Gatwick Airport Submission to Airport Commission: Air Noise Assessment for 95mppa Case

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Gatwick Airport

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EXECUTIVE SUMMARY

The Aviation Policy Framework states the Government's aim '*to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise*'. This is reflected in the noise objective contained in the Airports Commission's (the Commission's) appraisal framework:

> *To minimise and where possible reduce noise impacts.*

The Commission recognises that the impact of air noise is a major factor in considering which runway option should be progressed to provide additional capacity to serve London. The way in which communities respond to aircraft noise is complex and varied, and the Commission's response to this is to introduce a noise 'Scorecard' which incorporates a number of different metrics, partly in recognition of the fact that people can be affected by noise even if they are outside the traditional L_{Aeq} 57dB noise contour. Gatwick Airport Ltd (GAL) supports this approach, and this report has been prepared as part of GAL's updated scheme design to provide the Commission with the information needed to carry out its appraisal.

The location of Gatwick Airport and the alignment of the existing runway mean that aircraft arrive and depart mostly over countryside with a low population density. As such, Gatwick currently affects relatively small numbers of people compared to other major airports, and does in fact affect far fewer people relative to the number of passengers moved than any other airport in the UK, and on this basis substantially (approximately 30 times) fewer than Heathrow.

This report provides information on the air noise impacts of GAL's second runway proposal as requested by the Commission, based on noise modelling carried out by ERCD, an independent centre of excellence in aircraft noise modelling.

The report updates the previous assessment that was provided as Appendix A7 of Gatwick's May 2014 Updated Scheme Design submission to the Commission. The previous assessment was based on a capacity of 87mppa in 2050. This study examines the air noise effects associated with a capacity of 95mppa in 2050.

As with the previous assessment the noise modelling is based on a series of cautious assumptions, omitting possible noise reductions through refined aircraft routings and operating procedures that could further reduce the numbers of people affected. It is, therefore, a conservative and robust assessment.

Importantly, and as before, the noise assessment compares the second runway case in 2040 with the base case single runway (do-minimum) situation in 2040 that would otherwise exist with only one runway. This approach is in line

with that required for transport schemes under the Government's Transport Appraisals Guidelines. It means that the noise reductions that will occur as older, noisier aircraft are replaced by new, quieter aircraft are included in the do-minimum case, and hence the comparison separates the impact of the new runway from the noise reductions that would happen in any case.

GAL notes that Heathrow has, so far, still failed to provide this form of comparison in its submissions to the Commission to date, nor in its public consultation and communication exercises, and has instead compared the future, new runway case with the present day case. This approach obscures the benefits that will accrue in any event as a result of the introduction of quieter aircraft over time.

The numbers of people affected by air noise with the second runway at Gatwick in 2040 compared to the do-minimum base case in 2040 is as follows:

- in terms of L_{Aeq} 57dB, there will be an increase of 12,000 people;
- in terms of L_{Aeq} 54dB, there will be an increase of 25,000 people;
- in terms of L_{Night} 48dB, there will be an increase of 20,000 people; and
- in terms of L_{DEN} 55dB, there will be an increase of 27,000 people.

These impacts are considerably smaller than those that would occur as a result of a third northern runway at Heathrow in 2030, on the basis of modelling carried out by ERCD in 2007.

GAL has a comprehensive noise management system in place and is currently exploring all reasonably practicable measures to reduce the impacts of a second runway further. For example, the capability of future precision navigational systems will be exploited to direct aircraft on routes optimised to minimise noise impacts on the ground. It is also recognised that the greatest impact will be to newly affected residential areas on the northern fringe of Crawley due to departures from the new runway. It may be possible to operate with a preference for departures from the existing runway at night when there are fewer flights.

The benefits of measures such as this have not yet been included in the noise assessment, and operational procedures of this kind will be developed as the scheme is progressed to further reduce air noise impacts.

GAL also recognises that, in order to deliver the benefits of the second runway, it is unavoidable that there will be communities negatively affected by noise and that these communities should be compensated. GAL's Noise Insulation Scheme was updated on 1 April 2014 and now covers over 2,000 homes. A Community Dividend scheme has been launched with the second runway proposal that will give annual compensation equivalent to Band 'A' Council Tax (currently £1,000) to all households within the two runway airport $L_{eq\ 16\ hr}$ 57dB noise contour.

Unavoidably, any new runway and the associated increase in air traffic movements will result in an increase in the number of people affected by air noise, compared with the do-minimum situation. However, it is clear that GAL's proposal will provide the required additional capacity whilst resulting in a relatively small increase in the number of people affected by air noise, even when compared with Gatwick's 'best in class' current noise performance. This is possible due to the favourable location of the airport in an area of low population density compared to other airports, and because GAL has a world class noise management system and an unprecedented noise compensation scheme.

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1 INTRODUCTION

1.1 SCOPE

> *The Airports Commission's spring 2013 Aviation Noise discussion paper generated a strong response, eliciting over 400 replies from airports, local councils, campaigners, members of the public, acoustic specialists and others. These responses have outlined the importance of measuring noise impacts accurately, and fairly evaluating its potential effects. (Ref 1)*

The Airports Commission's (the Commission's) appraisal framework sets out in detail the information it will be using to assess the options for additional runway capacity to serve London. It is accepted that the way in which communities respond to aircraft noise is complex and varied, and the Commission's response to this is to introduce a noise 'Scorecard' which incorporates a number of different metrics. Gatwick Airport Ltd (GAL) supports this approach, and this report has been prepared as part of GAL's updated scheme design to provide the Commission with the information required to complete its appraisal.

This report provides a full account of the expected noise impacts from a second runway at Gatwick in accordance with the Commission's appraisal framework, and the mitigation measures that are proposed to minimise and reduce them where possible.

In May GAL submitted an Air Noise report to the Commission based on noise modelling reflecting air traffic and passenger forecasts that assumed that with R2 Gatwick would grow to serve 78mppa in 2040 and 87mppa in 2050 with annual air transport movement of 467,768 and 512,705 respectively. Gatwick's case is that R2 could now serve some 83mppa in 2040 and 95mppa in 2050 with some 496,214 and 559,231 air transport movements. This report provides the results and analysis of the noise modelling for this updated case.

The May report anticipated that the greater air transport movements for the 95mppa case would increase noise levels by less than 0.5dB, and the changes to populations affected would be small. This report confirms this expectation and gives updated noise modelling results and populations affected for the 95mppa case.

1.2 STRUCTURE OF THIS REPORT

Following this introduction, this report comprises the following:

- *Chapter 2* outlines the background and noise policy framework, and provides details of Gatwick Airport's current noise impacts.

- *Chapter 3* provides the information requested in the appraisal framework, including noise exposure forecasts and health impacts.

- *Chapter 4* describes the mitigation measures proposed to minimise noise impacts.
- *Chapter 5* presents some concluding remarks.

A glossary of terms and references are also provided.

This report is one of a set of reports comprising GAL's updated scheme design. Information relevant to the noise assessment is provided in other reports and is not repeated here. This other information consists of the following:

- The London Traffic Forecast report provides details of the air traffic used to model noise.

- The Quality of Life report provides the background and detail of the health impacts of noise that are reported in *Chapter 3* of this report.

- The Economic Impact Assessment report provides information on the monetising of the health impacts reported in *Chapter 3* of this report.

- The Place report provides an assessment of the impact of aircraft noise on tranquillity in designated areas.

The updated noise modelling results presented in this report for the 95mppa case do not significantly change the noise assessments given in the Quality of Life, Economic Impact Assessment or Place reports issued in May 2014.

2 BACKGROUND AND POLICY FRAMEWORK

2.1 POLICY FRAMEWORK

The Aviation Policy Framework (APF) states the Government's aim '*to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise*'. This is very similar to the noise objective in the Commission's appraisal framework which is:

To minimise and where possible reduce noise impacts.

The Noise Policy Statement for England (NPSE) presents the Government's vision to '*promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development*'.

The NPSE forms a basis for the National Planning Policy Framework (NPPF) which sets out the following aims of planning policies and decisions relating to noise:

- '*avoid noise from (the new development) giving rise to significant adverse impacts on health and quality of life as a result of new development;*
- *mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions;*
- *recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established; and*
- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*'

Options for a new runway to serve London and the south east may result in impacts over a wide geographical area, and it is therefore important that any national impacts are considered. The Commission's appraisal framework refers to this as the 'net national impact'. A new runway will inevitably generate additional noise impacts on some communities (either in absolute terms or relative to the 'do nothing' or 'do minimum' situations). A new runway at either Gatwick or Heathrow has the *potential* to affect thousands of people, so minimising any additional impact to meet the APF objective '*to limit and where possible reduce the number of people in the UK significantly affected by aircraft noise*' is clearly an important consideration in the overall assessment process.

2.2 *NOISE EXPOSURE AT GATWICK*

The location of Gatwick Airport and the alignment of the main and emergency runways mean that aircraft arrive and depart mostly over countryside with a low population density. As such, Gatwick currently affects relatively small numbers of people compared to others major airports. *Figure 1* illustrates the current level of noise exposure from Gatwick in the form of the 2012 $L_{Aeq,\ 16\ hr}$ noise contours.

Table 2.1 indicates that, based on 2006 noise mapping, Gatwick ranks 7th in the UK in terms of the numbers of people it affects by aircraft noise, despite having the second highest number of passenger movements after Heathrow (with only Manchester coming close in terms of numbers of movements – all other airports have less than half the number of movements than Gatwick)).

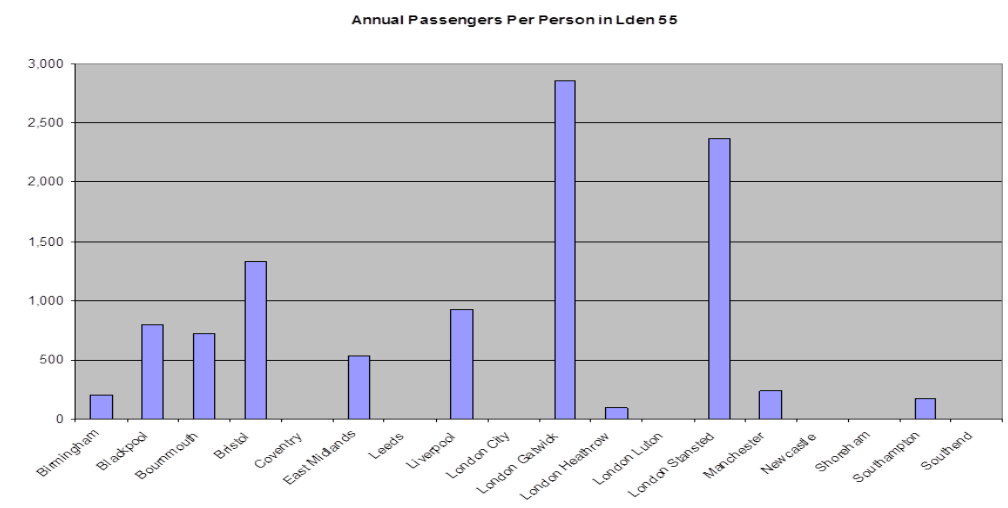
Table 2.1 Airport Population Ranking Using 2006 L_{DEN} Noise Mapping

	Airport	**Movements in 2006**	**Population exposed to Lden level**				
			<55	<60	<65	<70	<75
1	Heathrow	477,000	756,150	194,600	54,250	9,650	750
2	Manchester	230,000	92,950	30,650	3,950	700	50
3	Glasgow	110,000	56,750	11,650	400	<50	<50
4	Birmingham	119,000	48,400	15,300	2,200	<50	<50
5	London City	79,000	19,100	3,650	<50	<50	<50
6	Aberdeen	117,000	13,750	2,700	100	<50	<50
7	Gatwick	263,000	12,500	3,300	600	150	<50
8	Edinburgh	127,000	11,750	2,900	450	<50	<50
9	Southampton	56,000	11,550	1,850	100	<50	<50

ERCD Ref 2

Figure 2.1 illustrates the concept of an airport's 'Noise Efficiency'; the ratio of its annual passenger throughput to the population exposed to a noise level above L_{DEN} 55dB from its air traffic movements.

Figure 2.1 UK Airports 'Noise Efficiencies'



Based on 2006 data from draft Noise Action Plans.

An airport's Noise Efficiency is an indicator of how effective it is at moving passengers whilst minimising noise disturbance, and this metric is a valuable tool to identify the airport(s) which best meet Government's policy in this regard and which *may* therefore be best able to accommodate an additional runway whilst still meeting these objectives.

Based on this metric, in 2006 Gatwick was the most noise efficient and Heathrow was the worst, of the major UK airports in terms of delivering passengers movements per person affected by noise. Gatwick was 30 times more noise efficient than Heathrow. Only Stansted came close to Gatwick in terms of Noise Efficiency.

3 RESPONSE TO THE AIRPORTS COMMISSION FRAMEWORK

3.1 INTRODUCTION

This chapter responds to the Section 5 of the Commission's framework by providing Air Noise information as requested under a series of headings:

- Noise exposure forecasts – populations and areas;
- Noise levels at Noise Sensitive Buildings; and
- Health effects;

Under each of these headings the Commission's requirements are listed, our approach is summarised and the results are provided along with a discussion of their implications.

3.2 NOISE EXPOSURE FORECASTS

3.2.1 Airport Commission's Requirements

There are a number of noise metrics that can be used to estimate noise impacts. The Commission's framework requires noise modelling results to be presented as noise contours with corresponding areas of land and populations exposed to given noise levels using the following noise metrics:

- $L_{Aeq\ 16\ hr}$ 54, 57, 63, 66, 69, 72dB;
- L_{Night} 48, 51, 54, 57, 60, 63, 66, 69 and 72dB;
- L_{DEN} from 55dB;
- N70 day (no levels specified); and
- N60 night (no levels specified).

The following sections provide the required noise exposure information for a second runway at Gatwick as proposed by GAL. First the methodology and assumptions are summarised, followed by the 'local' assessment information and finally information on the 'net national impact' as requested by the Commission.

3.2.2 Methodology

The noise exposure information for Gatwick's proposal has been prepared by the Environmental Research and Consultancy Department of the Civil Aviation Authority (ERCD) using their Aircraft Noise Contour model (ANCON) v2.3 noise model. ANCON is an empirical model based on measurements of noise and flight tracks and flight profiles a particular airport. ERCD has collected relevant data from Gatwick over many years to test and refine the model. As GAL's subcontractor, the CAA's involvement was limited to aviation noise modelling, using the UK aircraft noise model (ANCON), of

airport scenarios and assumptions provided by GAL. The CAA provided no input into the development, and has neither supported nor opposed the appropriateness, of these scenarios and assumptions. This impartial approach has been consistently taken with all sponsors requesting noise modelling from the CAA of their proposals to the Airports Commission.

ERCD is a worldwide centre of excellent for aircraft noise modelling, acting independently of any commercial interests, hence the model used to calculate noise exposure around Gatwick is the most accurate available. Other models, such as the Integrated Noise Model (INM), are based on noise and flight performance data collected during aircraft certification in which aircraft fly fixed arrival and departure procedures. Whilst these models can be calibrated to a particular airport, they are unlikely to be as accurate as the empirical simulations of flight performance and noise exposure generated by the ANCON model. It is for this reason that the DfT publish ANCON modelling results for the designated London airports (Heathrow, Gatwick and Stansted) every year.

Forecast air traffic data has been supplied by ICF SH&E taking care to account for the different temporal averaging required, e.g. 92 day summer averages for $L_{eq,\,16\,hr}$, N60 and N70, and annual average day for L_{DEN} and L_{Night}. The forecasting of flights in the night period assumes that the number of flights remain limited to the current DfT Night Restrictions. The focus of the assessment is on the 2040 forecasts, with 2050 forecasts modelled with a lesser degree of certainty to provide an indication of noise levels further into the future. It is not considered reliable to rely on the modelling of local noise impacts beyond this further into the future.

As mentioned in the introduction, the modelling in this report updates that reported Appendix A7 of Gatwick's May 2014 Updated Scheme Design submission and is based on air traffic and passenger forecasts that assume that with R2 Gatwick would grow to serve 83mppa in 2040 and 95mppa in 2050 with some 496,214 and 559,231 air transport movements.

The noise impacts that are quantified in this report are based on Gatwick's Masterplan option for a new wide spaced runway to the south of the existing runway and with a new terminal between the runways. For aircraft to access the existing terminals from the proposed new runway aircraft would have to taxi across the existing runway. Gatwick's Masterplan submission also identifies a possible alternative solution which includes taxiways around the ends of the existing runway, which would reduce or eliminate the need for aircraft to cross the existing runway. Appendix 2 of this report summarises how the alternative option with end around taxiways would affect the results of this appraisal.

Runway modal splits have been based on long term seasonal averages:

- L_{DEN} and L_{Night} 10-year average modal split = 68% west / 32% east;
- Summer $L_{eq\,day}$ 20-year average modal split = 74% west / 26% east; and

- Summer day N70 and night N60 contours - 5-year summer night average modal split of 78% west / 22% east.

Terrain heights are modelled using Meridian 2 Gridded Heights data from Ordnance Survey.

The population database used is the 2013 update of the 2011 Census supplied by CACI Ltd. In addition, a major planned development has been included; the Crawley North East Sector development. This development of 1,900 homes (4,700 people) is to be located between the A23 and the London to Brighton Main line railway southeast of the airport. The planning permission for the scheme noted that noise from a future second runway at Gatwick would impact the site and included specific planning conditions to ensure that noise mitigation and noise insulation is provided to those parts of the site affected. The conditions refer directly to ERCD noise contours both in the past and future. The population of this development has been included in the analysis of population exposure in 2040 and 2050, despite the fact that the affected homes will have mitigation which will, at least in part, address the impact.

The 2040 base case single runway (do-minimum) model is based on mean departure/arrival tracks, spreads and flight profiles.

The 2040 and 2050 two runway model is based on the following assumptions:

- the approach slopes and thresholds of the existing runway are unchanged;
- nominal departure tracks as supplied by NATS based on standard airspace design practice and considerations;
- departure spreads based on similar routes in 2012;
- straight-in arrival routes;
- no changes to thresholds on existing runway;
- 2012 flight profiles of height, speed and thrust;
- arrivals split 50:50 between runways; and
- departures to south use new runway, departures to north use existing runway.

Reverse thrust on landings (referred to in the Commission's Framework) is included in the empirical ANCON database for the relevant aircraft types.

The two-runway noise modelling is cautious in several areas. The departure routes supplied by NATS were developed on the basis of reliability rather than noise control. It is almost certainly the case that with Precision Area Navigation (P-RNAV) routes can be developed that can be flown with greater precision and will further reduce noise exposure. The model also assumes the approach thresholds on the existing runways are unchanged and the approach glide slopes on both runways are 3 degrees. As discussed later in *Section 4.3.3*, these parameters can slightly reduce noise levels from arriving aircraft. The

Gatwick model effectively assumes 2012 air navigation technology in the future and is inherently cautious in its noise forecasts.

Another key aspect of modelling noise from airports in the future is not only the forecasting of the numbers and types of aircraft that will be operating, but also (because the majority of aircraft currently flying will be phased out by 2040) estimating the noise emission levels for each type of aircraft that will be built in the future and will come into service over time. ERCD is a worldwide centre of excellence in this field.

For each future aircraft type, an explicit 'surrogate' has been chosen; a similar aircraft type whose certificated noise levels are known. For a given future type, the noise model data for this surrogate aircraft are then adjusted based on the differences between the future type's predicted certification data and the surrogate aircraft's known data.

The assumptions relating to the noise characteristics of the future aircraft types presented in this assessment are based on the latest available data (ref 2). There are two categories of future aircraft:

- *Imminent* aircraft types incorporating Generation 1 technology with significant fuel burn and noise benefits. These have recently entered, or are currently offered for sale to, the market and include all-new aircraft as well as re-engined aircraft.

- *Future* aircraft types incorporating Generation 2 technology, which aim to achieve the noise goals set out in Flightpath 2050 (ref 3). These types are envisaged to eventually replace the Imminent Generation 1 aircraft.

For Imminent aircraft types the noise characteristics are well-defined. For Future types the assumptions are based on expected technological advances and underlying trends as well as the entry into service date of the Generation 2 aircraft type relative to Generation 1 predecessors. *Table 3.1* and *Table* 3.2 below identify the new types, and present the surrogate types and corresponding noise adjustments used to model them.

Table 3.1 Generation 1 Imminent Aircraft Types and Modelling Assumptions

Aircraft category	**Aircraft type**	**New ANCON model**	**ANCON model surrogate**	**Adjustment, dB**	
				Departure	**Arrival**
Airbus single-aisle	A319 NEO	EA319NEO	A319V	-2.6	-1.9
Airbus single-aisle	A320 NEO	EA320NEO	A320V	-2.6	-2.2
Airbus single-aisle	A321 NEO	EA321NEO	A321V	-2.7	-1.0
Airbus twin-aisle	A350-800	EA358	EA33	-4.1	0.1
Airbus twin-aisle	A350-900	EA359	EA33	-4.2	0.4

Aircraft category	Aircraft type	New ANCON model	ANCON model surrogate	Adjustment, dB	
Airbus twin-aisle	A350-1000	EA3510	EA33	-1.8	1.6
Airbus very large	A380-900	EA389	EA38	0.0	0.0
Boeing single-aisle	B737-700 MAX	B7377MAX	B736	-3.5	-1.0
Boeing single-aisle	B737-800 MAX	B7378MAX	B738	-3.9	-0.4
Boeing single-aisle	B737-900 MAX	B7379MAX	B738	-2.7	-0.1
Boeing twin-aisle	B787-8	B788	B763G	-4.3	-2.3
Boeing twin-aisle	B787-9	B789	B763G	-2.3	-1.1
Boeing twin-aisle	B787-10	B7810	B763G	-1.0	-0.3
Boeing very large	B747-8	B748	B744G	-4.65	-2.9
Generic regional jet	E170 NEO	ERJ170NEO	ERJ170	-6.5	-2.8
Generic regional jet	E190 NEO	ERJ190NEO	ERJ170	-4.6	-0.3

Table 3.2 Generation 2 Future Aircraft Types and Modelling Assumptions

Aircraft category	Aircraft type	New ANCON model	ANCON model surrogate	Adjustment, dB	
				Departure	Arrival
Airbus single-aisle	A319 NEO G2	EA319N2	EA319NEO	-0.7	-0.2
Airbus single-aisle	A320 NEO G2	EA320N2	EA320NEO	-0.7	-0.2
Airbus single-aisle	A321 NEO G2	EA321N2	EA321NEO	-0.7	-0.2
Airbus twin-aisle	A350-800 G2	EA358N2	EA358	-1.7	-0.4
Airbus twin-aisle	A350-900 G2	EA359N2	EA359	-2.1	-0.4
Airbus twin-aisle	A350-1000 G2	EA3510N2	EA3510	-2.0	-0.4
Airbus very large	A380-800 NEO G2	EA38NEO	EA38	-1.0	0.0
Airbus very large	A380-900 NEO G2	EA389NEO	EA389	-1.0	0.0
Boeing single-aisle	B737-700 MAX G2	B7377N2	B7377MAX	-0.7	-0.1
Boeing single-aisle	B737-800 MAX G2	B7378N2	B7378MAX	-0.6	-0.1
Boeing single-aisle	B737-900 MAX G2	B7379N2	B7379MAX	-0.6	-0.1
Boeing twin-aisle	B787-8 G2	B788N2	B788	-1.9	-0.4
Boeing twin-aisle	B787-9 G2	B789N2	B789	-2.2	-0.4
Boeing twin-aisle	B787-10 G2	B7810N2	B7810	-1.9	-0.4
Boeing very large	B747-8 G2	B748N2	B748	-2.3	-0.5
Generic regional jet	E170 NEO G2	ERJ170N2	ERJ170NEO	-1.4	-0.3
Generic regional jet	E190 NEO G2	ERJ190N2	ERJ190NEO	-1.4	-0.3

It can be seen that for most categories of aircraft significant noise reductions are envisaged; on average about 4dB reductions in departure noise and 1dB reduction in arrivals noise.

These noise level reductions result in significant reductions in noise contour areas and populations exposed to given noise levels. It is essential, therefore, that robust assumptions are made, and vital that they are taken into account in both new runway and the future base cases (i.e. the 2040 two runway and

single runway cases used herein), to allow the Commission to make a fair comparison between runway options. This point is considered in more detail in *Section 3.2.4* below. We would stress that the same consideration would need to be applied in the case of Heathrow to allow a like for like comparison.

3.2.3 Local Assessment Results

$L_{Aeq,\ 16\ hr}$

Table 3.3 and
Table 3.4 present the $L_{Aeq\ 16\ hr}$ noise contour areas and populations for the following cases:

- 2012 – actual fights on the single runway in summer 2012;
- 2040 base case – the do-minimum the single runway in 2040;
- 2040 R2 – second runway in 2040; and
- 2050 R2 – second runway in 2050.

The 2012 contours are available in ERCD report 1302 (ref 6). The forecast 2040 and 2050 contours are plotted in *Figures 2, 3* and *4*.

The impact of the second runway in 2040 can be seen as the difference between the 2040 second runway case and the 2040 base case (2040 R2- base case).

Table 3.3 $L_{Aeq\ 16\ hr}$ Noise Contour Areas (km^2)

Case	54dB	57dB	60dB	63dB	66dB	69dB	>72dB
2012 Base		41.2	23.4	12.8	6.9	3.6	2.0
2040 Base	64.1	35.5	19.6	10.2	5.2	2.7	1.5
2040 R2	121.7	66.5	37.8	19.3	9.6	4.9	2.8
2050 R2	126.7	68.2	37.9	18.8	9.0	4.6	2.6
2040 R2 - Base	57.6	31	18.2	9.1	4.4	2.2	1.3

Table 3.4 $L_{Aeq\ 16\ hr}$ Noise Contour Populations (1000s)

Case	54dB	57dB	60dB	63dB	66dB	69dB	>72dB
2012 Base		3.2	1.3	0.4	0.2	<0.1	0
2040 Base	7.7	3.1	1.0	0.3	0.1	0	0
2040 R2	32.2	15.4	6.2	1.4	0.1	<0.1	0
2050 R2	31.4	14.6	5.6	1.1	0.1	<0.1	0
2040 R2 - Base	24.5	12.3	5.2	1.1	0	0	0

Comparing the 2040 base case with the 2012 case, it can be seen that the increase in flights expected in this period is offset by the improvements in aircraft technology expected in that period. The 2040 air traffic forecasts

assume that about 85% of aircraft currently operating will be replaced with quieter types (as described above) by 2040.

The effect of the second runway in 2040 can be summarised as roughly doubling the size of the noise contours and increasing the population within the outermost 54dB contour by 24,500 people from 7,700 to 32,200. These 24,500 people are currently, and in the 2040 base case scenario, exposed to aircraft noise levels below 54dB, so they can be considered as 'newly exposed' to aircraft noise as a result of the second runway. This is illustrated in *Figure 5*.

The majority of the population affected are on the northern fringe of Crawley, including Ifield. It should be noted that the proposed North East Sector development accounts for 4,700 of the 24,500 total newly affected. The population exposure in the proposed North East Sector development in 2040 can be summarised as follows:

- > 54dB $L_{Aeq\ 16\ hr}$ 4,700 people;
- > 57dB $L_{Aeq\ 16\ hr}$ 4,300 people;
- > 60dB $L_{Aeq\ 16\ hr}$ 3,000 people; and
- > 63dB $L_{Aeq\ 16\ hr}$ 700 people.

This comprises approximately one fifth (19%) of the population newly exposed. As mentioned above, these new homes will be constructed with noise mitigation and populated by residents who are aware of the second runway proposals. It may be reasonable to assume that people choosing to move into a home (if they do all have that choice) known to be close to a new existing or planned runway would not do so if they were particularly sensitive to aircraft noise, so they may be less affected than a typical annoyance dose/response relationship would suggest.

There will also be smaller numbers of people newly affected in homes in the rural areas and outlying villages such as Rusper and Kingsfold to the West and Copthorne, Felcourt, Dormansland, Hever and possibly Chiddingstone to the East.

There are no areas where populations exposed to noise above this threshold in the 2040 base case are subsequently not exposed to noise above this level in the second runway case (so called 'winners'). This is the case for all the increases in noise exposure estimated for the Gatwick second runway. There is therefore no balancing or offsetting of 'winners' and 'losers' in arriving at exposure totals. Such offsetting could in any case be misleading because it would make the assumption that a reduction in aircraft noise is valued equally to an increase, whereas in practice this may not be the case because people habituate and make adjustments (e.g. noise insulation) to long term noise exposure.

The 2050 data is provided to give an indication of how the impacts might change beyond 2040 based on less certain air traffic forecasts. In this 10 year

period the proportion of aircraft replaced by newer quieter types is expected to continue to rise from 85% to about 90% and this is expected to roughly offset the increase in flights in this period, so that in 2050 the population affected is similar to that in 2040. In some of the outer contours from 2040 to 2050 the population decreases slightly despite the contour area increasing. This is because the newer aircraft that increase the contour areas have slightly narrower but longer noise footprints because they are quieter on departure than older types, but less quiet on arrival. Thus the contours grow longer but slightly thinner and affect slightly lower populations on the northern fringe of Crawley.

Appendix 2 of this report summarises how the alternative option with end around taxiways would affect the results of this appraisal. It is concluded that the change in noise impacts due to the addition of end around taxiways would be insignificant.

L_{Night}

Table 3.5 and *Table 3.6* give the L_{Night} noise contour areas and populations. The contours are plotted in *Figures 6, 7* and *8*.

Table 3.5 L_{Night} Noise Contour Areas (km^2)

Case	45dB	48dB	51dB	54dB	57dB	60dB	63dB	66dB	69dB	72dB
2040 Base	88.9	50.4	28.2	15.2	7.7	3.8	2.0	1.2	0.7	0.4
2040 R2	195.7	108.4	60.3	34.6	16.6	7.9	4.1	2.3	1.4	0.9
2050 R2	222.1	124.8	67.8	37.9	18.1	8.2	4.2	2.4	1.5	0.9
2040 R2 - Base	106.8	58.0	32.1	19.4	8.9	4.1	2.1	1.1	0.7	0.5

Table 3.6 L_{Night} Noise Contour Populations (1000s)

Case	45dB	48dB	51dB	54dB	57dB	60dB	63dB	66dB	69dB	72dB
2040 Base	10.9	5.6	2.2	0.7	0.2	0.1	0	0	0	0
2040 R2	49.3	26.0	11.7	4.9	0.9	0.1	0	0	0	0
2050 R2	68.0	28.1	13.5	5.1	1.1	0.1	0	0	0	0
2040 R2 - Base	38.4	20.4	9.5	4.2	0.7	0	0	0	0	0

The Commission's appraisal framework required noise exposure data to be reported for L_{Night} from 48 to 72dB. The effect of the second runway in 2040 can be summarised as roughly doubling the size of the noise contours and increasing the population within the 48dB contour by 20,000 people from 5,600 to 26,000. The data for the L_{Night} 45dB contour is provided because it is required by the Commission's appraisal framework to assess sleep disturbance.

The 2050 data is provided to give an indication of how the impacts might change beyond 2040 based on less certain air traffic forecasts. In this 10 year period the contours are expected to grow by about 10% with increases in populations affected of 8 to 22%.

L_{DEN}

Table 3.7 and
Table 3.8 give the L_{DEN} noise contour areas and populations. The contours are plotted in *Figures 9, 10, 11* and *12.*

Table 3.7 L_{DEN} Noise Contour Areas (km^2)

Case	55dB	60dB	65dB	70dB	75dB
2011 Base (Ref 7)	85.7	31.9	11.9	4.1	1.5
2040 Base	75.7	28.4	9.8	3.1	1.2
2040 R2	154.3	56.6	19.8	5.9	2.3
2050 R2	173.6	62.3	21.4	6.1	2.3
2040 R2 - Base	78.6	28.2	10.0	2.8	1.1

Table 3.8 L_{DEN} Noise Contour Populations (1000s)

Case	55dB	60dB	65dB	70dB	75dB
2011 Base (Ref 7)	11.3	4.5	0.5	0.1	0
2040 Base	9.5	1.7	0.3	0.1	0
2040 R2	36.9	10.3	1.7	0.1	0
2050 R2	39.6	12.6	1.9	1.1	0
2040 R2 - Base	27.4	8.6	1.4	0	0

Comparing the 2040 base case with the 2011 case, it can be seen that the increase in flights expected in this period is offset by the improvements in aircraft technology expected in that period.

The effect of the second runway in 2040 can be summarised as roughly doubling the size of the noise contours and increasing the population within the outermost L_{DEN} 55dB contour by 27,400 people from 9,500 to 36,900. The locations affected are similar to those described above for $L_{eq,\ 16\ hr}$.

The 2050 data is provided to give an indication of how the impacts might change beyond 2040 based on less certain air traffic forecasts. In this 10 year period the contour are expected to grow by about 10% with increases in populations of 7 to 22%.

N70

Table 3.9 and *Table* 3.10 give the N70 day noise contour areas and populations. The forecast 2040 and 2050 contours are plotted in *Figures 13, 14* and *15.* The values of N70 plotted (20, 50, 100, 200, and 500) are the number of noise events exceeding L_{max} 70dB in an average summer day. This metric is a further measure of noise impact, requested by the Commission. The metric does not account for the duration of noise events, so it cannot provide a complete picture of noise impact.

The impact of the second runway in 2040 can be seen as the difference between the 2040 second runway case and the 2040 do-minimum (2040 R2-Do-minimum).

Table 3.9 N70 Noise Contour Areas (km²)

Case	20 events	50 events	100 events	200 events	500 events
2040 Base	45.1	31.8	20.0	13.1	1.8
2040 R2	81.4	57.7	38.3	24.6	2.4
2050 R2	73.9	53.5	35.3	23.9	2.5
2040 R2 - Base	36.3	25.9	18.3	11.5	0.6

Table 3.10 N70 Noise Contour Populations (1000s)

Case	20 events	50 events	100 events	200 events	500 events
2040 Base	4.7	3.0	1.1	0.4	0
2040 R2	21.4	11.3	5.0	2.0	0
2050 R2	16.3	10.7	4.4	1.7	0
2040 R2 - Base	16.7	8.3	3.9	1.6	0

There are no people living in locations that experience more than 500 events above L_{max} 70 in any of the forecast years.

The number of people living in locations that would experience more than 200 events with a second runway is 2,000 in 2040 compared to 400 in the base case single runway in 2040.

The effect of the second runway in 2040, compared to the base case single runway in 2040, would increase the area of land within which people would hear between 20 and 200 events by 80-90%. In terms of people exposed to noise, the greatest increase is in that group of people who would experience up to 20 events, where the numbers of people would increase from 4,700 to 21,400 people.

The 2050 data is provided to give an indication of how the impacts might change beyond 2040 based on less certain air traffic forecasts. In this 10 year

period the proportion of aircraft replaced by newer quieter types is expected to continue to rise from 85% to about 90% and this will reduce the number of events that above L_{max} 70dB even though the numbers of flights would increase by about 10%. The N70 contours shrink slightly between 2040 and 2050. This trend is different to that arising from the L_{eq}-based sound energy metrics because those metric are indictors of total sound energy which continues to rise as aircraft are added, even if they are relatively quiet newer types.

N60

Table 3.11 and *Table* 3.12 give the N60 night noise contour areas and populations. The 2012 contours are available in ERCD report 1302. The forecast 2040 and 2050 contours are plotted in *Figures 16, 17* and *18.* The values of N60 plotted (25, 50, and 100) are the number of noise events exceeding L_{max} 60dB in an average summer night. Like N70 this metric does not account for the duration of noise events, so it cannot provide a complete picture of noise impact.

The impact of the second runway in 2040 can be seen as the difference between the 2040 second runway case and the 2040 single runway base case.

Table 3.11 N60 Night Noise Contour Areas (km²)

Case	25 events	50 events	100 events
2040 Base	49.7	3.8	-
2040 R2	98.5	33.2	1.4
2050 R2	104.6	39.8	1.8
2040 R2 - Base	48.8	29.4	1.4

Table 3.12 N60 Night Noise Contour Populations (1000s)

Case	25 events	50 events	100 events
2040 Base Case	5.8	0	0
2040 R2	21.3	2.5	0
2050 R2	25.8	4.4	1.7
2040 R2 - Base Case	15.5	2.5	0

The number of people living in locations that would experience more than 50 events at night with a second runway is 2,500 in 2040 and 4,400 in 2050.

The effect of the second runway in 2040, compared to the base case single runway in 2040, would, assuming an equal spread of movements across both runways, increase the areas of land within which people would hear 25 events above L_{max} 60dB by nearly 100%. In terms of people exposed to noise, the greatest increase is in that group of people who would experience 25

events, where the numbers of people would increase from 5,800 to 21,300 people.

The 2050 data is provided to give an indication of how the impacts might change beyond 2040 based on less certain air traffic forecasts. In this 10 year period the largest N60 contour for population exposure, the 25 events contour, is forecast to grow in area by about 6% and to increase in population exposure by 21%.

3.2.4 Assessment of Net National Impact

In paragraph 5.7 of the appraisal framework the Commission states:

> *Noise emissions will be assessed based on the net national impact of each scheme (i.e. considering the net change in the number of people affected by stated thresholds of noise).*

In making a choice as to where a new runway is located, the Commission has the opportunity to choose the option that has the least noise impact to the nation as a whole. Such a strategic decision would be directly in line with the Noise Policy Statement for England, as described above.

In the sections above we provide the noise exposure information for Gatwick based on ERCD modelling. We understand the Commission will be instructing ERCD to carry out equivalent modelling for the Heathrow options.

In the section above we have laid out the key assumptions made in the Gatwick modelling. It will be essential that equivalent assumptions are made for the Heathrow modelling to ensure that comparable results are obtained (e.g. fleet mix as it affects assumed noise emission reductions in the future).

At this stage Heathrow has not published any noise contours that provide the noise exposure information required. Heathrow has, however, made the following claim:

> *Even with a third runway, there will be 10-20% fewer people affected by air noise in 2030 than there are today* (ref 4).

This claim is misleading because it draws a comparison between a situation in 2030 with a situation now (in 2014). Without a third runway, but even with further growth of operations on the existing two runways, Heathrow will become quieter over the next 16 years, as will Gatwick with a single runway. The reason for this is largely due to the ongoing transition to quieter aircraft types.

Although we do not have access to reports on HAL's recent noise modelling, to consider HAL's claim quantitatively we can look at official ANCON modelling carried out by ERCD in 2007 (ref 5). In 2007, BAA was looking at future noise exposure in the context of complying with the Terminal 5

imposed 57dBA noise contour cap of 127 km² stated as a condition of a runway in the 2003 Future of Air Transport White Paper. They asked ERCD to model a third northerly runway in mixed mode (the option then being considered pursuant to the 2003 Future of Air Transport White Paper). The study looked carefully at future types of aircraft that would come into service.

Appendix 1 provides an analysis of the results of the ERCD study, and demonstrates that in fact the real effect of the third runway at Heathrow in 2030 compared to the do-nothing in 2030 would be an increase of 58,000 people, or 40% within the 57dB contour. That study was based on the short northern runway option that was being considered at the time. Our expectation is that the full length NW runway option now being promoted by Heathrow, with a throughput of 740,000 ATMs, and despite being staggered slightly further to the west, could lead to a greater increase in the number of people affected.

HAL will be producing noise modelling, and we trust that ERCD will be adding rigor to the Commissions assessment. However, in the meantime, the result of this ERCD study can allow an approximate comparison to be made between the noise exposure impact of a second runway at Gatwick with a third runway at Heathrow.

For Gatwick, ERCD modelling estimates 15,400 people would be within the 57dB contour with a wide separation second runway operating in full independent mixed mode in 2040 compared to about 3,100 for a single runway in the same year. So, the effect of a second runway at Gatwick in 2040 compared to the do-minimum in 2040 would be around an additional 12,300 people within that contour. Whilst not directly comparable, because of the difference in the assessment years, it is quite clear that the Gatwick proposal would affect several times fewer people than the Heathrow proposal. The Gatwick proposal therefore minimises the net national impact to a significantly greater extent than the Heathrow proposal.

3.3 NOISE SENSITIVE BUILDINGS

3.3.1 Airports Commission Requirements

In paragraph 5.26 of the appraisal framework the Commission requires consideration of the following:

- The absolute change in the number of amenities exposed to different noise levels (e.g. schools, hospitals, community centres, places of worship, etc.)

3.3.2 Methodology

Figure 19 shows the schools, hospitals and places of worship in the second runway 2040 $L_{Aeq\ 16hr}$ noise contours. There are only two hospitals. Since these

other noise sensitive buildings are largely unoccupied in night hours, exposure to night noise is not reported here. Based on 2013 InterestMap data the following schools, hospitals, community centres and places of worship were identified.

Schools	**Postcode**
Rusper Primary School	RH12 4PR
Hever Church of England Voluntary Aided Primary School	TN8 7NH
Fairway Infant School Copthorne	RH10 3QD
Lingfield Primary School	RH7 6HA
Langley Green Primary	RH11 7TF
Dormansland Primary School	RH7 6PE
Charlwood Village Infant School	RH6 0DA
Our Lady Queen of Heaven Catholic Primary School Crawley	RH11 7PZ
Copthorne C of E Junior School	RH10 3RD
Lingfield Notre Dame	RH7 6PH
Redehall Preparatory School	RH6 9QA
Copthorne Preparatory School	RH10 3HR
St Piers School (Young Epilepsy)	RH7 6PW
The Stables Nursery School	RH19 2LF
Marsh Green Pre-school	TN8 5QR
Charlwood Pre-school	RH6 0DA
Willow Tree Pre-school	RH11 7PF
Dormansland Village Pre School	RH7 6RA
Peter Bunny Nursery School	RH10 3EX
Donnybrook Nursery School	RH12 4QU
Ifield Community Centre	RH11 0HD
Our Lady Queen of Heaven Playgroup	RH11 7RZ
Gateways Playgroup	RH11 7RX
Chiddingstone Nursery School	TN8 7AD
The Coach House Nursery	RH10 3HR
Peter Pan Playgroup	RH10 3RE
The Little House Montessori	RH6 9RG
Jack and Jill Pre School	RH10 3QX
Rusper Playgroup	RH12 4QT
Stables Nursery School	RH7 6PW
Langley Lane Playgroup	RH11 0NB
Hospitals	**Postcode**
Weald Day Hospital - Adult Psychiatry	RH11 7EJ
Edenbridge & District War Memorial Hospital	TN8 5DA
Place of worship	**Postcode**
St John the Evangelist's C of E Church	RH7 6QU
St Mary Magdelene Church	RH12 4PX
Dormansland Baptist Church	RH7 6PU

St John the Evangelist's C of E Church	RH10 3RD
St Nicholas' C of E Church	RH6 0EE
Gulzar-e-Habib Islamic Centre	RH10
St Peter's C of E Church	TN8
Chaplaincy	RH6
Church of St Leonard	RH11
Mosque & Islamic Cultural Centre	RH10 9TA
Chapel (Private)	RH10
St Peter and St Paul's Church	RH7
Chapel (Private)	RH7
Providence Chapel	RH6
Friends Meeting House	RH11
Kingdom Hall	TN8
Copthorne Chapel	RH10
St Bernard's Church	RH7
St John's Church	TN8
Community Centres	**Postcode**
Parish Room	TN8
The Faraday Centre	RH10
Community Centre	RH11
Parish Room	RH7
The Lingfield & Dormansland Community Centre	RH7 6AB
Gurjar Hindu Union	RH11 0AF

Sensitive buildings within the R2 land take boundary are excluded.

3.3.3 Results

Table 3.13 and
Table 3.14 give the numbers of schools, hospitals, community centres, and places of worship within the $L_{Aeq\ 16hr}$ 54 and 57dB noise contours.

Table 3.13 Noise Sensitive Buildings within $L_{Aeq\ 16\ hr}$ 54dB Contours

Case	Schools	Hospitals	Places of Worship	Community Centres
2040 Base	10	0	10	1
2040 R2	33	1	20	8
2050 R2	29	2	20	8
2040 R2 – Base	23	1	10	7

Table 3.14 Noise Sensitive Buildings within $L_{Aeq\ 16\ hr}$ 57dB Contours

Case	Schools	Hospitals	Places of Worship	Community Centres
2040 Base Case	3	0	2	1
2040 R2	10	0	5	2
2050 R2	10	0	7	2
2040 R2 – Base	7	0	3	0

There is only one hospital, the Weald Day Hospital, within the 2040 $L_{Aeq\ 16\ hr}$ 54dB contour, predicted to be exposed to aircraft noise at about 55dB. The hospital buildings are within approximately 100-200m of the A23 main road in Crawley. It is likely that ambient noise levels in the area are relatively high and the increase in aircraft noise would have little impact on the hospital. Edenbridge & District War Memorial Hospital comes just inside the $L_{Aeq\ 16\ hr}$ 54dB contour in 2050.

There are 20 places of worship identified within the $L_{Aeq\ 16\ hr}$ 54dB contour compared to none in the 2040 base case. As with the Weald Day Hospital some of these are located in already noisy areas where additional aircraft noise may have little impact. There are also some, such as the two churches in Copthorne and the church in Rusper, which may currently enjoy low noise levels that will be increased significantly.

There are 33 schools identified within the $L_{Aeq\ 16\ hr}$ 54dB contours compared to 10 in the 2040 base case. These 33 comprise 9 primary schools, 18 nurseries and 6 other schools. Some of these are located in already noisy areas where additional aircraft noise may have little impact. There are also some, such as 3 in or near Rusper and several others, that may currently enjoy low noise levels that will be increased significantly. There is a school proposed in the North East Sector development which could experience noise levels above $L_{Aeq\ 16\ hr}$ 60dB, but it has been granted planning permission with specific conditions relating to its design to mitigate aircraft noise.

The noise changes at schools and its effects are discussed further in the following section.

There are 8 Community Centres identified within the $L_{Aeq\ 16\ hr}$ 54dB contours compared to 1 in the 2040 base case. Whilst this may be indicative of the potential for some form of noise effects, these centres are of varying uses, in varying ambient noise conditions, and many of them will not be sensitive to aircraft noise.

3.4 HEATH EFFECTS

3.4.1 Airports Commission's Requirements

The Airports Commission's appraisal framework requires the following health impacts to be quantified and then monetised:

- Annoyance;
- Sleep disturbance; and
- Acute Myocardinal Infarction (AMI), and hypertensive strokes and dementia.

We also consider that impacts on cognitive performance affecting learning in schools should be quantified and appraised as an important consideration.

3.4.2 Methodology

Overview

The methodology used to estimate the changes in annoyance, sleep disturbance, AMI, and hypertension are as required in the Commission's appraisal framework. Further explanation of the effects is provided in the health impacts assessment in the Quality of Life report..

The key assumptions made in applying these methods, and the method used to assess effects on children's leaning in schools, are outlined below.
It is recognised that the populations living in the area will increase in the future, but with the exception of the Crawley NE Sector that has been included in the do-minimum 2040 population, it has not been possible to account for other potential changes in the future populations within the various noise exposure bands.

Annoyance

Annoyance has been estimated using guidance given in the WHO Burden of disease from environmental noise report, 2011 (ref 9). This supports the noise/annoyance dose response relationship from the EU Position Paper 2002 (ref 10) for noise levels that cover the range L_{DEN} 45 to 75dB. This is an annoyance response relationship specific to aircraft noise, and is a stronger relationship than for road or railway noise. The WHO report notes there is evidence to suggest that population response to aircraft noise has changed so that the dose response curves probably underestimate annoyance.

Noise exposure data are not available for noise levels below L_{DEN} 55 dB. Under EC Directive 2002/49 (ref 11), this is the lowest noise level above which Member States are required to report population exposure to aircraft noise. Whilst there may be some annoyance response at lower levels it is also likely that in many locations, such as in northern Crawley, ambient noise levels will be above the 45dB level above which a dose/response relationship is

provided. In these locations the additional annoyance response from aircraft would be reduced.

Sleep Disturbance

The degree of sleep disturbance has been estimated using guidance given in the WHO Burden of disease from environmental noise report, 2011 (ref 9) as specified in the appraisal framework. This gives a dose/response relationship between the percentage of people Highly Sleep Disturbed (HSD) and L_{Night}. Noise levels above L_{Night} 45dB have been used. The dose response curve is based on self-reported sleep disturbance and may not accurately reflect the effects of sleep loss because people's perception of sleep loss tends not to be particularly accurate.

Acute Myocardial Infarction

The likely number of acute myocardial infarctions (AMI, heart attacks) due to the increase in aircraft noise exposure has been calculated using the method laid out in ERCD report 1209 (ref 8) as specified in the Commission's appraisal framework. The method draws on research from Babisch and research reported by the World Health Organisation (WHO) and gives a dose/response function as an odds-ratio (OR) for AMI from $L_{Aeq\ 16\ hr}$ 55.5 to 67.5dB. This OR is then multiplied by a generic AMI risk of 0.059% per year for the affected population (in 3dB noise exposure level bands) to predict AMIs per year as a result of the additional noise from the second runway.

Hypertension

The likely increase in hypertensive strokes and dementia due to the increase in aircraft noise exposure has been calculated using the method laid out in ERCD report 1209 (ref 8) as specified in the Commission's appraisal framework. Reference was also made to further research on quantifying the links between noise and related hypertension health effects referred to therein (ref 12).

The ERCD report gives a general odds-ratio for hypertension as a function of L_{Night} above a threshold of 50dB. It also gives a threshold of L_{DEN} 55dB for such effects and gives separate equations for hypertensive strokes and hypertensive dementia as a function of noise level above this base threshold. The ERCD report gives a dose/response for each effect for a generic sex/age population that is considered a reasonable approximation in this case. The effects have been calculated for the populations in the range L_{DEN} 55 to 75 dB to predict the additional cases of strokes and hypertensive dementia as a result of the additional noise from the second runway. Additional cases of each effect that could arise in people already suffering from hypertension are mentioned in reference 12, but not required in the ERCD report, so have not been included.

Learning in Schools

The Commission's appraisal framework does not provide a method for assessing this effect. This aspect of aircraft noise and health has been the subject of extensive research. The hypothesis is that the noise event caused by an aircraft passing over a school is sufficient to cause a distraction and thereby disrupt the learning process. Several notable studies have investigated this aspect of aircraft noise, including the switching of airport location at Munich (1998), the West London Schools Study (2000) and the Schools Environment and Health study around Heathrow airport (2001).

Perhaps the largest and most influential is the RANCH project (ref 13), which examined the performance of primary age schoolchildren around three airports (Heathrow, Madrid and Schipol). This cross sectional study enrolled a total of 2844 pupils aged 9 to 10 years at 89 schools, some of which were exposed to aircraft noise and some of which were in 'control' schools away from the airports. The key result was a clear linear association between reading comprehension and exposure to aircraft noise. A similar effect was not observed for exposure to road noise, suggesting that a constant source of noise has a lesser or no impact on cognitive performance.

The outcome of the RANCH study, supported by the previous studies, indicates that the effects of aircraft noise could be quite important for children's learning, which in turn is important as a long term determinant of health. It is not yet known if the observed effects are permanent or can be reversed at a later stage in education. A follow up study was carried out of the London schoolchildren involved in RANCH, aged 15-16 years. The results of this study are inconclusive with regard to reading comprehension; no association with exposure to aircraft noise was found. The authors believe this to be a function of the relatively small sample size compared with original cohort used.

To apply this research directly to the second runway proposal requires an assumption that the difference in noise levels indicated by the comparison of the 'with development', and 'without development' scenarios is brought about over a much shorter time period than would actually be the case. This assumption implies that the effects on reading age are likely to be worst case.

The key output from the RANCH study shows an influence on reading score over the range 40 dB to 70 dB L_{eq}. At noise levels below 50 dB L_{eq} it is difficult, in practice, to distinguish accurately aircraft noise from background noise. In addition, at noise levels approaching 40 dB L_{eq} the uncertainty in the aircraft noise model predictions increases. It is not possible, therefore, to apply this methodology for schools experiencing an exposure of L_{eq} 50 dB or less without introducing major uncertainties in the results. Only schools, therefore, which are exposed to air noise levels of 50 dB or more are included in the assessment. Schools where the change in noise exposure is less than 2 dB are discounted from the assessment.

3.4.3 Results

Annoyance

Table 3.15 summarises the calculation of annoyance due to aircraft noise for the second runway in 2040 versus the do-minimum in 2040.

Table 3.15 Increase in Noise Annoyance by L_{DEN} Contour Band

Case	**L_{DEN} Contour Band**				
	55-60	**60-65**	**65-70**	**70-75**	**>75**
% Highly Annoyed	13.7	21.8	31.5	42.9	NA
2040 Base Case Single Runway population	7,800	1,400	200	100	0
2040 R2 population	26,600	8,600	1,600	100	0
2040 Base Case population annoyed	1,065	305	63	43	0
2040 R2 population annoyed	3,633	1,871	505	43	0
2040 Change in population annoyed	2,568	1,566	422	0	0
Total					**4,576**

The analysis indicates that the second runway would create an increase in the population highly annoyed by aircraft noise of approximately 4,600 people.

Sleep Disturbance

Table 3.16 summarises the calculation of population Highly Sleep Disturbed due to aircraft noise for the second runway in 2040 versus the do-minimum in 2040.

Table 3.16 Increase in Highly Sleep Disturbed by L_{Night} Contour Band

Case	**L_{Night} Contour Band**					
	45-48	**48-51**	**51-54**	**54-57**	**57-60**	**60-63**
% Highly Sleep Disturbed (HSD)	6%	7%	9%	11%	13%	15%
2040 Base case population	5,300	3,400	1,500	500	100	100
2040 R2 population	23,300	14,300	6,800	4,000	800	100
2040 Base case population HSD	304	243	132	54	13	15
2040 R2 population HSD	1,337	1,021	599	430	104	15
2040 Change in population HSD	1,033	778	467	376	91	0
Total						**2,744**

The analysis indicates that the second runway would create an increase in the population Highly Sleep Disturbed of approximately 2,700 people.

Acute Myocardial Infarction

Table 3.17 summarises the calculation of annual AMIs due to aircraft noise for the second runway in 2040 versus the do-minimum in 2040.

Table 3.17 Increase in Acute Myocardial Infarction by L_{Aeq} Contour Band

Case	L_{Aeq} Contour Band				
	54-57	**57-60**	**60-63**	**63-66**	**66-69**
AMI Odds-ratio	1.00	1.01	1.02	1.05	1.10
2040 Base case population	4,600	2,100	700	200	100
2040 R2 population	16,800	9,200	4,800	1,300	100
2040 Base case AMIs	0	0	0	0	0
2040 R2 population AMIs	0	0	0.1	0	0
2040 Change in AMIs	0	0	0.1	0	0
Total					**0.1**

The analysis indicates that the second runway would create an increase in the annual number of AMIs due to aircraft noise of approximately 0.1.

Hypertension

Table 3.18 summarises the calculation of hypertensive strokes due to aircraft in for the second runway in 2040 versus the do-minimum in 2040.

Table 3.18 Increase in Hypertensive Strokes by L_{DEN} Contour Band

Case	L_{DEN} Contour Band				
	55-60	**60-65**	**65-70**	**70-75**	**>75**
2040 Base Case Single Runway population	7,800	1,400	200	100	0
2040 R2 population	26,600	8,600	1,600	100	0
2040 Base Case hypertensive strokes	0.105	0.057	0.014	0.010	0
2040 R2 hypertensive strokes	0.359	0.352	0.110	0.010	0
2040 Change in hypertensive strokes	0.254	0.295	0.097	0	0
Total					**0.645**

The analysis indicates that the second runway would create an increase in the annual number of hypertensive strokes due to aircraft noise of approximately 0.6.

Table 3.19 summarises the calculation of hypertensive dementia due to aircraft in for the second runway in 2040 versus the do-minimum in 2040.

Table 3.19 Increase in Hypertensive Dementia by L_{DEN} Contour Band

Case	L_{DEN} Contour Band				
	55-60	**60-65**	**65-70**	**70-75**	**>75**
2040 Base Case Single Runway population	7,800	1,400	200	100	0
2040 R2 population	26,600	8,600	1,600	100	0
2040 Base Case hypertensive strokes	0.158	0.086	0.021	0.015	0
2040 R2 hypertensive strokes	0.537	0.526	0.165	0.015	0
2040 Change in hypertensive strokes	0.380	0.440	0.144	0	0
Total					**0.964**

The analysis indicates that the second runway would create an increase in the number of people with hypertensive dementia due to aircraft noise of approximately 1.

The additional effects on health from hypertension and from aircraft noise more generally are small because a second runway would increase noise exposure in low noise level exposure bands where the dose/response relationship is weak. The health effects of noise become more prevalent at much higher noise levels, such as those that are experienced by residents living close to main roads.

Cognitive Learning in Schools

There are 20 schools where predicted noise levels in 2040 with a second runway are expected to be above $L_{eq\ 16\ hr}$ 50dB and where noise levels are expected to increase above 50dB by at least 5dB. *Table 3.20* lists these schools with the associated noise change above the 50dB threshold used to assess the potential impact of learning lost implied from the RANCH study result.

Table 3.20 $L_{eq\ 16\ hr}$ Noise Changes at Schools

School	2040 Base Case	R2 2040	Change	Change above 50dB
Copthorne C of E Junior School	47.1	57.6	10.5	7.6
Dormansland Primary School	48.8	55.3	6.5	5.3
Fairway Infant School Copthorne	45.7	56.0	10.3	6.0
Langley Green Primary	47.9	54.2	6.3	4.2
Our Lady Queen of Heaven Catholic Primary School Crawley	48.3	55.6	7.2	5.6
Rusper Primary School	51.5	57.7	6.2	6.2
Copthorne Preparatory School	45.3	55.7	10.3	5.7
Donnybrook Nursery School	45.2	56.1	10.9	6.1
Dormansland Village Pre School	48.9	55.5	6.6	5.5
Gateways Playgroup	48.3	54.7	6.4	4.7
Ifield Community Centre	47.2	54.7	7.5	4.7
Jack and Jill Pre School	47.9	58.4	10.5	8.4
Langley Lane Playgroup	49.8	59.0	9.2	9.0
Our Lady Queen of Heaven Playgroup	48.3	54.6	6.3	4.6

School	2040 Base Case	R2 2040	Change	Change above 50dB
Peter Bunny Nursery School	46.7	56.0	9.3	6.0
Peter Pan Playgroup	47.8	58.2	10.4	8.2
Rusper Playgroup	48.3	54.6	6.3	4.6
The Coach House Nursery	45.3	55.7	10.4	5.7
The Stables Nursery School	52.3	58.2	5.9	5.9
Willow Tree Pre-school	47.9	54.3	6.4	4.3

There are 14 schools where the predicted noise increase would be sufficient (more than 5dB) to imply at least 2 months of lost learning. These comprise one junior school, 3 Primary schools, 1 infant school, 1 pre-school and 8 pre-schools/nursery/playgroups. Whether or not these schools are all sensitive to noise, for example nurseries and those on noisy roads may not be, should be considered in future studies.

4 MEASURES TO MINIMISE NOISE IMPACTS

4.1 INTRODUCTION

Gatwick Airport has a detailed noise strategy and a comprehensive approach to aircraft noise management. This is supported by a Section 106 Legal Agreement with West Sussex County Council and Crawley Borough Council which forms the foundations of the airport's Noise Action Plan (ref 14). As such, there are a large number of noise mitigation measures that are embedded in the airports operations now and will be in the future. To use Environmental Impact Assessment terminology these can be considered to be '*embedded mitigation*'.

Embedded mitigation will reduce the impact of noise from a second runway at Gatwick, and so is of interest to the Commission's noise objective to minimise and where possible reduce noise impacts. Accordingly, a summary of these measures is provided below. However, embedded mitigation will be in place with or without a second runway, so the do-minimum single runway base case in the future will have a reduced impact in any case. So of particular interest to the Commission will be additional mitigation that the airport commits to so as to specifically address impacts of the second runway. In this section a distinction is therefore drawn between *embedded mitigation* and *additional mitigation*.

4.2 EMBEDDED MITIGATION

Section 6 of the Gatwick Airport Noise Action Plan (NAP, see ref 14) provides a detailed description of the statutory and voluntary noise management controls already in place. In headline terms the measures include the following:

- noise and track keeping monitoring arrangements;
- operating restrictions;
- runway use;
- night flight restrictions;
- operational procedures;
- departure procedures;
- noise preferential routes;
- 1000ft rule;
- arrival procedures;
- continuous descent approach (CDA);
- joining point rules;
- reverse thrust;
- noise limits;
- departures;
- ground noise controls;

- differential landing fees;
- noise mitigation and compensation schemes; and
- stakeholder engagement.

Alongside the statutory noise objectives, Gatwick Airport has set the following long term objective for the management of aircraft noise:

> *'To gain the trust of our stakeholders that we are using best practicable means to minimise aircraft noise impacts'*

In practice this has meant that in recent years Gatwick Airport has been striving to be a world leader in aircraft noise management. A set of key performance indicators are used to assess progress and independent consultants are used to audit performance. Noise Communications Solutions reviewed Gatwick's noise management system in 2014 (http://www.gatwickairport.com/PublicationFiles/business_and_community/all_public_publications/2014/LGW%20peer%20review%20FINAL%20copy%20Mar2014.pdf**)** and concluded that Gatwick Airport … *has invested a significant amount of time and effort in its noise management activities and people, to ensure top performance amongst UK and Worldwide airports*.

Fly Quiet and Clean is a unique framework that pulls together all the airport's noise initiatives. Launched in December 2012, it includes both on-going initiatives and new thinking. The nine components of Fly Quiet &Clean are summarised in *Box 4.1*.

Box 4.1 Fly Quiet and Clean

A-CDM
Airport Collaborative Decision Making aims to improve the operational efficiency of all airport operators by reducing delays, increasing the predictability of events during a flight and optimising resources. This in turn then provides the best environmental solutions and reduces noise and emissions for aircraft on the ground and in the air.

Airspace Design
This piece of work looks at how the airspace directly affecting Gatwick flights can be better managed with more direct routes and better ways of operating. The result will be reduced noise and emissions.

Precise Area Navigation (P-RNAV)
Precision based satellite navigation is the ability of an aircraft's flight management system to navigate by means of waypoints defined by latitude and longitude, rather than by conventional ground based navigational aids. Gatwick has been trialling P-RNAV routes and once fully implemented the benefits noise reduction, reduced emissions, fuel savings and reduced engine maintenance costs.

Airline community
The aim is to continue to work with our airlines to help them improve the way they fly through collaborative working, trials and by sharing best practice.

Noise Action Plan (NAP)
The NAP is an evolving five-year plan for how Gatwick manages noise which was adopted by the Secretary of State for Transport in 2010.

Departures and Arrivals Codes of Practice
These Codes of Practice are collaborative initiatives driven by Sustainable Aviation and its member organisations. Many years of work, including trials, modelling and data analysis have developed best practice methods for arriving and departing aircraft. These have been identified and implemented throughout airlines in order to reduce noise and emissions

Quiet and Clean Innovation Group
The Quiet and Clean Innovation Group is a dedicated team looking at creating ground-breaking solutions within our Fly Quiet and Clean programme. The group is technical in nature with a membership comprising airlines, NATS and the regulator.

Sustainable Aviation
Sustainable Aviation is an essential link within our programme because of its reputation within industry.

The Future
Advancements in aircraft design, the overall strategic UK and European wide airspace management, together with forward thinking within the aviation industry are all key components to the future of noise management for Gatwick Airport.

In summary, Gatwick Airport already has a comprehensive range of embedded mitigation that reduces its air noise impact now, compared to what it otherwise would be, and will continue to do so in the future single runway case.

4.3 ADDITIONAL MITIGATION

4.3.1 Overview

Using the framework provided in EC Directive 2002/30 (ref 15) Gatwick Airport's noise management system can be summarised under the four headings of the Balanced Approach. *Table 4.1* provides a high level summary of the main elements of Gatwick Airport's noise management system that can be enhanced with the second runway. It lists the main categories of embedded mitigation already in place for which additional mitigation measures will be applied as result of the second runway, each of which is then discussed further below.

Table 4.1 Additional Noise Mitigation Summary

Embedded Mitigation	Additional Mitigation for Second Runway
Land Use Planning	
Discourages new sensitive development within published noise contours	GAL has proactively ensured planning applications account for the second runway's noise contours (see below).
Operational Procedures	
Continuous Decent Approach and AIP joining height limits	Will continue, the airspace and new runway will be designed to further facilitate.
Noise Preferential Routes	New Noise Preferential Routes will be developed taking account of air space change and future Precision Air Navigation (P-RNAV) capabilities.
Operating Restrictions	Will continue, no change to night restrictions assumed.
Compensation	
Noise Insulation Scheme	Recently extended (see below).
	New Second Runway Compensation Scheme (see below).
Stakeholder Engagement	Will continue, and be enhanced.

4.3.2 Land Use Planning

The North East Sector development is a good example of how a second runway at Gatwick has been accounted for in local planning to address noise impacts in the future. The proposal for 1,900 new homes South East of the airport has been promoted and GAL provided early noise forecasts to demonstrate the likely impact on the proposed development from a second runway. Whilst GAL objected to the development on grounds of noise impact, the development was subsequently granted planning permission by the Secretary of State in 2010 with a series of planning conditions attached that require building design and noise insulation to houses and a school to meet acceptable internal noise standards taking account of the safeguarded plans for a second runway. This will partly mitigate the impact of the second runway on this presently unbuilt development.

4.3.3 Operational Procedures

As discussed in *Section 3.2.1* the current noise modelling assumes simple routings of aircraft with current (2012) navigation practices, such as spread around Noise Preferential Routes. If a second runway is progressed these routes will be studied in detail to take account not only of airspace changes and new technologies (P-RNAV etc) but also existing Noise Preferential Routes, and through consultation with local stakeholders will be optimised to minimise noise impact. It is important to note that this is likely to reduce the impacts to below those identified at this stage.

The current modelling has also assumed unrestricted mixed mode operations on the two runways, i.e. with both runways free to operate a mix of departures and arrivals independently. Noise modelling has demonstrated that the greatest impact will be on the newly affected residential areas on the northern fringe of Crawley due to departures from the new runway. In order to reach full capacity the two runway airport would need to operate in mixed mode when flight frequencies are highest. However, it may be possible, for example, to operate a preference for departures off the existing runway at night when there are fewer flights. This may significantly reduce noise levels in the northern fringe of Crawley at night and reduce the numbers of people newly affected by noise at night. The possible benefit of this additional mitigation measure has not been included in the current noise assessment.

Other operational procedures are assumed to be as at present. For example, other airports have suggested they may increase approach slopes to reduce noise. Notwithstanding the difficulties associated with increasing the approach slope of an international aircraft fleet, the noise benefit, if this were to prove possible, would be very small. For example, if the approach slope could be increased from 3.0 to 3.2 degrees, this would increase the height of an aircraft 1km from the runway threshold by 3.5m creating a noise reduction immediately under the approaching aircraft of less than 0.3dB $L_{Aeq, T}$. Similarly, for aircraft 10km from the runway threshold it would increase height by 35m creating a similar noise reduction immediately under the approaching aircraft of less than 0.3dB. These noise reductions would be imperceptible. The reductions would be less to the sides of the extended runway centre line and further from the airport and of course not relevant to departures, making the benefit of the measure negligible. Clearly larger increases in approach slope would create larger noise reductions (eg 4.5 degrees would give over 1dB $L_{Aeq, T}$ reduction) but are not possible for large commercial aircraft.

Other marginal benefits, such as those gained by moving approach thresholds, could be possible in Gatwick in the future with a second runway, as they could at other airports, but they are considered marginal to the noise assessment, and have been ignored in this analysis of noise impacts from a second runway at Gatwick.

4.3.4 Compensation

Gatwick Airport's Noise Insulation Scheme was updated from 1 April 2014 to extend the area in which noise insulation can be offered. *Figure 19* shows the area of the new scheme. The new scheme is based on the $L_{eq\ 16\ hr}$ 60dB noise contour and extends a further 15km further east and west. It now covers one thousand more homes across Surrey, Sussex and Kent, the owners of which can apply for up to £3,000 towards double glazing for their windows and doors as well as loft insulation. Over 2,000 homes are now covered by the scheme.

The effects of air noise on schools will be studied further, taking into account the nature and construction of each school and its local noise environment. Schools identified as being significantly impacted by air noise will be offered mitigation, in the form of noise insulation or other enhancements.

Gatwick Airport's Home Owner Support Scheme 2005 will provide compensation for loss of property values within the $L_{eq\ 16\ hr}$ 66dB noise contour, subject to conditions and details specified.

In March 2014, GAL announced a Community Dividend scheme though which all households within the two runway airport $L_{eq\ 16\ hr}$ 57dB noise contour would receive the annual compensation equivalent to Band A Council Tax (currently £1,000).

Overall, this is a comprehensive, and so far unrivalled, compensation offering by GAL. It has been offered in recognition that, even after reducing and mitigating noise as far as practicable, there is still something that can be done to address the residual impact of aircraft noise at Gatwick Airport.

The Airports Commission recognises that the impact of air noise is a major factor in considering which runway option should be progressed.

The location of Gatwick Airport and the alignment of the runways mean that aircraft arrive and depart mostly over countryside with a low population density. As such, Gatwick currently affects relatively small numbers of people compared to other major airports.

It is recognised that community response to air noise is complex and a number of noise metrics are required to ensure all the effects can be accounted for. Some of these metrics are used in recognition of the fact that people are affected by noise beyond the traditional L_{Aeq} 57dB noise contours.

This report provides the air noise impact and health impact information for GAL's second runway proposal requested by the Commission, based on noise modelling carried out by ERCD, an independent centre of excellence in aircraft noise modelling.

The noise modelling is based on a series of cautious assumptions, omitting possible noise reductions through refined aircraft routings and operating procedures that could reduce populations impacted further. GAL will consider these options as additional mitigation measures as plans for the second runway develop.

Importantly, the noise assessment compares the second runway case in 2040 with the base case single runway (do-minimum) situation in 2040 that would otherwise exist with one runway. This approach is as required for transport schemes under the Government's Transport Appraisals Guidelines. It means the noise reductions expected as older aircraft are replaced by new ones are included in the do-minimum, and hence the comparison isolates the impact of the new runway from the noise reductions that would happen anyway. Heathrow has failed to provide this form of comparison in its submissions to the Commission to date, nor in its public consultation and communication exercises.

The impact of the second runway in 2040 compared to the base case in 2040 has been quantified in terms of people newly affected as follows:

- L_{Aeq} 57dB increase of 12,000 people;
- L_{Aeq} 54dB increase of 25,000 people;
- L_{Night} 48dB increase of 20,000 people; and
- L_{DEN} 55dB increase of 27,000 people.

These impacts are considerably smaller than have been deduced from modelling carried out by ERCD in 2007of a third northern runway at Heathrow in 2030.

GAL has a comprehensive noise management system in place and will explore all reasonably practicable measures to reduce the impacts of a second runway further. GAL also recognises that in order to deliver the benefits of the second runway to many, there will be communities negatively affected by noise, and these should be compensated. The Community Dividend scheme will give annual compensation equivalent to Band 'A' Council Tax (currently £1,000) to all households within the two runway airport $L_{eq\ 16\ hr}$ 57dB noise contour.

Glossary	
AC	Airports Commission Appraisal Framework Consultation, January 2014
ANCON	The UK civil aircraft noise contour model, developed and maintained by ERCD.
ATC	Air Traffic Control.
CAA	Civil Aviation Authority – the UK's independent specialist aviation regulator.
CDA	Continuous Descent Approach.
dB	Decibel units describing sound level or changes of sound level.
dB(A)	Units of sound level on the A-weighted scale, which incorporates a frequency weighting approximating the characteristics of human hearing.
Defra	Department for Environment, Food and Rural Affairs.
DfT	Department for Transport (UK Government).
END	Environmental Noise Directive.
ERCD	Environmental Research and Consultancy Department of the Civil Aviation Authority.
ILS	Instrument Landing System.
$L_{Aeq,16hr}$	Equivalent sound level of aircraft noise in dBA for the 16-hour day (0700-2300 local time) period. For this report, the *annual* average day is used.
L_{Day}	Equivalent sound level of aircraft noise in dBA for the 12-hour annual average day (0700-1900 local time) period.
L_{DEN}	Equivalent sound level of aircraft noise in dBA for the 24-hour annual average period with 5 dB weightings for Levening and 10 dB weightings for Lnight.
L_{eq}	Equivalent sound level of aircraft noise in dBA, often called 'equivalent continuous sound level'. For conventional historical contours this is based on the daily average movements that take place within the 16-hour period (0700-2300 local time) over the 92-day summer period from 16 June to 15 September inclusive.
$L_{Evening}$	Equivalent sound level of aircraft noise in dBA for the 4-hour annual average evening (1900-2300 local time) period.
L_{max}	The maximum sound level measured during an aircraft event, A-weighted unless otherwise stated.
L_{Night}	Equivalent sound level of aircraft noise in dBA for the 8-hour annual average night (2300-0700 local time) period.
NPR	Noise Preferential Route.
N70 Day	The number of noise events exceeding L_{max} 70dB in an average day.
N60 Night	The number of noise events exceeding L_{max} 60dB in an average night.
NTK	Noise and Track Keeping monitoring system. The NTK system associates radar data from air traffic control radar with related data from both fixed (permanent) and mobile noise monitors at prescribed positions on the ground.
OR	Odd Ratio – the fraction of a population additional affected, 1.0 being no affect.
QC	Quota Count, the basis of the London airports night restrictions regime.
SID	Standard Instrument Departure.

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4. A New Approach – Heathrow's options for connecting the UK to growth – Heathrow Airport Ltd (July 2013).

5. ERCD Report 0705 Revised Future Aircraft Noise Exposure Estimates for Heathrow Airport.

6. ERCD Report 1302, Noise Exposure Contours for Gatwick Airport, 2012.

7. ERCD Report 1205, Strategic Noise Maps for Gatwick Airport 2011.

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9. Burden of disease from environmental noise, Quantification of healthy life years lost in Europe, WHO Europe, 2011.

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12. Quantifying the links between environmental noise and related hypertension and health effects, MSU/2011/07, Anne-Helen Harding.

13. Stansfeld et al (2005) Aircraft and road traffic noise and children's cognition and health: a cross national study. The Lancet 365 1942-1949.

14. Gatwick Airport Environmental Noise Directive Noise Action Plan 2010-2015 (June 2010).

15. European Commission Directive 2002/30 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Community airports (March 2002).

Appendix 1

HEATHROW AIRPORT FUTURE NOISE EXPOSURE

Currently Heathrow Airport Limited's (HAL's) central claim for air noise is this:

Even with a third runway, there will be 10-20% fewer people affected by air noise in 2030 than there are today.[1]

This claim is repeated in various current documents, but is not substantiated.

We understand HAL have been undertaking INM modelling to test R3 options, but no modelling studies have been released making the claim seemingly unchallengeable. However, at this stage it can be investigate by reference to a modelling study carried out for ERCD in 2007 using the official ANCON noise model .

HAL's central claim is likely to be factually true. It is, however, hugely misleading because it draws a comparison between a situation in 2030, when its third runway would be operating at less than half its predicted capacity, with a situation now (in 2014). Without a third runway, but even with further growth of operations on the existing two runways Heathrow will, over the next 16 years, become quieter. The reason for this is largely due to the ongoing transition to quieter aircraft types (i.e. even without further noise management interventions a two runway Heathrow will get quieter). We can call this the 'do-nothing' R2 scenario. Heathrow's omission in its central claim of reference to the 2030 do-nothing scenario is contrary to government transport appraisal guidelines (eg WebTAG).

The ANCON modelling carried out by the CAA's ERCD is reported in ERCD Report 0705 in 2007 (ref 5). In 2007 BAA were looking at future noise exposure in the context of complying with the Terminal 5 imposed 57dBA noise contour cap of 127 km^2 stated as a condition of a 3rd runway in the 2003 Future of Air Transport White Paper. They asked ERCD to model R2 segregated and mixed mode options, and a third short northerly runway in mixed mode (with the existing runways in segregated mode to offer partial respite). The study looked carefully at future types of aircraft that would come into service by 2020 and by 2030, i.e. the do-nothing scenario, as shown in Table 1.

[1] A New Approach – Heathrow's options for connecting the UK to growth – Heathrow Airport Ltd (July 2013)

Table 1 Surrogate aircraft types and adjustment factors for future aircraft types

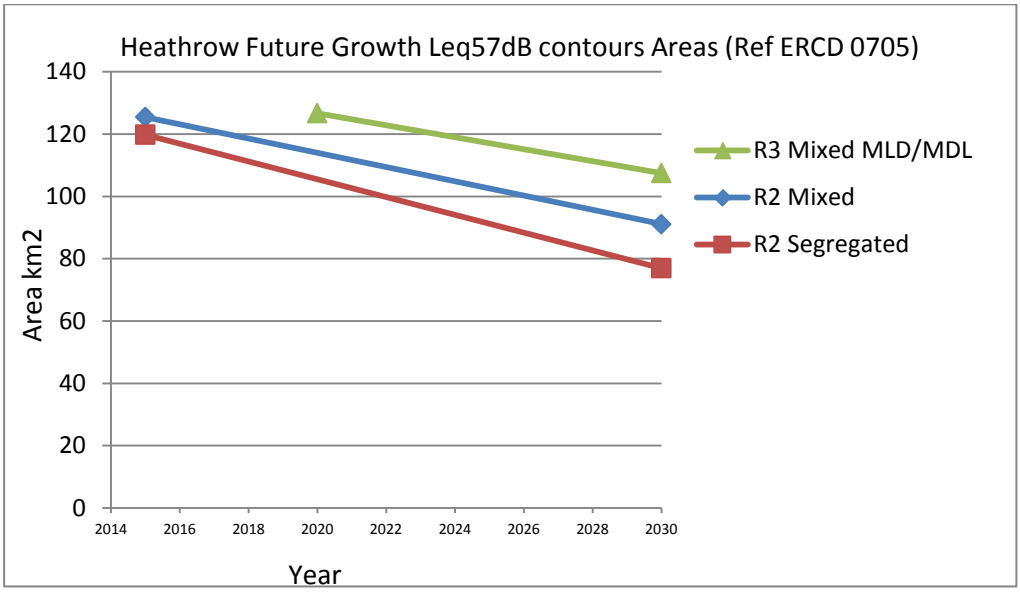
Type	Surrogate	Departure Adjustment dB	Arrivals Adjustment dB
Airbus A380*	Boeing 747-400 GE	-4.45	-5.8
Boeing 747-8*	Boeing 747-400 GE	-3.5	-3
New technology 120 seat	Airbus A319C	-4	-3
New technology 150 seat	Airbus A320C	-4	-3
New technology 180 seat	Airbus A321C	-4	-3
New technology	220 seat Airbus A321C	-3.5	-2
New technology 220 seat long-haul	Boeing 767-300 GE	-3.7	-1.7
New technology 250 seat long-haul	Boeing 767-300 GE	-3.7	-1.7
New technology 300 seat long-haul	Boeing 767-300 GE	-2.7	-1.7
New technology 300 seat short-haul	Boeing 767-300 GE	-4.2	-1.7
New technology 450 seat twin	Boeing 777-300 GE	-4	-2

*Already entered service since 2007 study.

All these aircraft were expected to come into service by 2020. It can be seen that significant reductions in individual aircraft noise emission levels are expected, and this will flow into airport noise contours as older noisier aircraft are retired from the global fleet. The ERCD modelling assumed that 90% of the Heathrow fleet would be of these quieter types by 2030.

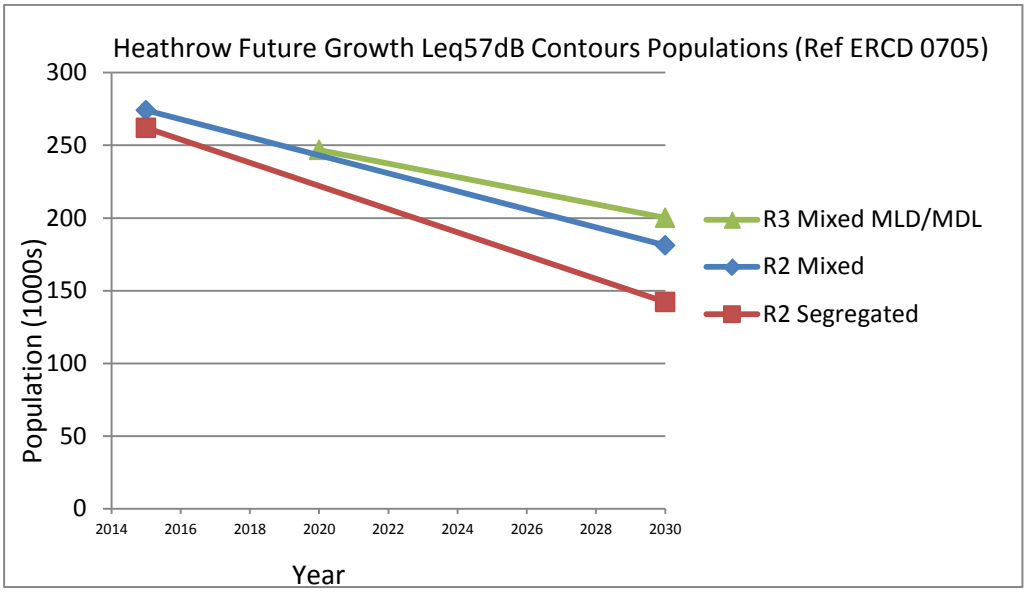
Contour areas and populations were reported, and are summarised in Figure A1 and Figure A2 respectively. Whilst the exact runway location and the passenger forecasts are not as HAL propose now, they illustrate through ERDC modelling the expected effect of a quietening fleet at Heathrow by 2030, and how a third (2,200m long) northern runway (referred to in the figures as R3 Mixed MLD/MDL) would only partially offset that effect.

Figure A1



MLD/MDL – The modelled operational mode for each of the 3 runways; north, meddle and south; 'M' Mixed mode, 'L' Landing, and 'D' Departure. The two options have been averaged in this analysis

Figure A2



Thus, looking at Figure A2, the 3 runway mixed mode case in 2030 includes 200,000 people within the 57dB contour, some 60,000 (24%) less than the 2 runway segregated mode case in 2015, ie confirming the HAL headline claim. But in 2030, with no third runway the 2 runway segregated mode case (do-nothing) would affect only 142,000 people, 45% fewer than in 2015.

Or, to make the correct meaningful comparison required to assess the impact of a third runway in isolation:

The effect of the third runway in 2030 compared to the do-nothing in 2030 would be an increase of 58,000 people, or 40% within the 57dB contour.

This clearly constitutes a significant negative environmental impact from a third runway at Heathrow.

For Gatwick, ERCD modelling estimates 15,400 people would be within the 57dB contour with a wide separation second runway operating in full independent mixed mode in 2040 compared to about 3,100 for a single runway. So, the effect of a second runway at Gatwick in 2040 compared to the do-minimum in 2040 would be about 12,300 people.

Considering the 'national' impact of noise, the difference between adding a third runway at Heathrow in 2030 and adding second runway at Gatwick in 2040, is estimated at an additional 46,000 people within the 57dB contour. We consider that this negative effect is likely to be understated if the work was to be re-done now assuming Heathrow's full length NW Runway Option. But even so this additional impact is greater than the noise impact of Manchester Airport (29,000 people in 2010).

Appendix 2

THE EFFECT OF END AROUND TAXIWAYS

The addition of end around taxiways moves the runways ends slightly, and shifts the air noise contours accordingly. In the noise modelling the existing runway 08R threshold is shifted to the east by 348 m, and the runway 26L threshold is shifted to the east by 11 m. The runway ends of the proposed runway are not moved. The changes that this creates for $L_{Aeq\ 16\ hr}$ contours areas and populations are shown in Tables A2.1 and A2.2.

Table A2.1 ***$L_{Aeq\ 16\ hr}$ Noise Contour Areas (km^2)***

Case	54dB	57dB	60dB	63dB	66dB	69dB	>72dB
2040 R2 No EATs	121.7	66.5	37.8	19.3	9.6	4.9	2.8
2040 R2 With EATs	121.6	66.4	37.7	19.3	9.6	4.8	2.8
2050 R2 No EATS	126.7	68.2	37.9	18.8	9	4.6	2.6
2050 R2 With EATS	126.7	68.1	37.9	18.8	8.9	4.6	2.6

Table A2.2 ***$L_{Aeq\ 16\ hr}$ Noise Contour Populations (1000s)***

Case	54dB	57dB	60dB	63dB	66dB	69dB	>72dB
2040 R2 No EATS	32.2	15.4	6.2	1.4	0.1	<0.1	0
2040 R2 With EATS	32.2	15.4	6.2	1.4	0.1	<0.1	0
2050 R2 No EATS	31.4	14.6	5.6	1.1	0.1	<0.1	0
2050 R2 With EATS	31.4	14.6	5.7	1.1	0.1	<0.1	0

The changes in noise contour areas and population affected with the end around taxiways are very small and would result in insignificant differences in noise impacts. Similar changes would arise to contour areas and populations for other noise metrics. It can be concluded that the change in noise impacts due to the addition of end around taxiways would be insignificant.

Figures

ERCD Noise Contours

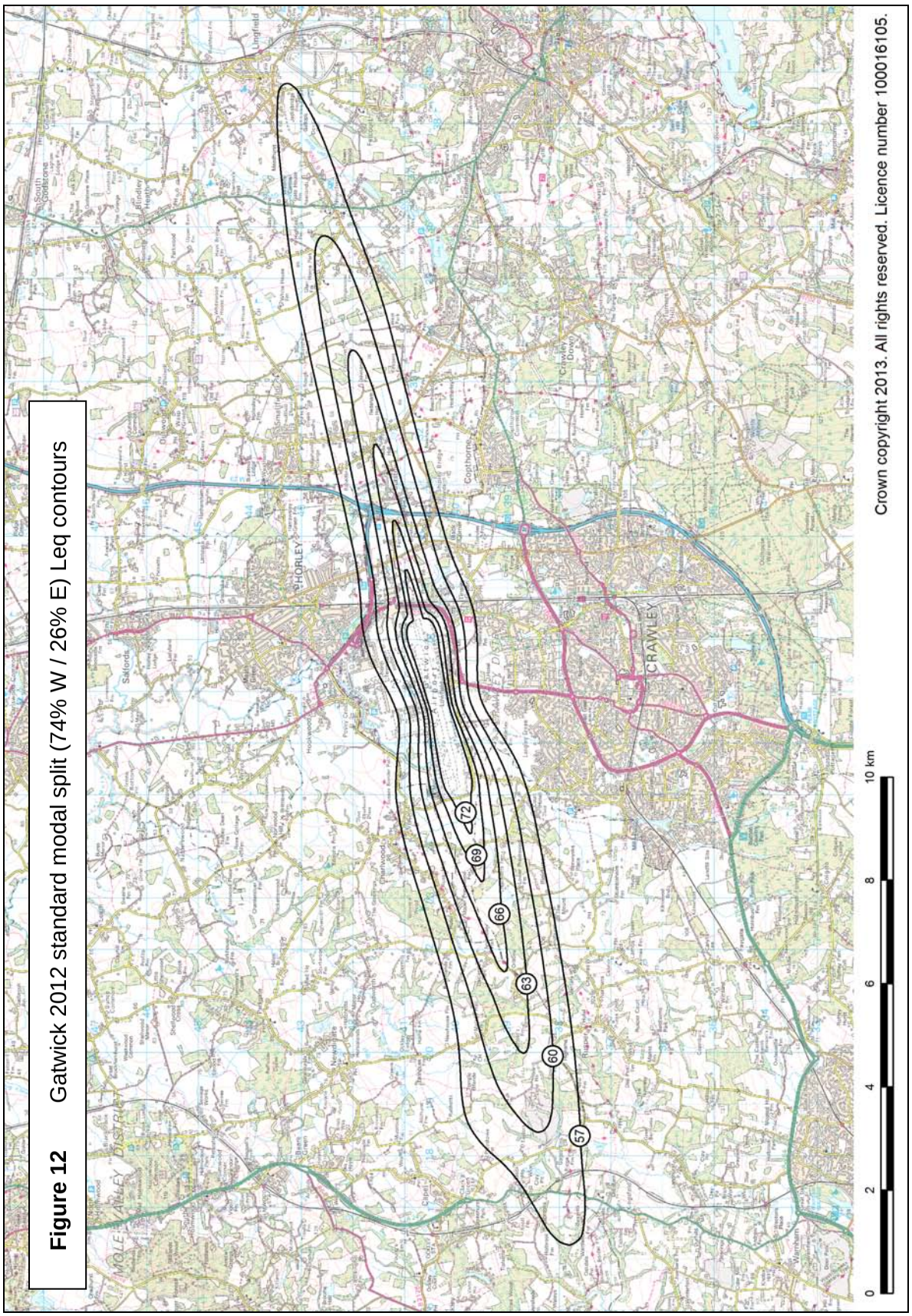
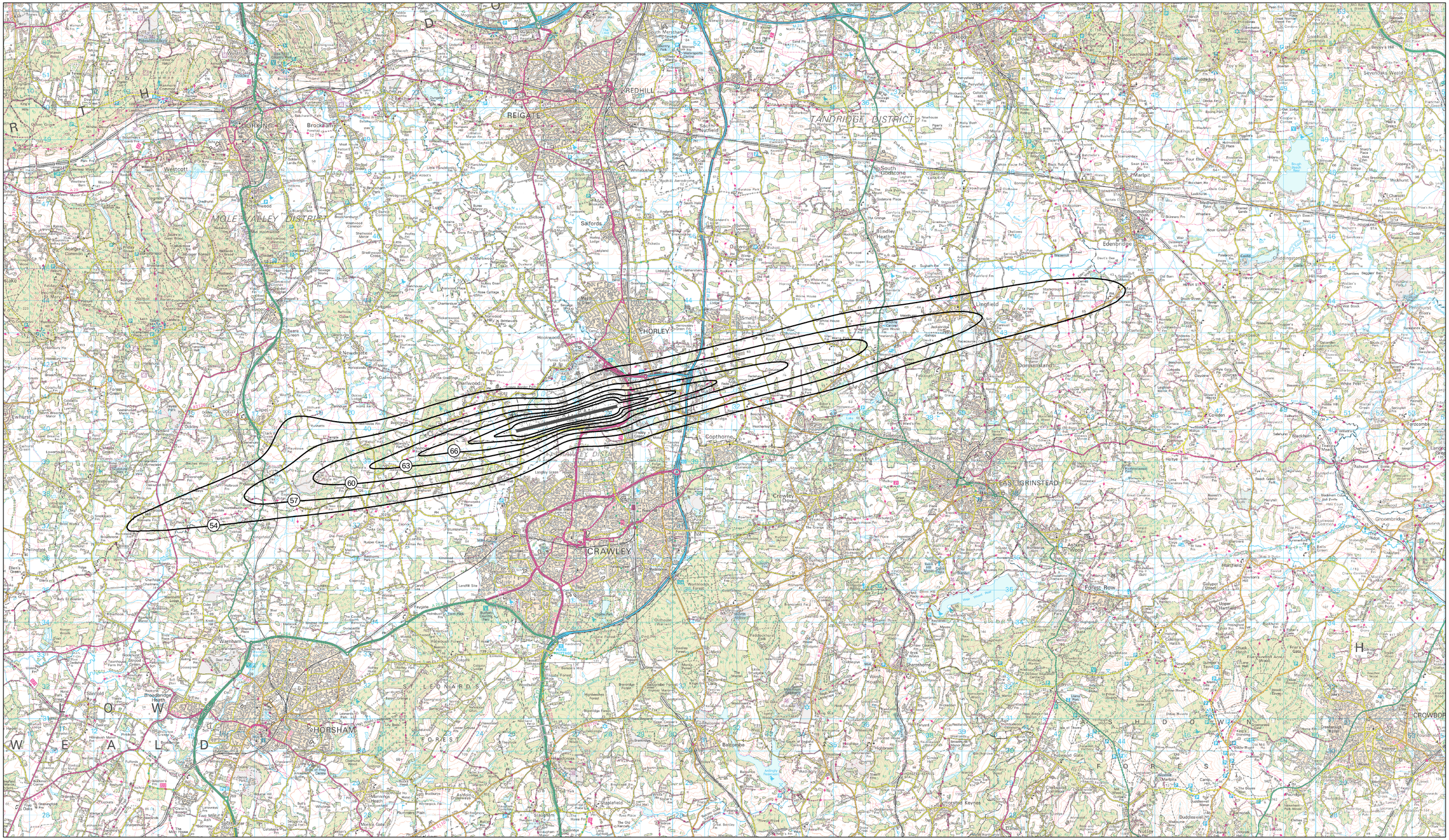


Figure 12 Gatwick 2012 standard modal split (74% W / 26% E) Leq contours

Figure 1



GATWICK AIRPORT

R2 Option 0 Base Case 2040 L_{eq} 54-72 dB(A) Contours

Modal split 74% west / 26% east

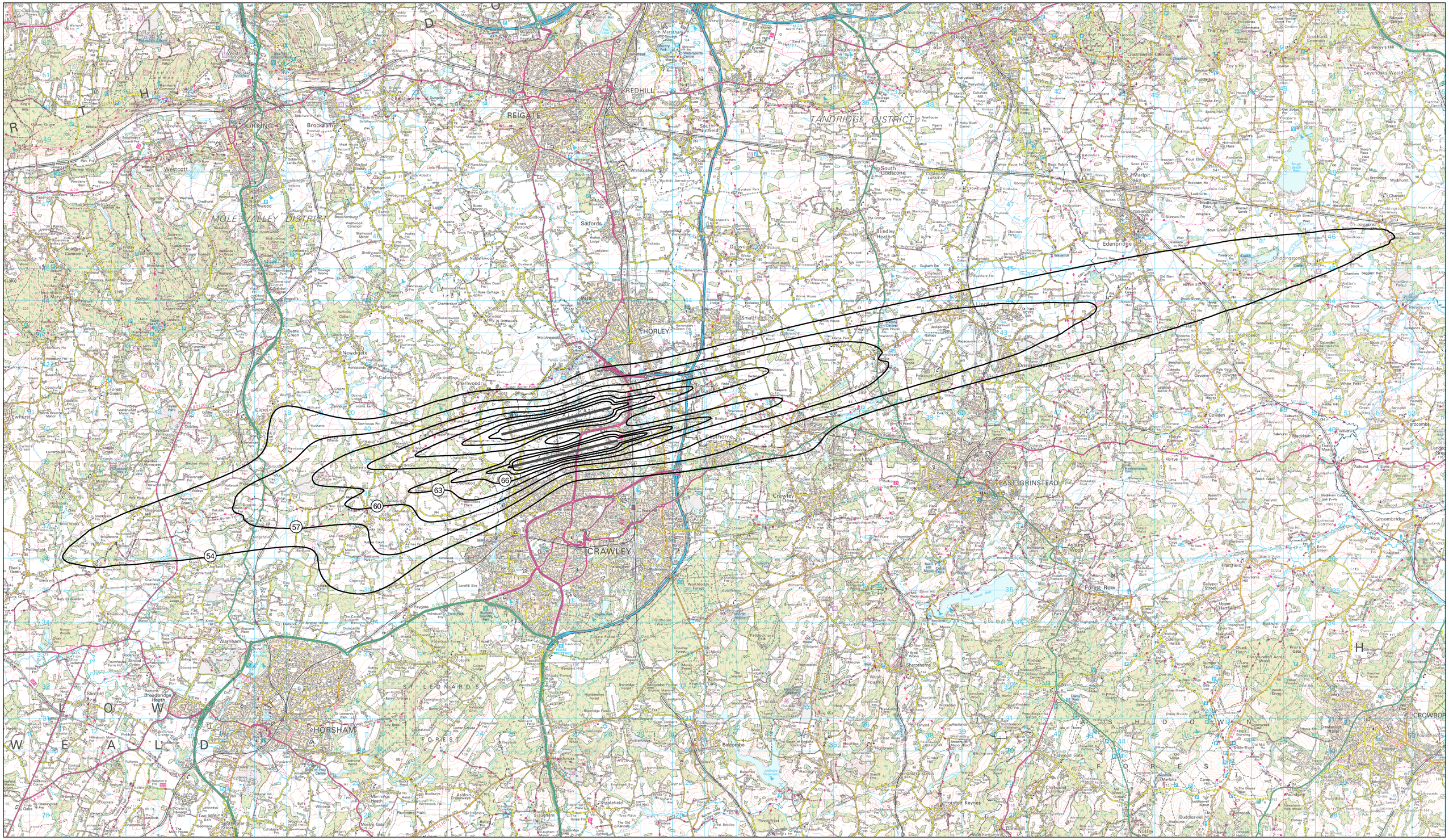
Figure 2

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 L_{eq} 54-72 dB(A) Contours

Modal split 74% west / 26% east

Figure 3



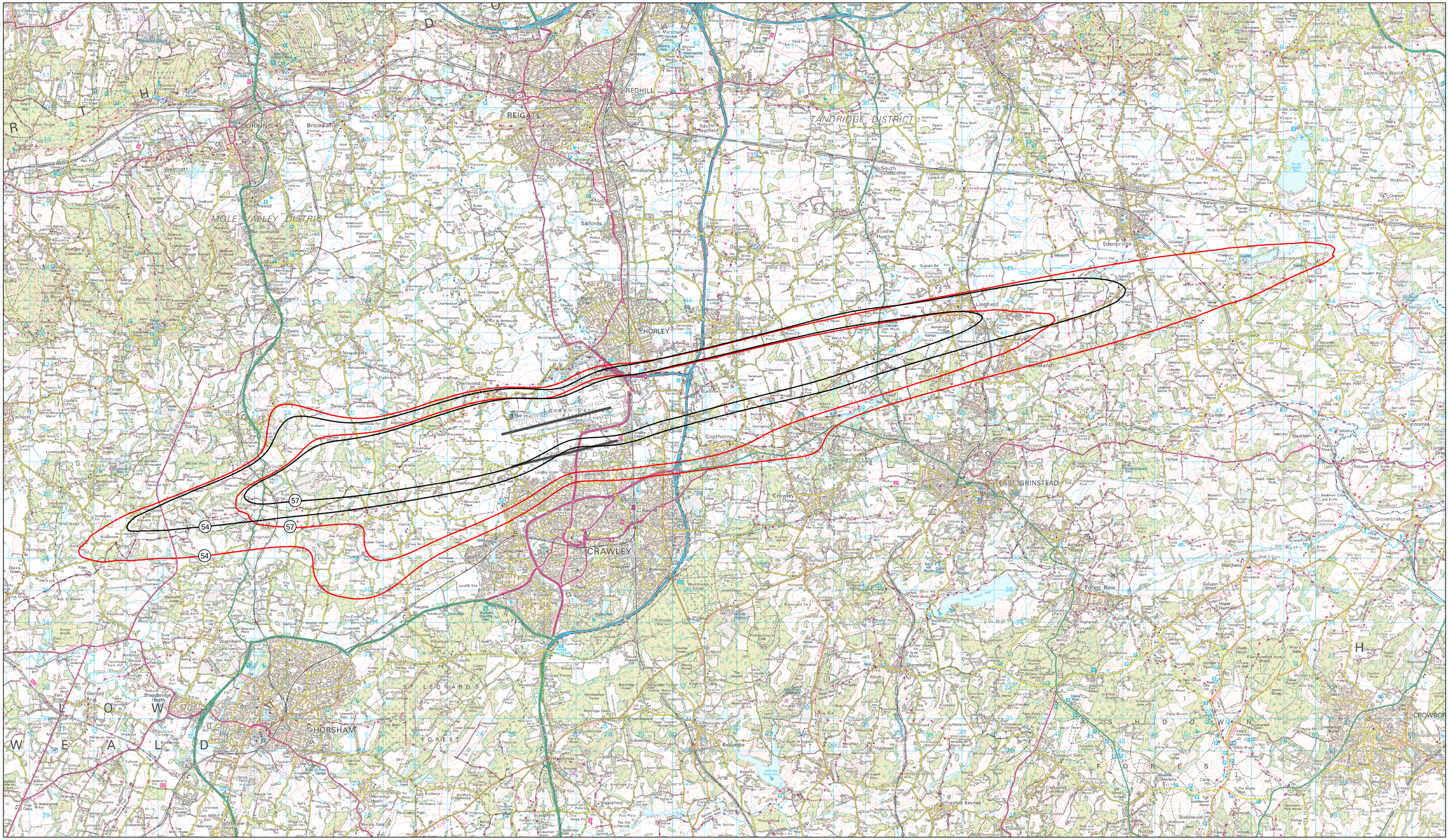
0 5 10 15 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2050 L_{eq} 54-72 dB(A) Contours

Modal split 74% west / 26% east

Figure 4



GATWICK AIRPORT

95mppa R2 Option 3 No EATs 2040 vs Option 0 (Base Case) 2040 L_{eq} 54-57 dB(A) Contours

Modal split 74% west / 26% east

Figure 5

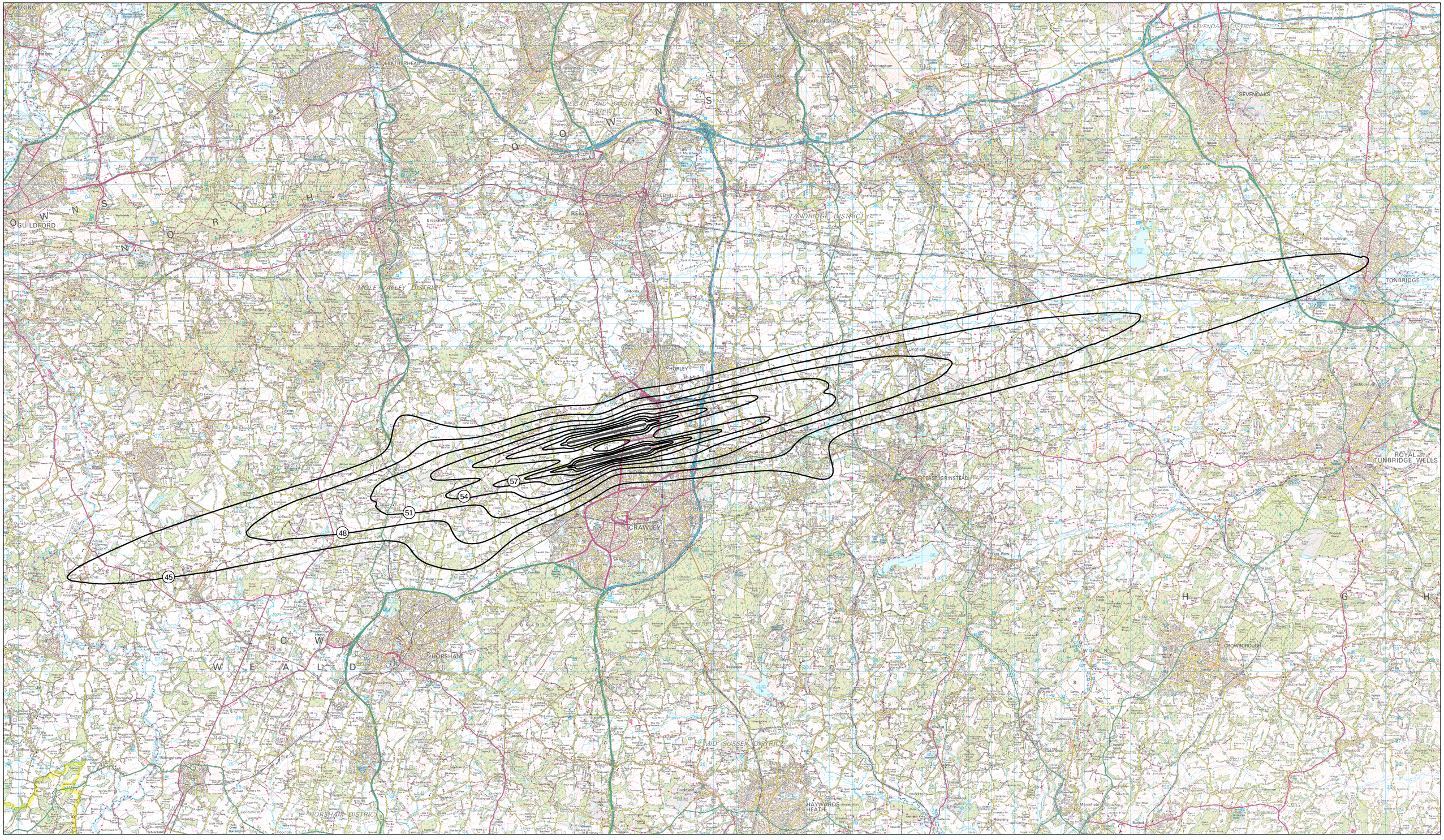
0 5 10 15 20 km

GATWICK AIRPORT

R2 Option 0 Base Case 2040 L_{night} 45-66 dB(A) Contours

Modal split 68% west / 32% east

Figure 6



0 5 10 15 20 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 L_{night} 45-66 dB(A) Contours

Modal split 68% west / 32% east

Figure 7

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2050 L_{night} 45-66 dB(A) Contours

Modal split 68% west / 32% east

Figure 8

Figure 6 Gatwick 2011 L_{den} (68% W / 32% E) contours

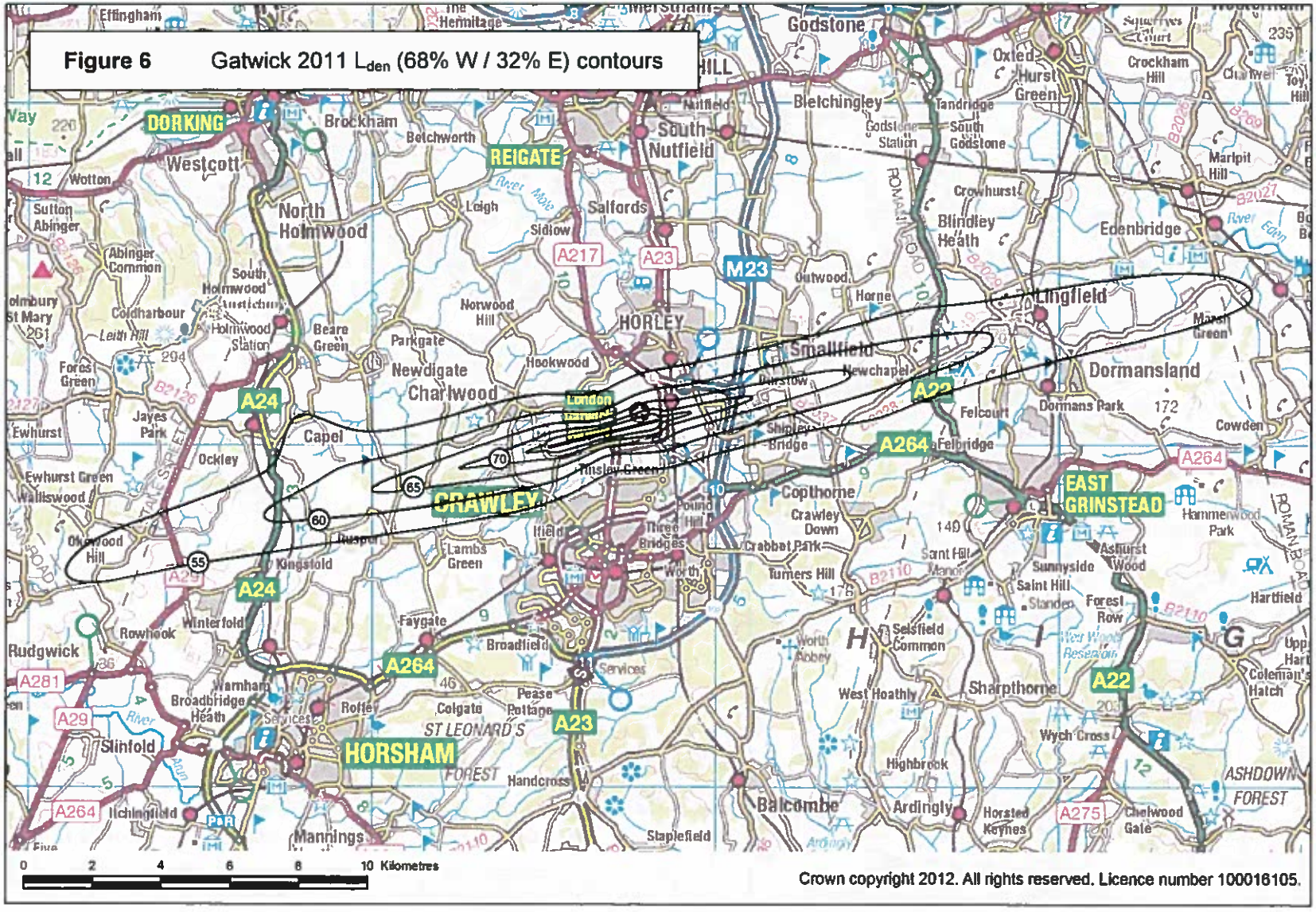
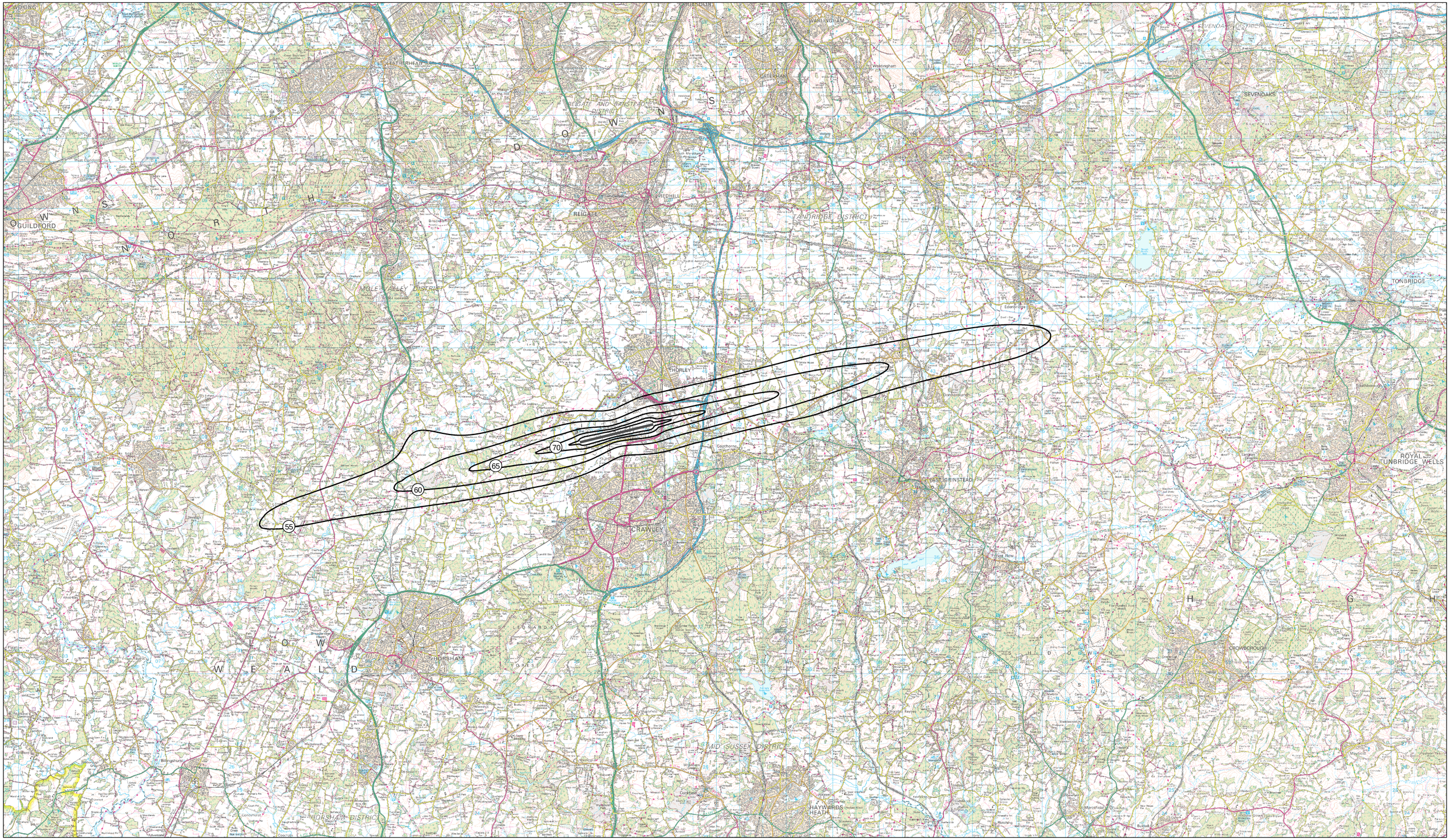


Figure 9



0 5 10 15 20 km

GATWICK AIRPORT

R2 Option 0 (Base Case) 2040 L_{den} 55-75 dB(A) Contours

Modal split 68% west / 32% east

Figure 10

0 5 10 15 20 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 L_{den} 55-75 dB(A) Contours

Modal split 68% west / 32% east

Figure 11

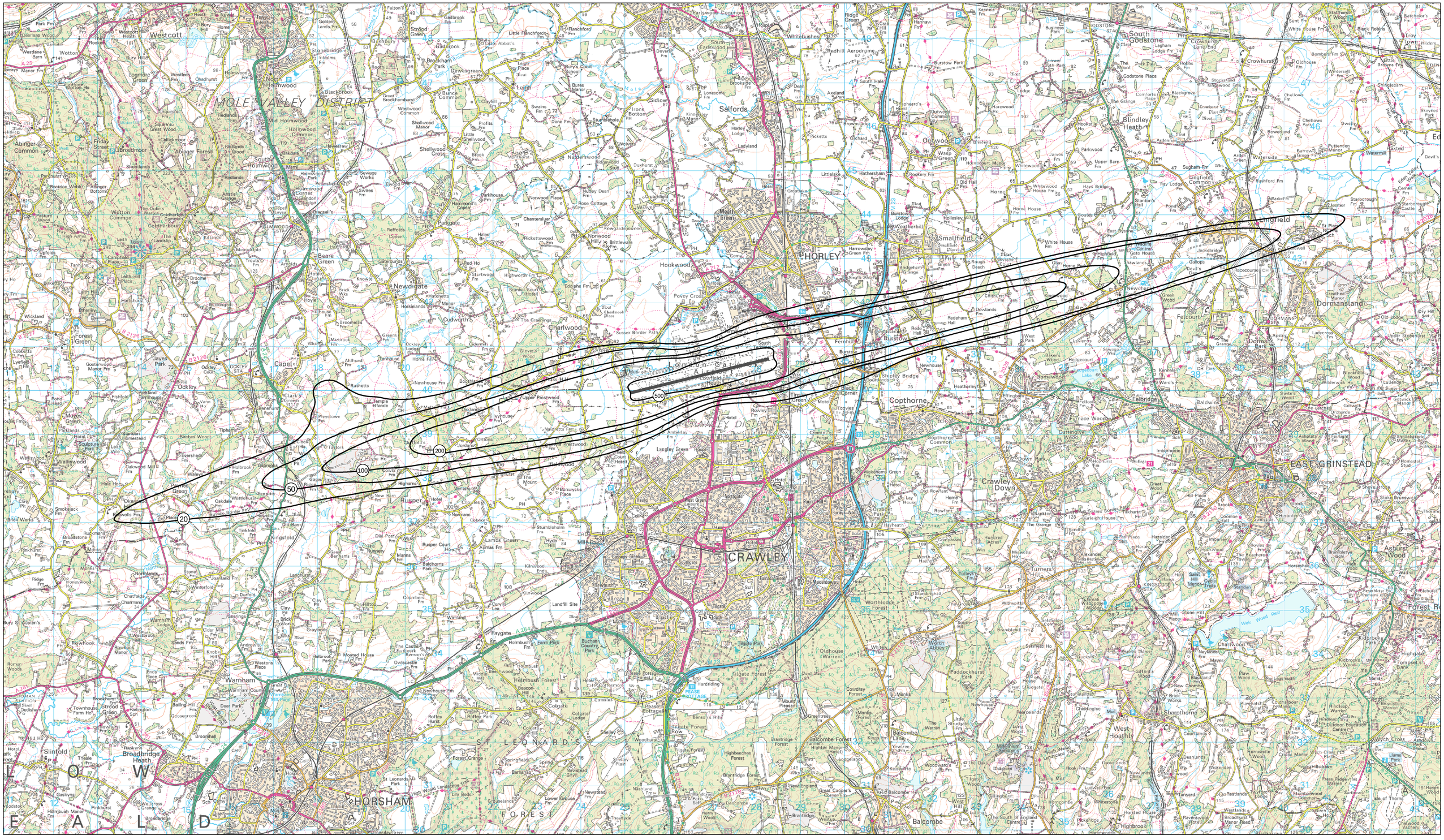
0 5 10 15 20 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2050 L_{den} 55-75 dB(A) Contours

Modal split 68% west / 32% east

Figure 12



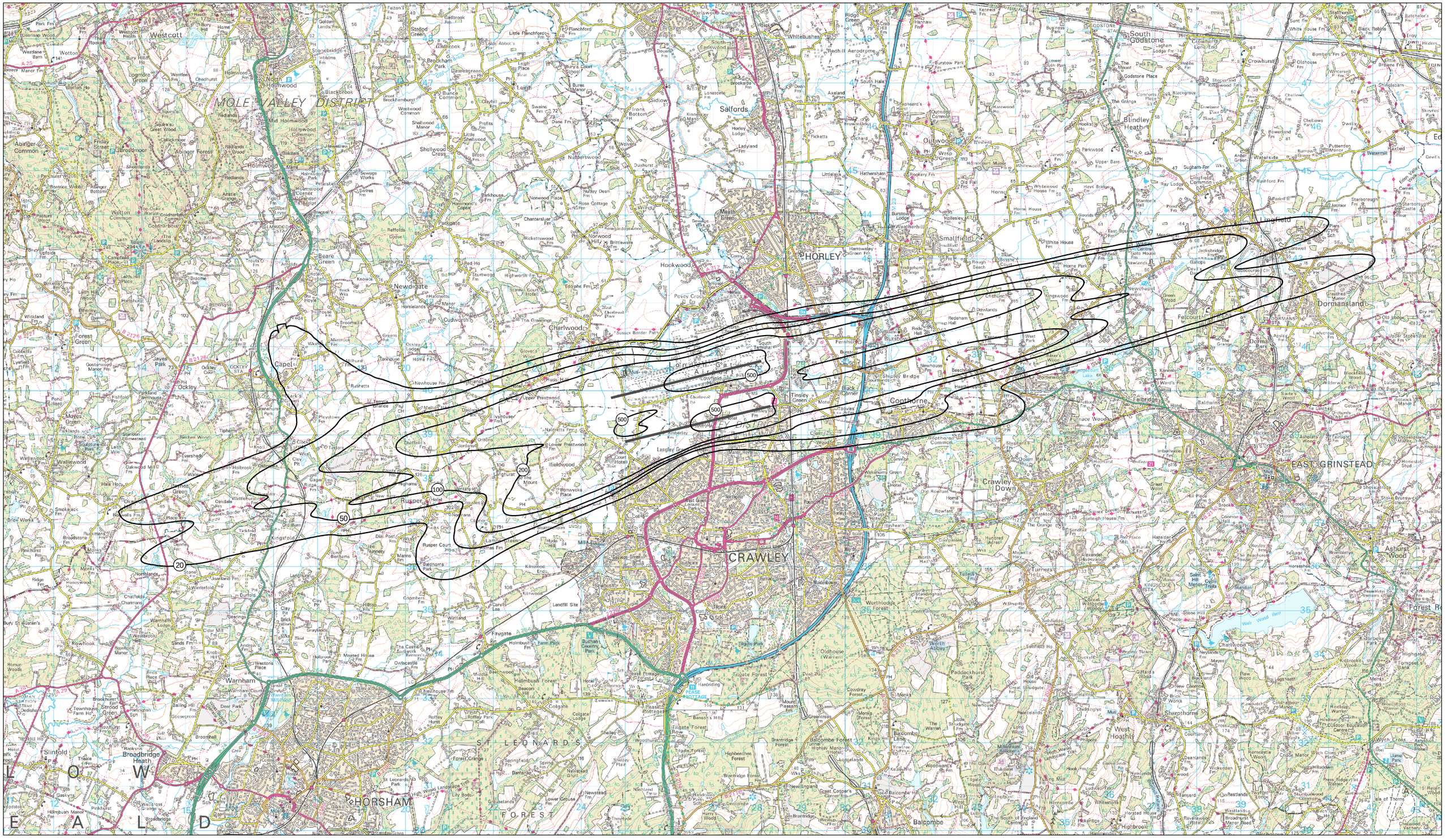
0 2 4 6 8 10 km

GATWICK AIRPORT

R2 Option 0 (Base Case) 2040 N70 Contours

Modal split 74% west / 26% east

Figure 13

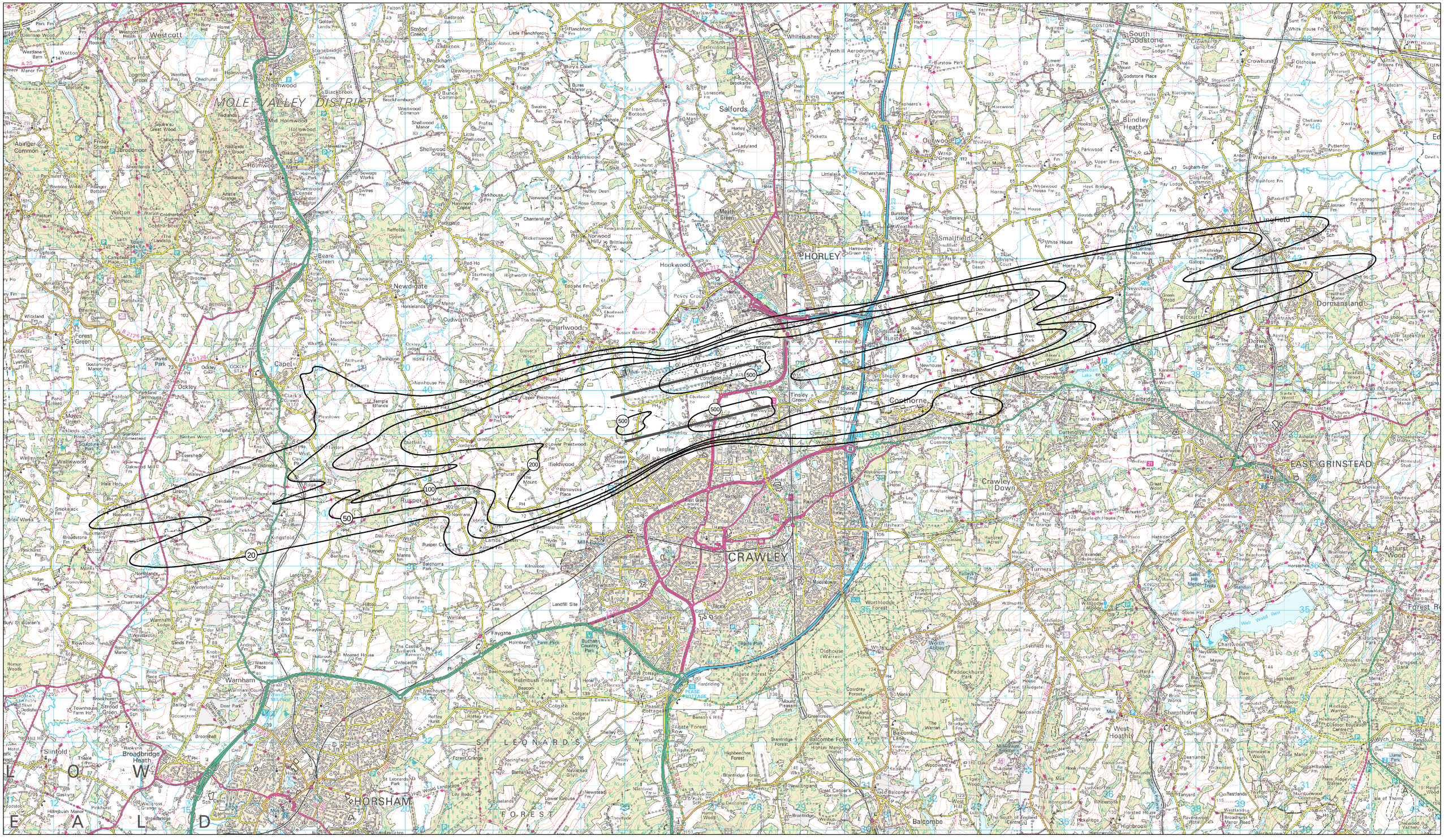


GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 Summer Day N70 Contours

Modal split 74% west / 26% east

Figure 14

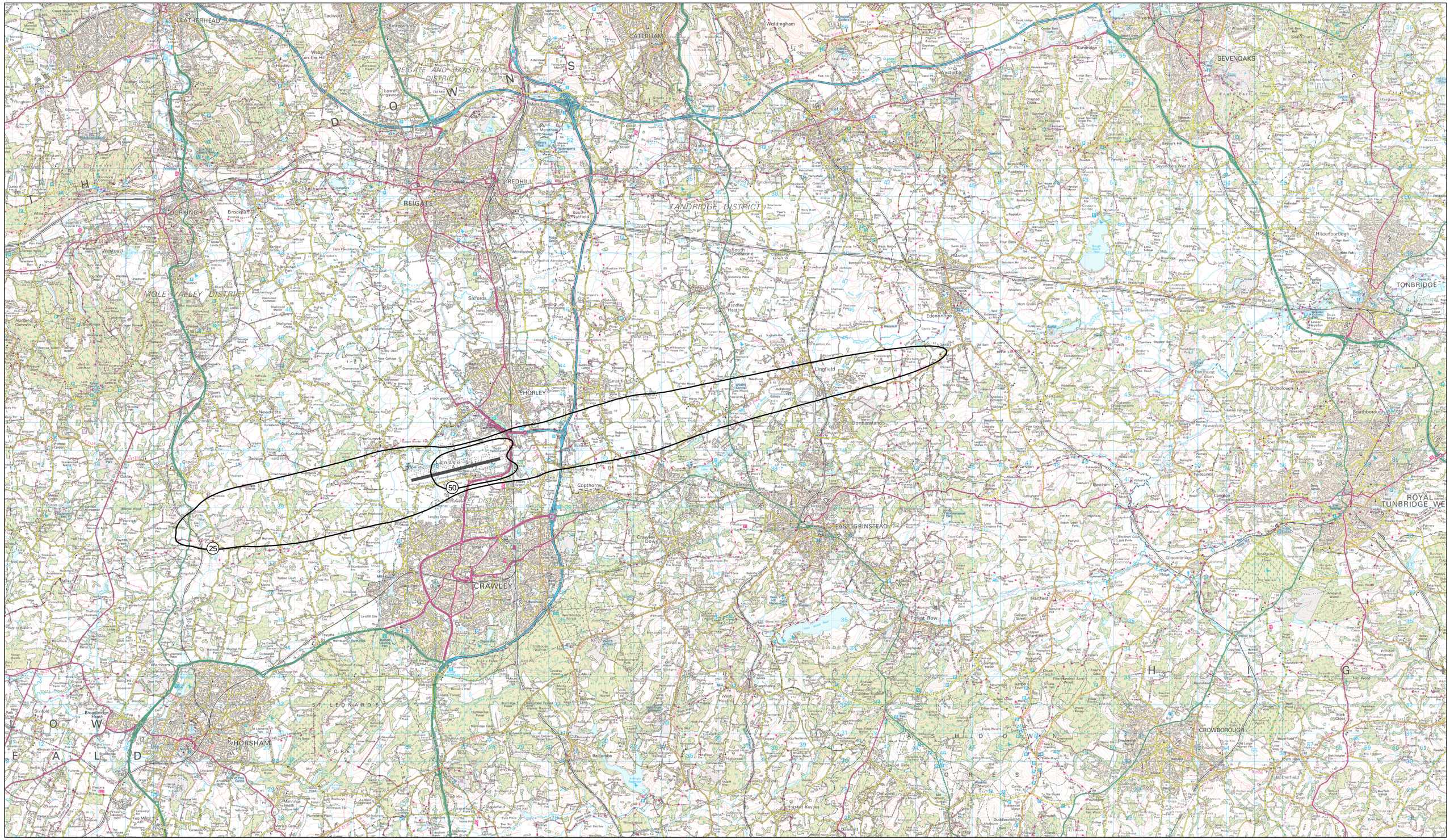


GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2050 Summer Day N70 Contours

Modal split 74% west / 26% east

Figure 15

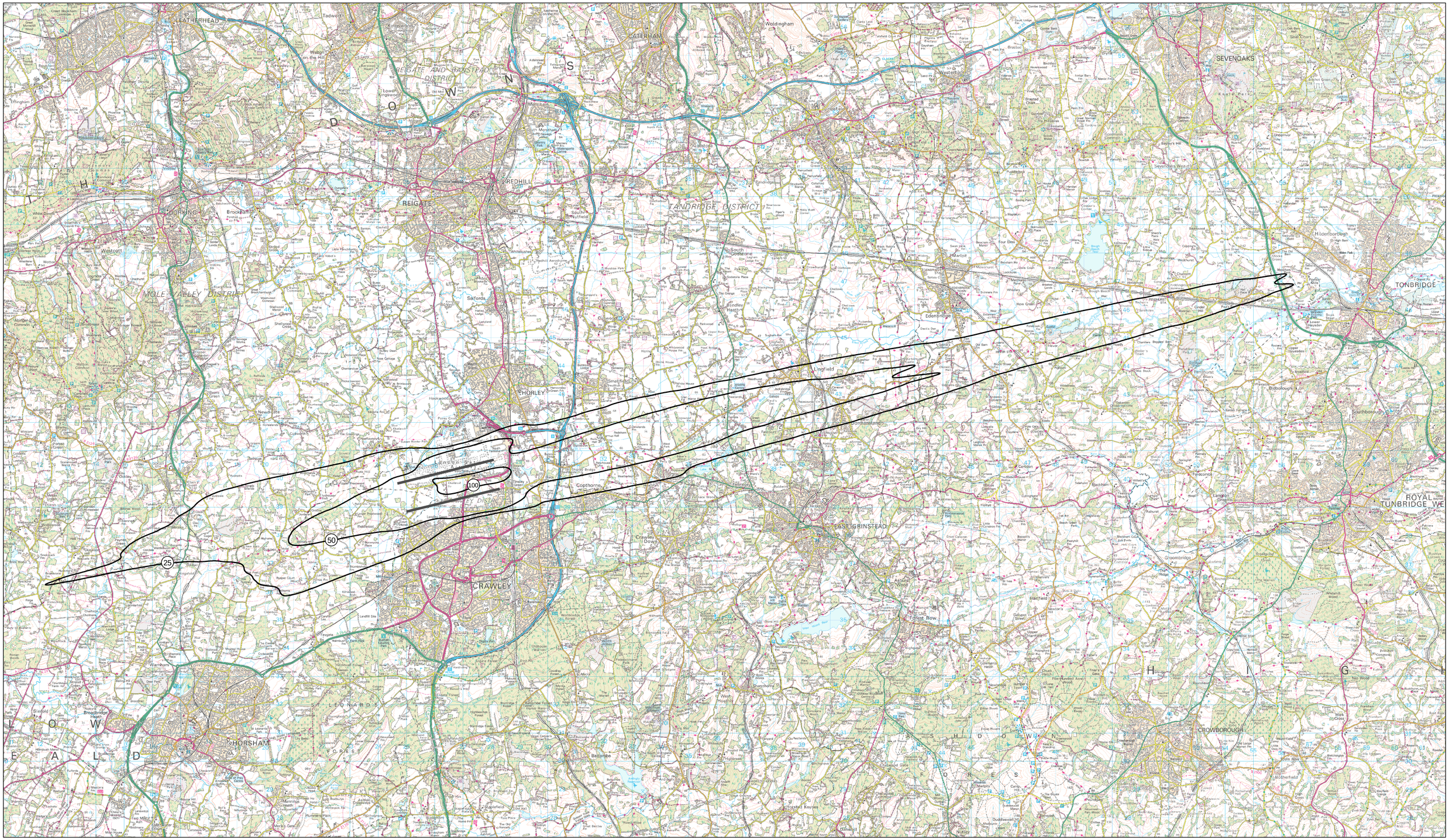


GATWICK AIRPORT

R2 Option 0 (Base Case) 2040 Summer Night N60 Contours

Modal split 78% west / 22% east

Figure 16



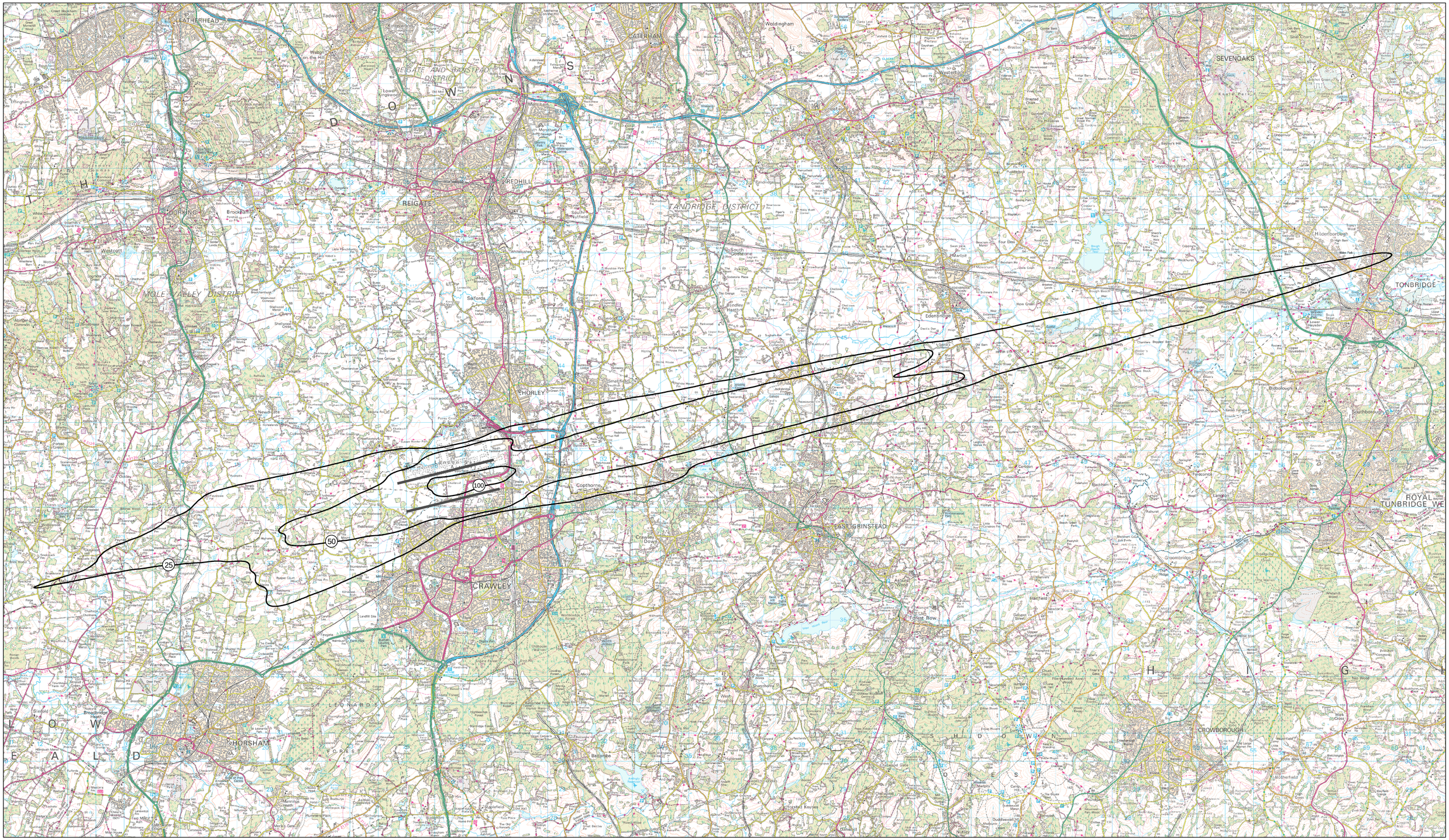
0 5 10 15 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 Summer Night N60 Contours

Modal split 78% west / 22% east

Figure 17



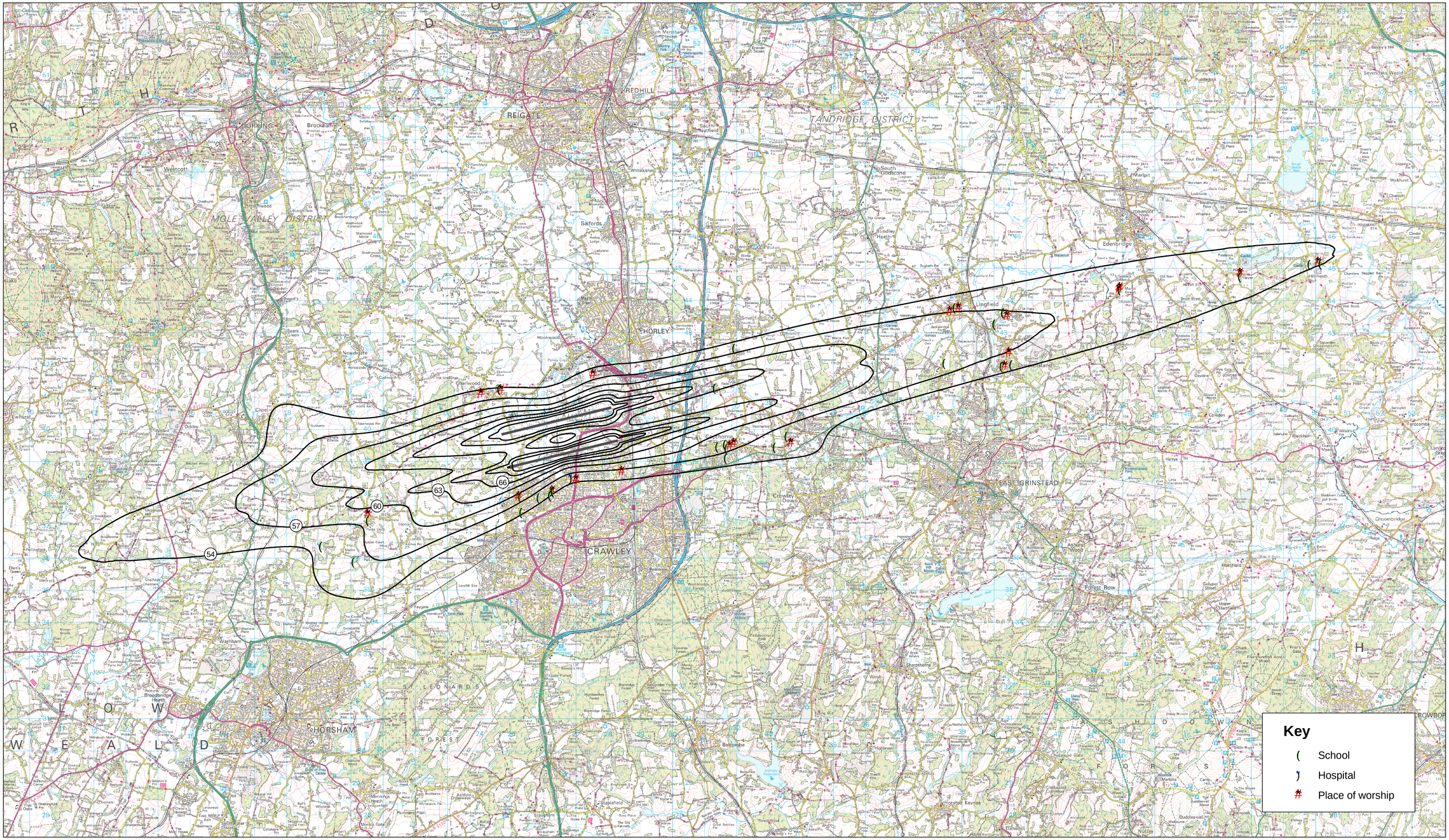
0 5 10 15 km

GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2050 Summer Night N60 Contours

Modal split 78% west / 22% east

Figure 18



GATWICK AIRPORT

95mppa R2 Option 3 (Wide Spaced Mixed Mode) No EATs 2040 L_{eq} 54-72 dB(A) Contours

Modal split 74% west / 26% east

Figure 19

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