2200	2400	3150
East Midlands	41.6	44.2	46.7	20050	22150	23300
Manchester	57.9	62.3	66.9	80700	92400	107750
Sub-total	**139.8**	**150.8**	**169.0**	**142450**	**163150**	**197600**
London City	12.1	11.1	9.6	65800	61750	51700
London Luton	25.9	30.5	28.5	13100	17100	15950
London Southend	5.7	5.7	6.7	7750	8300	10550
London Stansted	54.9	53.2	50.6	7350	7400	7250
Sub-total	**98.6**	**100.5**	**95.4**	**94000**	**94550**	**85450**
London Gatwick	70.7	64.1	65.2	9400	9200	9500
London Heathrow	152.8	145.2	135.8	580500	588900	583500
Total	**545.3**	**557.8**	**575.5**	**878750**	**919100**	**945700**

Table A.10 : Gatwick 2R Contour Results, 55 dB L_{DEN}

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	33.7	48.2	59.8	22200	33550	39200
Edinburgh	30.7	30.7	31.9	7500	7850	8500
Glasgow	18.6	17.5	17.8	22500	19900	20850
Sub-total	**83.0**	**96.4**	**109.5**	**52200**	**61300**	**68550**
Birmingham	22.6	24.2	26.8	39050	43400	48750
Bristol	17.0	17.2	19.8	2200	2250	2700
East Midlands	41.6	43.2	44.2	19900	21600	22600
Manchester	57.4	61.4	65.8	80100	90700	106150
Sub-total	**138.6**	**146.0**	**156.6**	**141250**	**157950**	**180200**
London City	11.0	10.7	10.6	58250	57050	58900
London Luton	24.5	26.3	28.5	11950	13750	15900
London Southend	5.7	5.6	6.6	7750	8100	10350
London Stansted	52.7	52.9	51.9	6950	7350	7450
Sub-total	**93.9**	**95.5**	**97.6**	**84900**	**86250**	**92600**
London Gatwick	83.7	81.5	90.1	22100	21300	24600
London Heathrow	152.8	145.2	135.8	580500	588900	583500
Total	**552.0**	**564.6**	**589.6**	**880950**	**915700**	**949450**

Table A.11 : Heathrow NWR Contour Results, 55 dB L_{DEN}

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	33.3	47.5	58.8	21150	32700	38350
Edinburgh	28.8	30.8	31.9	6400	7850	8500
Glasgow	17.0	14.1	14.5	18200	12600	14400
Sub-total	**79.1**	**92.4**	**105.2**	**45750**	**53150**	**61250**
Birmingham	19.5	17.2	18.1	31750	28200	31000
Bristol	15.5	15.0	16.5	2000	2100	2250
East Midlands	40.9	42.4	43.5	19200	21200	22150
Manchester	55.0	56.9	60.3	76250	83450	94950
Sub-total	**130.9**	**131.5**	**138.4**	**129200**	**134950**	**150350**
London City	9.3	9.2	9.9	45700	47700	53200
London Luton	21.0	18.7	19.4	9200	8100	7850
London Southend	5.3	5.1	5.9	7100	6850	8500
London Stansted	46.8	48.0	49.3	5550	6300	7050
Sub-total	**82.4**	**81.0**	**84.5**	**67550**	**68950**	**76600**
London Gatwick	60.0	53.2	56.4	8400	7400	7800
London Heathrow	189.2	193.6	186.7	556200	618100	637700
Total	**541.6**	**551.7**	**571.2**	**807100**	**882550**	**933700**

Table A.12 : Heathrow ENR Contour Results, 55 dB L_{DEN}

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	33.3	47.5	58.9	21250	32700	38500
Edinburgh	29.0	31.0	31.8	6500	7850	8500
Glasgow	17.2	14.5	15.2	18750	13800	15200
Sub-total	**79.5**	**93.0**	**105.9**	**46500**	**54350**	**62200**
Birmingham	20.2	18.8	19.5	33400	31700	33550
Bristol	15.7	15.3	16.6	2100	2100	2250
East Midlands	41.0	42.6	43.8	19250	21350	22400
Manchester	54.8	57.6	61.7	76050	84250	97900
Sub-total	**131.7**	**134.3**	**141.6**	**130800**	**139400**	**156100**
London City	9.4	10.1	9.8	46450	53650	52900
London Luton	21.6	19.7	20.4	9750	8700	9350
London Southend	5.4	5.2	6.0	7200	6850	8650
London Stansted	47.0	48.6	50.4	5550	6450	7250
Sub-total	**83.4**	**83.6**	**86.6**	**68950**	**75650**	**78150**
London Gatwick	61.9	55.3	57.7	8500	7700	8100
London Heathrow	201.4	201.4	187.5	806800	856200	852500
Total	**557.9**	**567.6**	**579.3**	**1061550**	**1133300**	**1157050**

Table A.13 : Do-Minimum Contour Results, 63 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	2.2	2.3	2.4	50	50	50
Edinburgh	4.3	4.0	4.2	450	450	450
Glasgow	2.7	2.6	2.4	0	0	0
Sub-total	**9.2**	**8.9**	**9.0**	**500**	**500**	**500**
Birmingham	3.2	3.4	4.5	400	600	2050
Bristol	2.3	2.4	2.8	0	<50	50
East Midlands	3.0	3.3	3.6	400	600	650
Manchester	9.9	10.6	11.3	3850	6100	7850
Sub-total	**18.4**	**19.7**	**22.2**	**4650**	**7350**	**10600**
London City	2.2	1.8	1.5	2900	1500	1050
London Luton	3.8	4.4	3.9	<50	500	<50
London Southend	0.7	0.7	0.9	100	100	150
London Stansted	8.7	8.3	7.7	150	200	150
Sub-total	**15.4**	**15.2**	**14.0**	**3200**	**2300**	**1400**
London Gatwick	8.9	8.4	9.0	400	500	500
London Heathrow	25.7	23.4	21.7	35200	33900	34900
Total	**77.6**	**75.6**	**75.9**	**43950**	**44550**	**47900**

Table A.14 : Gatwick 2R Contour Results, 63 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	2.2	2.3	2.4	50	50	200
Edinburgh	4.2	4.1	4.2	450	450	450
Glasgow	2.6	2.4	2.3	0	0	0
Sub-total	**9.0**	**8.8**	**8.9**	**500**	**500**	**650**
Birmingham	3.1	3.2	3.5	400	350	600
Bristol	2.2	2.2	2.5	0	0	<50
East Midlands	3.0	3.1	3.0	400	550	550
Manchester	9.8	10.4	11.1	3800	5250	7750
Sub-total	**18.1**	**18.9**	**20.1**	**4600**	**6150**	**8950**
London City	2.0	1.8	1.7	2200	1400	1300
London Luton	3.6	3.7	3.9	<50	<50	<50
London Southend	0.7	0.7	0.9	100	100	150
London Stansted	8.3	8.2	7.9	150	200	200
Sub-total	**14.6**	**14.4**	**14.4**	**2500**	**1750**	**1700**
London Gatwick	11.9	12.3	15.8	400	500	800
London Heathrow	25.7	23.4	21.7	35200	33900	34900
Total	**79.3**	**77.8**	**80.9**	**43200**	**42800**	**47000**

Table A.15 : Heathrow NWR Contour Results, 63 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	2.1	2.2	2.3	50	50	50
Edinburgh	4.0	4.1	4.2	450	450	450
Glasgow	2.4	1.9	1.9	0	0	0
Sub-total	**8.5**	**8.2**	**8.4**	**500**	**500**	**500**
Birmingham	2.7	2.3	2.3	<50	<50	<50
Bristol	2.0	1.9	2.1	0	0	0
East Midlands	2.9	2.9	2.9	400	400	550
Manchester	9.3	9.5	10.0	3500	4050	5950
Sub-total	**16.9**	**16.6**	**17.3**	**3950**	**4500**	**6550**
London City	1.6	1.5	1.6	1250	850	1150
London Luton	3.0	2.6	2.6	<50	<50	<50
London Southend	0.7	0.7	0.8	100	100	150
London Stansted	7.2	7.3	7.4	150	150	150
Sub-total	**12.5**	**12.1**	**12.4**	**1550**	**1150**	**1500**
London Gatwick	7.2	6.4	7.2	400	400	400
London Heathrow	35.7	34.7	33.3	38300	41300	42900
Total	**80.8**	**78.0**	**78.6**	**44700**	**47850**	**51850**

Table A.16 : Heathrow ENR Contour Results, 63 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	2.1	2.2	2.3	50	50	50
Edinburgh	4.0	4.1	4.1	450	450	450
Glasgow	2.4	2.0	2.0	0	0	0
Sub-total	**8.5**	**8.3**	**8.4**	**500**	**500**	**500**
Birmingham	2.8	2.5	2.5	<50	<50	<50
Bristol	2.0	1.9	2.1	0	0	0
East Midlands	2.9	3.0	2.9	400	550	550
Manchester	9.3	9.7	10.3	3350	4250	6550
Sub-total	**17.0**	**17.1**	**17.8**	**3800**	**4850**	**7150**
London City	1.6	1.7	1.5	1250	1300	1050
London Luton	3.1	2.7	2.8	<50	<50	<50
London Southend	0.7	0.7	0.8	100	100	150
London Stansted	7.2	7.4	7.6	150	150	150
Sub-total	**12.6**	**12.5**	**12.7**	**1550**	**1600**	**1400**
London Gatwick	7.3	6.7	7.6	400	400	400
London Heathrow	34.0	32.2	29.5	63800	66900	67000
Total	**79.4**	**76.8**	**76.0**	**70050**	**74250**	**76450**

Table A.17 : Do-Minimum Contour Results, 69 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	0.8	0.8	0.8	0	0	0
Edinburgh	1.3	1.2	1.3	0	0	0
Glasgow	0.9	0.9	0.8	0	0	0
Sub-total	**3.0**	**2.9**	**2.9**	**0**	**0**	**0**
Birmingham	1.1	1.1	1.4	0	0	0
Bristol	0.7	0.7	0.8	0	0	0
East Midlands	1.0	1.0	1.1	0	0	0
Manchester	3.3	3.5	3.7	150	300	700
Sub-total	**6.1**	**6.3**	**7.0**	**150**	**300**	**700**
London City	0.7	0.5	0.5	0	0	0
London Luton	1.1	1.3	1.2	0	0	0
London Southend	0.3	0.3	0.3	0	0	50
London Stansted	2.7	2.5	2.3	0	0	0
Sub-total	**4.8**	**4.6**	**4.3**	**0**	**0**	**50**
London Gatwick	2.6	2.4	2.6	200	200	200
London Heathrow	6.7	6.0	5.6	2100	2100	2100
Total	**23.2**	**22.2**	**22.4**	**2450**	**2600**	**3050**

Table A.18 : Gatwick 2R Contour Results, 69 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	0.8	0.8	0.8	0	0	0
Edinburgh	1.3	1.2	1.3	0	0	0
Glasgow	0.9	0.8	0.8	0	0	0
Sub-total	**3.0**	**2.8**	**2.9**	**0**	**0**	**0**
Birmingham	1.0	1.0	1.1	0	0	0
Bristol	0.7	0.7	0.7	0	0	0
East Midlands	1.0	1.0	1.0	0	0	0
Manchester	3.3	3.4	3.6	150	300	450
Sub-total	**6.0**	**6.1**	**6.4**	**150**	**300**	**450**
London City	0.6	0.5	0.5	0	0	0
London Luton	1.1	1.1	1.2	0	0	0
London Southend	0.3	0.3	0.3	0	0	50
London Stansted	2.6	2.5	2.4	0	0	0
Sub-total	**4.6**	**4.4**	**4.4**	**0**	**0**	**50**
London Gatwick	3.4	3.6	4.3	<50	<50	<50
London Heathrow	6.7	6.0	5.6	2100	2100	2100
Total	**23.7**	**22.9**	**23.6**	**2300**	**2450**	**2650**

Table A.19 : Heathrow NWR Contour Results, 69 dB $L_{Aeq,16h}$

Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	0.8	0.8	0.8	0	0	0
Edinburgh	1.2	1.2	1.3	0	0	0
Glasgow	0.9	0.7	0.7	0	0	0
Sub-total	**2.9**	**2.7**	**2.8**	**0**	**0**	**0**
Birmingham	0.9	0.8	0.8	0	0	0
Bristol	0.6	0.6	0.6	0	0	0
East Midlands	0.9	0.9	1.0	0	0	0
Manchester	3.2	3.2	3.3	100	150	300
Sub-total	**5.6**	**5.5**	**5.7**	**100**	**150**	**300**
London City	0.5	0.5	0.5	0	0	0
London Luton	0.9	0.8	0.8	0	0	0
London Southend	0.3	0.3	0.3	0	0	0
London Stansted	2.2	2.2	2.3	0	0	0
Sub-total	**3.9**	**3.8**	**3.9**	**0**	**0**	**0**
London Gatwick	2.2	1.9	2.2	200	<50	<50
London Heathrow	9.5	9.0	8.8	900	900	800
Total	**24.1**	**22.9**	**23.4**	**1200**	**1100**	**1150**

Table A.20 : Heathrow ENR Contour Results, 69 dB $L_{Aeq,16h}$

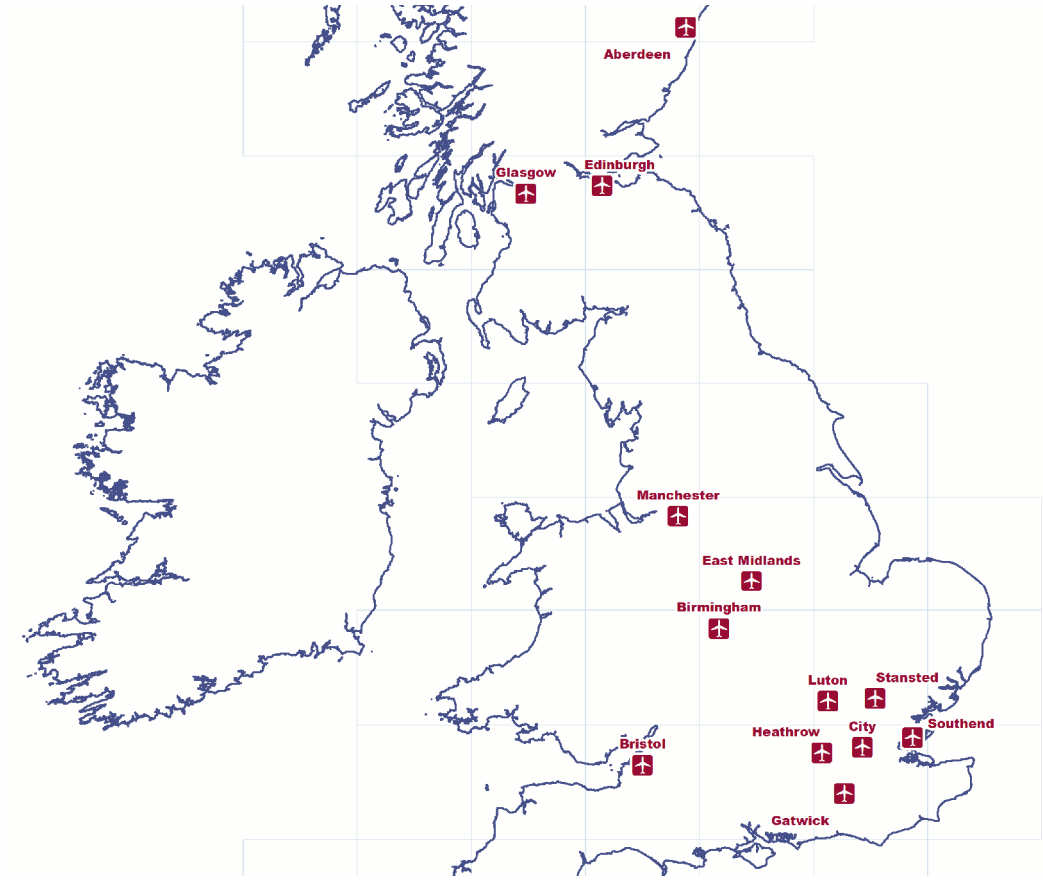
Airport	Area (km²)			Population		
	2030	2040	2050	2030	2040	2050
Aberdeen	0.8	0.8	0.8	0	0	0
Edinburgh	1.2	1.2	1.3	0	0	0
Glasgow	0.9	0.7	0.7	0	0	0
Sub-total	**2.9**	**2.7**	**2.8**	**0**	**0**	**0**
Birmingham	1.0	0.8	0.8	0	0	0
Bristol	0.6	0.6	0.6	0	0	0
East Midlands	0.9	1.0	1.0	0	0	0
Manchester	3.1	3.2	3.4	100	150	300
Sub-total	**5.6**	**5.6**	**5.8**	**100**	**150**	**300**
London City	0.5	0.5	0.5	0	0	0
London Luton	1.0	0.8	0.9	0	0	0
London Southend	0.3	0.3	0.3	0	0	0
London Stansted	2.2	2.2	2.3	0	0	0
Sub-total	**4.0**	**3.8**	**4.0**	**0**	**0**	**0**
London Gatwick	2.2	2.0	2.2	200	<50	200
London Heathrow	9.9	9.3	8.8	3900	4000	3900
Total	**24.6**	**23.4**	**23.6**	**4200**	**4200**	**4400**

Appendix B Airborne Aircraft Noise Methodology and Assumptions

The evaluation of national aviation noise has involved a consideration of 13 airports in the UK. These airports have been selected to reflect the major provision of aviation infrastructure in the UK based on the definition in the European Noise Directive (interpreted here as >50,000 Air Transport Movements) and the London Terminal Manoeuvring Area (LTMA). Consideration of LTMA airports includes Southend: this is considered of value for two key reasons: it is the fastest growing of the south east England airports, and has the potential to be affected significantly by airport expansion.

The Airports included in this study and shown in Figure B1 are therefore the Scottish airports, Aberdeen, Edinburgh and Glasgow; the English regional airports, Birmingham, Bristol, East Midlands and Manchester; the LTMA Airports (including airports where schemes have been shortlisted), Gatwick, Heathrow, London City, Luton, Southend and Stansted.

Figure B1: National Noise Assessment Study Area



Noise contours for Gatwick and Heathrow airports were calculated by the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority (CAA) on behalf of the Airports Commission, using the UK civil aircraft noise model ANCON (version 2.3) which is developed and maintained by ERCD on behalf of the Department for Transport (DfT). This is the model that has been used to produce noise contours at these two airports for a number of years.

Noise contours for the other 11 airports were calculated by Bickerdike Allen Partners (BAP), using the publicly available Federal Aviation Administration (FAA) Integrated Noise Model (INM) software, version 7.0d. This was to spread the volume of contouring work, and allowing for consistency in the results of the short listed schemes between the local and national noise assessments. It also had the benefit that at a number of the airports the INM model is routinely used to produce noise contours.

With both methods, detailed input assumptions are necessary, and this appendix outlines the assumptions made for the work in this national study on the airports.

Both INM and ANCON are fully compliant with the latest European guidance on noise modelling, ECAC.CEAC Doc 29 (3rd edition), published in December 2005. They differ however in the databases used by each to describe aircraft performance. The ANCON model utilises measured noise and radar data obtained around Gatwick and Heathrow, whilst the civil aircraft noise and performance data that make up the INM database are included in ICAO's Aircraft Noise and Performance (ANP) database (2012)[2]. Further comparison of the differences between INM and ANCON may be found in ERCD report 1102 (ERCD, 2010) [3].

ANCON and INM both estimate long-term average impacts using average input conditions. Differences between predicted and actual noise levels will also occur because some complex noise propagation phenomena which have comparatively small effects are not explicitly modelled by either ANCON or INM.

Aircraft Movements

The aircraft movement numbers used in the modelling are those given in the Assessment of Need carbon capped scenario Airport Commission Demand Forecast 2014, which provides annual passenger and ATM numbers by aircraft type. No alternative scenarios have been assessed.

The forecasts only include air transport movements. Therefore these forecasts represent an underestimation of the total air traffic in the future. This is not expected to significantly affect the national noise exposure, although it may have a significant effect on some of the smaller airports where a large proportion of the movements are made up of general aviation or business aviation aircraft.

(a) ANCON Model

For Gatwick and Heathrow airports, the annual aircraft movement data in the Airports Commission Assessment of Need Forecast (carbon capped) has been processed by LeighFisher into movements for the summer period, as well as movements for the day, evening and night periods, by aircraft type.

(b) INM Model

For the other 11 airports assessed, the average ratio between summer and annual movements over the last 10 years has been calculated at each airport based on the CAA's published statistics, and this has been applied equally to each aircraft type.

[2] http://www.aircraftnoisemodel.org/
[3] http://www.caa.co.uk/docs/68/dap_ercd_1102_modelaccuracy.pdf

The summer total ranges between 25% and 29% of the annual total, depending on the airport, and are given in Table B.1.

Table B.1: Summer Movements Relative to Annual

Airport Name	Summer Movements as % of Annual, 2004-2013 Average
Aberdeen	26%
Birmingham	28%
Bristol	29%
East Midlands	29%
Edinburgh	28%
Glasgow	28%
London City	25%
London Luton	28%
London Southend	29%
London Stansted	28%
Manchester	29%

It has been assumed 70% of the activity, split equally by type and operation, occurs during the day, 20% during the evening and 10% at night, with the exception of Aberdeen, East Midlands and London City, where there is public information available to suggest otherwise. These assumptions are summarised in Table B.2.

Table B.2: Distribution of Aircraft Movements Between Day, Evening and Night Periods

Airport Name	Day %	Evening %	Night %
Aberdeen	79%	14%	7%
Birmingham	70%	20%	10%
Bristol	70%	20%	10%
East Midlands (Passenger)	70%	20%	10%
East Midlands (Freight)	25%	8%	67%
East Midlands (Mail)	19%	6%	75%
Edinburgh	70%	20%	10%
Glasgow	70%	20%	10%
London City	78%	20%	2%
London Luton	70%	20%	10%
London Southend	70%	20%	10%
London Stansted	70%	20%	10%
Manchester	70%	20%	10%

Aircraft Type Assumptions

Both ANCON and INM contain databases of aircraft, however some of the forecast aircraft types are aircraft which have not yet entered service. These future aircraft types have been modelled by using an existing similar aircraft as a surrogate type and adjusting the noise levels as required, for arrivals and departures separately. The same surrogate types and adjustments have been used for both ANCON and INM.

Some types in the forecast were listed as generic types rather than a specific aircraft type. In these cases, they were modelled as a composite of aircraft types, allocated

on the basis of equal market share. That is, movements were divided equally among manufacturers and then the movements for each manufacturer were divided equally among their respective aircraft.

The assumptions on the noise characteristics of future aircraft types have been based on the latest available data, (ERCD, 2013a)

Runway and Route Usage

(a) ANCON Model

The runway usage for Gatwick and Heathrow airports has been based on the average of the last 20 years for the summer day metrics. For the other metrics, they are based on the average of the last 10 years for Gatwick and the last 5 years for Heathrow. The runway usage is shown in Table B.3.

Table B.3: Runway Usage for ANCON model

Time Period	Runway Usage (% westerly)	
	Gatwick	Heathrow
Summer day	74	77
Summer night	78	83
Annual 12-hr day (L_{DEN} component)	67	70
Annual 4-hr evening (L_{DEN} component)	68	70
Annual 8-hr night (L_{DEN} component)	68	72

For the Gatwick 2R and Heathrow ENR schemes the location of the departure and arrival routes for noise modelling purposes have been determined as a result of a workshop between the Commission, the CAA, NATS and the promoters. For the Heathrow NWR scheme the airport operator supplied indicative flight path designs covering a range of operating modes, which were used as the basis for the noise modelling.

The distribution of movements between different routes has been given in the data provided by LeighFisher as discussed above.

(b) INM Model

For the other 11 airports, runway usage has been based on airport publications, such as annual reports, action plans, etc. Where no public information is available it has been assumed that 75% of the movements operate in a westerly direction annually.

Where information is not separately available for summer and annual periods, it has been assumed that there is a summer peak of 10% more westerly operations compared to the annual runway usage for runways aligned east-west, and a summer peak of 5% in the most common direction otherwise. This is based on historical seasonal wind direction.

Unless information is available, it has been assumed that the runway usage is the same for all metrics. The assumed runway usage is given in Table B.4.

Table B.4: Distribution of Aircraft Movements by Runway and Period

Airport Name	Runway End	Summer Usage	Annual Usage
Aberdeen	16	69%	64%
	34	31%	36%
Birmingham	15(Day)	31%	36%
	33(Day)	69%	64%
	15(Night)	22%	27%
	33(Night)	78%	73%
Bristol	09	19%	29%
	27	81%	71%
East Midlands	09	15%	25%
	27	85%	75%
Edinburgh	06	26%	31%
	24	74%	69%
Glasgow	05	19%	24%
	23	81%	76%
London City	09	15%	25%
	27	85%	75%
London Luton	08	22%	30%
	26	78%	70%
London Southend	06 (Arr Day)	24%	29%
	24 (Arr Day)	76%	71%
	06 (Dep Day)	41%	46%
	24 (Dep Day)	59%	54%
	06 (Arr Night)	9%	14%
	24 (Arr Night)	91%	86%
	06 (Dep Night)	69%	74%
	24 (Dep Night)	31%	26%
London Stansted	04	25%	30%
	22	75%	70%
Manchester	05	15%	20%
	23	85%	80%

Departure routes have been assumed to remain as currently published in AIP entries, with movements split equally between them unless there is public information suggesting otherwise. Arrival routes assumed to be straight in the area being considered.

Population Assessments

Population data has been provided by CACI Ltd, comprising a 2013 postcode database which is an update of the latest 2011 Census, and forecasts for 2030, 2040 and 2050. Each postcode in the database is described by a single geographical point, and if this point is within a contour then all of the population assigned to the postcode are counted.

Due to the nature of the postcode database, similar contours may have different population counts when the geographical point representing a postcode lies just inside one contour and just outside another. When the population inside a contour is small, this can lead to large relative changes in assessed population despite the change in contour area and/or shape being small.

These population forecasts include growth at locations in close proximity to the shortlisted airports. However, in practice it is unlikely that the planning authority will permit any new dwellings in locations already subject to aircraft noise levels at or above the Significant Observed Adverse Effect Level (SOAEL) adopted by the local planning authority.