Bickerdike Allen Partners
Architecture Acoustics Technology

NOISE MODELLING REPORT

ABP RFI 27 APR 2023

Report to

daa plc
Old Central Terminal Building
Dublin Airport
Co Dublin
Ireland

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 60 years of continuous practice.

Architects: Design and project management services which cover all stages of design, from feasibility and planning through to construction on site and completion.

Acoustic Consultants: Expertise in planning and noise, the control of noise and vibration and the sound insulation and acoustic treatment of buildings.

Construction Technology Consultants: Expertise in building cladding, technical appraisals and defect investigation and provision of construction expert witness services.

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1.0 EXECUTIVE SUMMARY

Following a request from An Bord Pleanála (ABP) this report provides the clarification and further information sought. While preparing this the opportunity has been taken to produce and EIAR Supplement to update the basis of the forecast future noise to allow for developments since the 2021 EIAR.

Impact of Peak Noise Levels

The probability of additional awakenings has been determined for the population in the same study area as the EIAR Supplement, which contains over 1 million people. The probability of additional awakenings is computed for each person, and expressed as overall totals of the expected number of additional awakenings across the total population.

While there are no specific criteria by which to judge the significance of the number of additional awakenings, the relative values for the scenarios can be compared. Considering the annual situation, a reduction is expected from 2018. In 2025 this is by around 40% irrespective of whether the proposed change to the controls at night proceeds. By 2035 a greater reduction is forecast, by around 55% with the proposed change, and 65% without it.

The EIAR assessed the effects of noise at night using the L_{night} metric to determine the population highly sleep-disturbed (%HSD). The values from that assessment are of a similar magnitude to the number of additional awakenings and show the same pattern across the scenarios.

Sensitivity Testing

Sensitivity testing has been undertaken on the future exposure of sensitive receptors, and of the resulting effect of the proposed Relevant Action. This considers two scenarios; the first assumes that for both the Permitted and Proposed scenarios the noise is 1 dB(A) higher, and the second assumes that for both the Permitted and Proposed scenarios the noise is 1 dB(A) lower.

Compared to the exposures detailed in the replacement Chapter 13 of the EIAR Supplement, those for the corresponding Permitted and Proposed scenarios where the noise is 1 dB(A) higher are consequently higher, and those for the corresponding Permitted and Proposed scenarios where the noise is 1 dB(A) lower are consequently lower.

In terms of significance for residential receptors the situation is that although the absolute numbers vary, the relationship between those with beneficial and adverse effect is generally consistent under each of the scenarios. When it comes to non residential receptors, the findings for the sensitivity scenarios are also consistent with those in the EIAR.

Baseline years

In relation to baseline years the response clarifies that when undertaking environmental assessment, the approach is to set out the current situation and then to consider what may happen in the future with or without the change being sought.

Information is presented on past night activity which demonstrates that 2014 was the last year in which the number of movements, both annually and in the summer period, were at least 25% below those in 2018.

The number of number of dwellings and people forecast to experience an increase in their L_{night} level to over 50 dB(A) and separately to over 55 dB(A) has been determined. This has been done by comparing against the situation in the Permitted Scenario in the relevant year. The results show that there are dwellings and populations whose exposure increases in both years under either the Proposed Scenario or the Proposed Reduced Scenario although the numbers are smaller in the case of the latter which has fewer movements.

The analysis also finds that in both of the Proposed scenarios there are dwellings and populations overflown by departures to the west from the South Runway that benefit compared to the Permitted scenarios. In particular this affects Blanchardstown and the surrounding communities which are relatively densely populated compared to other areas overflown.

2.0 INTRODUCTION

In a letter dated 27th April 2023, An Bord Pleanála (ABP) advised that, having regard to the documentation submitted and specifically the noise analysis undertaken in the EIAR, they requested that Dublin Airport Authority (daa) provide clarification and further information in under the following headings:

1. Impact of Peak L_{Amax} Noise Levels from Air Traffic Movements (ATMs) on Sleep
2. Sensitivity Testing on the Population Numbers Covered by the Noise Contour Predictions
3. Baseline years assumed in the assessment

daa have retained Bickerdike Allen Partners LLP (BAP) to prepare the noise modelling information requested by ABP. This report considers each issue in turn and summarises the methodology, inputs to the model, and details the outputs where relevant. A response is also included on issue 3.

A glossary of acoustic terminology in contained in Appendix 1.

2.1 Update to Environmental Information

While preparing the information requested by ABP the opportunity has been taken to update the basis of the forecast future noise to allow for developments since the 2021 EIAR. Given the extensive nature of this update an EIAR Supplement has prepared including replacement chapters for certain topics and updates for other. The replacement Chapter 13, and specifically Appendix 13B, contains full details of the updated noise modelling methodology. In summary, the changes compared to 2021 are as follows:

- Updated forecasts which allow for the recent recovery in activity following the Covid pandemic and the ongoing modernisation of airline fleets
- Changes to the runway use assumption in the early morning, in particular that segregated mode, where either the North or South runway is used for departures, with the other used for arrivals, will occur
- Updated departures routes, in particular for westerly departures, based on recent radar data
- Changes to the distribution of the aircraft from the runways following analysis of the distribution of flights in 2022
- The noise modelling has also been updated allowing for more recent noise levels from airports Noise and Track Keeping system and radar information on flight profiles.

3.0 ISSUE 1 – IMPACT OF PEAK NOISE LEVELS

3.1 ABP Request and Clarification

The request from ABP was as follows:

You are requested to assess the probability of additional awakening due to the peak $L_{A,s,Max}$ of ATMs at night between 2300 and 0700hrs for the 92 day summer average of ATMs and airport modes, and for the single modes of airport operation and for the likelihood of additional awakenings for the overall annual average number of ATMs at night, based on the approach described in the review supporting the WHO ENG 2018 (Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and the Effects on Sleep – International Journal of Environmental Research and Public Health).

daa sought clarification on this and in their letter of 26 May 2023 ABP responded that:

Regarding scenarios to be tested the following years are acceptable;

I. 2018,

II. 2025 Permitted and,

Ill. 2025 Proposed

3.2 Awakenings

As noted in the ABP request, the EIAR assessed the effects of noise at night using the L_{night} metric using a standardised scale following the guidance in the World Health Organisation's (WHO) Environmental Noise Guidelines (2018). The WHO justify the use of this approach in Table 3 of the guidelines, and note that for the critical health outcome of effects on sleep (L_{night}) that the percentage of the population highly sleep-disturbed (%HSD), self-reported, assessed with a standardised scale is 'the most meaningful, policy-relevant measure of this health outcome'[1].

This approach was also endorsed by the European Commission in Directive 2020/367 which amends Annex III to Directive 2002/49/EC of the European Parliament and of the Council as regards the establishment of assessment methods for harmful effects of environmental noise. This amendment advises that for the purposes of the assessment of harmful effects three measures shall be considered, the one relating to night noise is high sleep disturbance. The directive advises that this is to be calculated from the L_{night} metric.

[1] World Health Organisation Europe Environmental Noise Guidelines for the European Region (2018): Table 3. Critical health outcomes, outcome measures identified and justifications for selection https://www.who.int/europe/publications/i/item/9789289053563

The L_{night} metric is equivalent to the noise from all the individual events, so is a way of expressing the total noise at a location and allowing comparison between different exposures.

ABP note that aircraft noise is not experienced in an "average" fashion and so seek further information in addition to that provided by the L_{night} metric which is an energy average. However, it should be noted that the use of the L_{night} metric is not treating the aircraft noise as a steady level, it is simply a way of adding up the noise from the individual aircraft events in the period. In the supporting research the responses from individuals who have experienced a series of individual aircraft events are attributed to such an overall level to allow comparison to other recipients who have experienced a different series of aircraft events to establish a typical response.

The ABP request is for an alternative measure of sleep disturbance which assesses the probability of additional awakening based on the maximum noise level ($L_{As,max}$) from individual events. This is set out in WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Effects on Sleep.

The term awakenings in this context is that used by researchers in the field and differs from the lay meaning of becoming awake and aware of your surroundings. As stated in the WHO systematic review referred to by ABP, the outcome of this research was the probability of 'a sleep stage change to awake or S1'.

The document also states that 'a healthy adult briefly awakens ca. 20 times during an 8 h bed period (most of these awakenings are too short to be remembered the next morning)'. Such an underlying level is relevant particularly when considering forecast additional awakenings due to a particular noise source.

3.3 Noise Modelling

For the awakenings assessment the maximum noise level ($L_{As,max}$) from individual aircraft events have been determined across the receptors in the study area. The maximum noise levels at the individual receptors have then been used to determine the probability of each aircraft event causing an awakening, separately for each receptor. These have then been combined with the number of times each event occurs on an average night to determine an expected number of awakenings. The totals for each of the receptors have then been combined to give a single value for the population set.

For example, if an aircraft event produced a noise level that gave a 10% chance of an awakening at 10 receptors, then the expected number of awakenings would be 1, although for each individual receptor the chance of an awakening is only 10%.

For 2018 the existing noise modelling already included contours giving the number of times a specific noise level was exceeded at night. These were extended to determine the number of events at the relevant maximum noise levels across all the dwellings in the study area.

For 2025 and 2035 the noise levels were determined using the updated model, allowing for recent noise levels, routes and radar data, by aircraft type and modelled track. This equated to almost 3,000 individual cases after allowance was also made for different flight lengths which affect aircraft weight because of the fuel needed.

The same study area was used for all of the awakenings assessments and is described in replacement Chapter 13 of the EIAR Supplement, and specifically Appendix 13B section 13B.3 and Figure 13B-1.

To convert the predicted external noise levels to internal noise levels a reduction of 21 dB has been assumed. This is the value selected in the WHO Europe Night Noise Guidelines for Europe (2009). It is a composite value with an allowance for windows not always being closed. The guidelines note that this is a relatively low value and is subject to national and cultural differences. The assessment therefore makes an allowance for the existing and proposed enhancement of the sound insulation scheme at the airport.

3.4 Noise Outputs

3.4.1 Annual

The noise modelling described in Section 3.3 has been used to determine the expected number of additional awakenings for 2018, 2025 and 2035 based the annual average nightly movements, and these are given in Table 1 below. They show a reduction over time from 2018 with or without the proposed Relevant Action.

Year	Nightly Additional Awakenings
2018	46,261
2025 Permitted	27,094
2025 Proposed	26,785
2035 Permitted	16,087
2035 Proposed	20,536

Table 1: Nightly Additional Awakenings based on Annual Average

3.4.2 Summer

For the future years additional the expected number of additional awakenings based on the summer average nightly movements are given in Table 2 below. These are higher than those based on the annual average, due to greater activity in the summer.

Year	Nightly Additional Awakenings
2025 Permitted	30,416
2025 Proposed	30,095
2035 Permitted	18,062
2035 Proposed	23,074

Table 2: Nightly Additional Awakenings based on Summer Average

3.4.3 Annual – Single Mode

For the future years the expected number of additional awakenings based on the annual average nightly movements and easterly operations are given in Table 3 below. These are higher than those based on the average split of easterly and westerly operations.

Year	Nightly Additional Awakenings
2025 Permitted	33,326
2025 Proposed	40,985
2035 Permitted	20,849
2035 Proposed	33,089

Table 3: Nightly Additional Awakenings based on Annual Average – Easterly Operations

For the future years the expected number of additional awakenings based on the annual average nightly movements and westerly operations are given in Table 4 below. These are lower than those based on the average split of easterly and westerly operations.

Year	Nightly Additional Awakenings
2025 Permitted	24,515
2025 Proposed	21,468
2035 Permitted	14,075
2035 Proposed	15,801

Table 4: Nightly Additional Awakenings based on Annual Average – Westerly Operations

3.4.4 Summer – Single Mode

For the future years the expected number of additional awakenings based on the summer average nightly movements and easterly operations are given in Table 5 below. These are higher than those based on the average split of easterly and westerly operations.

Year	Nightly Additional Awakenings
2025 Permitted	37,413
2025 Proposed	46,051
2035 Permitted	23,409
2035 Proposed	37,179

Table 5: Nightly Additional Awakenings based on Summer Average – Easterly Operations

For the future years the expected number of additional awakenings based on the annual average nightly movements and westerly operations are given in Table 6 below. These are lower than those based on the average split of easterly and westerly operations.

Year	Nightly Additional Awakenings
2025 Permitted	27,522
2025 Proposed	24,121
2035 Permitted	15,803
2035 Proposed	17,754

Table 6: Nightly Additional Awakenings based on Summer Average – Westerly Operations

3.5 Discussion

When considering the expected number of nightly awakenings given in Section 3.4 it should be noted that they relate to a population of over 1 million people, and that awakenings occur irrespective of the any aircraft noise events. The WHO notes a healthy adult briefly awakens ca. 20 times during an 8 h bed period. Combining these values gives an underlying level of awakenings of ca. 20 million. In comparison to this the additional awakenings due to aircraft noise are much lower.

Given the size of the population under consideration, this also means that for much of the population the chance of an additional awakening is low, and on average it is under 3%.

While there are no specific criteria by which to judge the significance of the number of additional awakenings the relative values for the scenarios can be compared. Considering the annual situation, a reduction is expected from 2018. In 2025 this is by around 40% irrespective of

whether the proposed change to the controls at night proceeds. By 2035 a greater reduction is forecast, by around 55% with the proposed change, and 65% without it.

Looking at the future years in more detail, the forecast level on a summer night is 12% higher than on an annual night, due to the greater number of movements. During nights with easterly operations the values are higher than the average for the relevant period, annual or summer, whereas on the more common nights with westerly operations they are lower than the average.

As noted in Section 3.2 above, the EIAR assessed the effects of noise at night using the L_{night} metric to determine the population highly sleep-disturbed (%HSD). The values from that assessment are of a similar magnitude to the number of additional awakenings and show the same pattern across the scenarios.

4.0 ISSUE 2 – SENSITIVITY TESTING

4.1 ABP Request and Clarification

The request from ABP was as follows:

To better understand what the consequences of uncertainty in the input data might be, or at least the associated trends with such uncertainty on the area covered, and the population affected by the noise contours presented in the EIAR. You are requested to present further analysis by sensitivity testing of:

(a) the noise contours,

(b) the area covered and

(c) crucially the number and type of sensitive receptors affected when assessed using the

significance criteria in the EIAR, based on the assumption of +/- 1 dBA change in the predicted noise levels (crudely equivalent to an approximately 25% change in the area of the noise contours or all things being equal the number of ATMs used to calculate the noise contours).

4.2 Approach

Information has been prepared in response to the request for the years of 2025 and 2035. The approach has been to consider two scenarios for each year. In the first it is assumed that for both the Permitted and Proposed scenarios the noise is 1 dB(A) higher. For the second it is assumed that for the Permitted and Proposed scenarios the noise is 1 dB(A) lower.

This approach is on the basis that the input data for the future scenarios both Permitted and Proposed are either the same in both scenarios, for example the noise performance of the aircraft and the routes flown, or are related, like the forecasts. The latter have a common basis, with adjustments made to reflect the difference between the scenarios. Also given the other controls on the airport such as the limit on passenger numbers, for which no change is sought as part of this application, there being significantly more movements in the Proposed scenario than the Permitted scenario does not seem realistic.

The results prepared include noise contours, their areas, and the sensitive receptors they contain, both residential and other noise sensitive buildings. No allowance has been made in the figures for any benefits of sound insulation schemes, as these could vary in extent and so would be another variable.

4.3 Noise Outputs

4.3.1 2025 L_{den} – Predicted Levels 1 dB(A) Higher

Figure 01 shows L_{den} noise contours for the 2025 Proposed (+1 dB(A)) Scenario and Figure 02 the corresponding contours for the 2025 Permitted (+1 dB(A)) Scenario.

For the 2025 scenarios L_{den} contours, the number of dwellings and the estimated population that they contain have been determined as described in replacement Chapter 13 of the EIAR Supplement, and specifically Appendix 13B Air Noise Methodology section 13B.4. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (+1 dB(A)) Scenario are given by contour in Table 7 along with the areas of the contours. The results for the Proposed (+1 dB(A)) Scenario are given by contour in Table 8 along with the areas of the contours.

The contour results presented in this report are all cumulative, e.g. any dwellings inside a 55 dB contour are also included in the totals for any lower value contour.

Scenario		2025 Permitted (+1 dB(A))			
Contour L_{den}	Area (km²)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	705.2	147,154	432,582	160,531	474,956
50	263.6	42,197	127,196	50,953	154,213
55	109.0	9,659	29,525	16,438	50,333
60	41.3	1,699	4,551	4,132	12,175
65	13.5	121	338	121	338
70	4.4	6	19	6	19

Table 7: Areas, number of dwellings and population in 2025 Permitted L_{den} contours

Scenario		2025 Proposed (+1 dB(A))			
Contour L_{den}	Area (km²)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	824.2	139,298	407,521	151,167	444,530
50	293.6	45,912	137,544	54,904	165,309
55	122.0	10,850	31,246	17,869	52,720
60	48.2	1,968	5,532	4,319	12,729
65	16.1	206	685	258	882
70	5.6	23	70	23	70

Table 8: Areas, number of dwellings and population in 2025 Proposed L_{den} contours

The 2025 Proposed (+1 dB(A)) Scenario is compared with the 2025 Permitted (+1 dB(A)) Scenario in Table 9. The table includes all people in existing residential receptors who are exposed to at least 45 dB L_{den} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	70,494	229,337
Not Significant	74,054	43,311
Slight	5,511	14,282
Moderate	5,310	3,759
Significant	8,487	186
Very Significant	0	0
Profound	0	0

Table 9: Air Noise (L_{den}) People by Magnitude of effect – 2025 Proposed vs 2025 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. The numbers of each of these above the thresholds given in the EIAR for the 2025 Proposed (+1 dB(A)) Scenario are given in Table 10, where they are compared with the numbers for the 2025 Permitted (+1 dB(A)) Scenario.

Scenario	No. Receptors Above Threshold for Medium Absolute Effect		
	Schools	Residential Healthcare Facilities	Places of Worship
2025 Proposed (+1 dB(A))	10	4	5
2025 Permitted (+1 dB(A))	10	4	6

Table 10: Schools, residential healthcare facilities and places of worship in 2025 L_{den} contours

The increases for the individual non residential receptors are all less than 3 dB(A) and would not be rated as significant.

4.3.2 2025 L_{night} – Predicted Levels 1 dB(A) Higher

Figure 03 shows L_{night} noise contours for the 2025 Proposed (+1 dB(A)) Scenario and Figure 04 the corresponding contours for the 2025 Permitted (+1 dB(A)) Scenario.

For the 2025 scenarios L_{night} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential

development. The results for the Permitted (+1 dB(A)) Scenario are given by contour in Table 11 along with the areas of the contours. The results for the Proposed (+1 dB(A)) Scenario are given by contour in Table 12 along with the areas of the contours.

Scenario		2025 Permitted (+1 dB(A))			
Contour L_{night} (dB)	Area (km²)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	295.6	67,905	206,497	79,673	244,093
45	113.1	14,943	44,499	21,999	66,058
50	45.4	4,411	14,063	8,626	27,414
55	15.6	348	796	509	1,402
60	5.0	49	127	49	127
65	1.6	2	6	2	6

Table 11: Areas, number of dwellings and population in 2025 Permitted L_{night} contours

Scenario		2025 Proposed (+1 dB(A))			
Contour L_{night} (dB)	Area (km²)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	400.8	70,590	209,083	80,508	239,571
45	171.0	20,490	61,419	27,855	84,011
50	71.3	4,015	11,494	9,999	30,090
55	26.6	735	2,105	2,332	7,084
60	8.6	38	117	38	117
65	2.9	2	6	2	6

Table 12: Areas, number of dwellings and population in 2025 Proposed L_{night} contours

The 2025 Proposed (+1 dB(A)) Scenario is compared with the 2025 Permitted (+1 dB(A)) Scenario in Table 13. The table includes all people in existing residential receptors who are exposed to at least 40 dB L_{night} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	29,138	75,189
Not Significant	13,069	31,070
Slight	59,720	28,155
Moderate	3,671	8,354
Significant	9,086	11,526
Very Significant	77	852
Profound	0	197

Table 13: Air Noise (L_{night}) People by Magnitude of effect – 2025 Proposed vs 2025 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. Of these, only residential healthcare facilities are highly sensitive to noise at night. The numbers of each of these above the thresholds given in the EIAR for the 2025 Proposed (+1 dB(A)) Scenario are given in Table 14, where they are compared with the numbers for the 2025 Permitted (+1 dB(A)) Scenario.

Scenario	No. Residential Healthcare Facilities Above Threshold for Medium Absolute Effect
2025 Proposed (+1 dB(A))	6
2025 Permitted (+1 dB(A))	3

Table 14: Schools, residential healthcare facilities and places of worship in 2025 L_{night} contours

For 3 of these residential healthcare facilities in the 2025 Proposed (+1 dB(A)), the increases for the individual receptors are greater than 3 dB(A) and would be rated as significant.

4.3.3 2025 L_{den} – Predicted Levels 1 dB(A) Lower

Figure 05 shows L_{den} noise contours for the 2025 Proposed (-1 dB(A)) Scenario and Figure 06 the corresponding contours for the 2025 Permitted (-1 dB(A)) Scenario.

For the 2025 scenarios L_{den} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (-1 dB(A)) Scenario are given by contour in Table 15 along with the areas of the contours. The results for the Proposed (-1 dB(A)) Scenario are given by contour in Table 16 along with the areas of the contours.

Scenario		2025 Permitted (-1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	447.8	93,847	281,034	105,495	317,496
50	184.6	23,347	69,768	30,806	92,670
55	75.3	5,075	15,382	11,036	33,905
60	26.9	532	1,633	1,999	6,244
65	8.6	36	108	36	108
70	2.9	2	6	2	6

Table 15: Areas, number of dwellings and population in 2025 Permitted L_{den} contours

Scenario		2025 Proposed (-1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	522.5	90,373	264,529	100,619	295,963
50	207.0	27,615	82,847	35,587	107,407
55	83.9	5,390	15,662	11,263	33,621
60	32.6	1,062	2,946	2,859	8,525
65	10.6	66	197	66	197
70	3.7	5	16	5	16

Table 16: Areas, number of dwellings and population in 2025 Proposed L_{den} contours

The 2025 Proposed (-1 dB(A)) Scenario is compared with the 2025 Permitted (-1 dB(A)) Scenario in Table 17. The table includes all people in existing residential receptors who are exposed to at least 45 dB L_{den} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	36,595	178,243
Not Significant	46,758	22,117
Slight	7,780	10,745
Moderate	5,777	2,621
Significant	4,374	113
Very Significant	0	0
Profound	0	0

Table 17: Air Noise (L_{den}) People by Magnitude of effect – 2025 Proposed vs 2025 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. The numbers of each of these above the thresholds given in the EIAR for the 2025 Proposed (-1 dB(A)) Scenario are given in Table 18, where they are compared with the numbers for the 2025 Permitted (-1 dB(A)) Scenario.

Scenario	No. Receptors Above Threshold for Medium Absolute Effect		
	Schools	Residential Healthcare Facilities	Places of Worship
2025 Proposed (+1 dB(A))	8	4	4
2025 Permitted (+1 dB(A))	9	4	4

Table 18: Schools, residential healthcare facilities and places of worship in 2025 L_{den} contours

The increases for the individual non residential receptors are all less than 3 dB(A) and would not be rated as significant.

4.3.4 2025 L_{night} – Predicted Levels 1 dB(A) Lower

Figure 07 shows L_{night} noise contours for the 2025 Proposed (-1 dB(A)) Scenario and Figure 08 the corresponding contours for the 2025 Permitted (-1 dB(A)) Scenario.

For the 2025 scenarios L_{night} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (-1 dB(A)) Scenario are given by contour in Table 19 along with the areas of the contours. The results for the Proposed (-1 dB(A)) Scenario are given by contour in Table 20 along with the areas of the contours.

Scenario		2025 Permitted (-1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	193.4	41,141	125,758	49,392	151,168
45	80.7	7,822	24,050	14,030	43,270
50	30.4	1,881	6,047	5,474	17,542
55	9.9	95	253	95	253
60	3.1	6	19	6	19
65	1.1	0	0	0	0

Table 19: Areas, number of dwellings and population in 2025 Permitted L_{night} contours

Scenario		2025 Proposed (-1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	282.4	44,310	132,952	53,255	160,556
45	122.3	11,221	33,075	18,222	54,499
50	49.1	2,293	6,308	5,976	17,538
55	16.5	347	1,126	903	2,917
60	5.5	13	41	13	41
65	1.9	0	0	0	0

Table 20: Areas, number of dwellings and population in 2025 Proposed L_{night} contours

The 2025 Proposed (-1 dB(A)) Scenario is compared with the 2025 Permitted (-1 dB(A)) Scenario in Table 21. The table includes all people in existing residential receptors who are exposed to at least 40 dB L_{night} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	22,239	47,303
Not Significant	6,100	14,464
Slight	32,084	24,992
Moderate	6,397	7,965
Significant	3,843	7,243
Very Significant	3	448
Profound	0	116

Table 21: Air Noise (L_{night}) People by Magnitude of effect – 2025 Proposed vs 2025 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. Of these, only residential healthcare facilities are highly sensitive to noise at night. The numbers of each of these above the thresholds given in the EIAR for the 2025 Proposed (-1 dB(A)) Scenario are given in Table 22, where they are compared with the numbers for the 2025 Permitted (-1 dB(A)) Scenario.

Scenario	No. Residential Healthcare Facilities Above Threshold for Medium Absolute Effect
2025 Proposed (-1 dB(A))	4
2025 Permitted (-1 dB(A))	2

Table 22: Schools, residential healthcare facilities and places of worship in 2025 L_{night} contours

For 3 of these residential healthcare facilities in the 2025 Proposed (-1 dB(A)), the increases for the individual receptors are greater than 3 dB(A) and would be rated as significant.

4.3.5 2035 L_{den} – Predicted Levels 1 dB(A) Higher

Figure 09 shows L_{den} noise contours for the 2035 Proposed (+1 dB(A)) Scenario and Figure 10 the corresponding contours for the 2035 Permitted (+1 dB(A)) Scenario.

For the 2035 scenarios L_{den} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (+1 dB(A)) Scenario are given by contour in Table 23 along with the areas of the contours. The results for the Proposed (+1 dB(A)) Scenario are given by contour in Table 24 along with the areas of the contours.

Scenario		2035 Permitted (+1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	431.9	80,706	241,551	90,708	272,297
50	180.6	21,095	63,358	28,423	85,876
55	78.2	5,278	15,840	11,311	34,580
60	29.1	827	2,329	2,524	7,608
65	9.3	39	119	39	119
70	3.0	2	6	2	6

Table 23: Areas, number of dwellings and population in 2035 Permitted L_{den} contours

Scenario		2035 Proposed (+1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	582.9	92,271	269,635	102,586	301,250
50	222.3	28,392	84,940	36,387	109,576
55	93.5	6,079	17,742	12,709	38,059
60	36.8	1,523	4,142	3,449	10,086
65	12.0	76	228	76	228
70	4.1	6	19	6	19

Table 24: Areas, number of dwellings and population in 2035 Proposed L_{den} contours

The 2025 Proposed (+1 dB(A)) Scenario is compared with the 2035 Permitted (+1 dB(A)) Scenario in Table 25. The table includes all people in existing residential receptors who are exposed to at least 45 dB L_{den} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	30,958	166,496
Not Significant	11,791	52,721
Slight	4,743	25,072
Moderate	5,173	2,733
Significant	110	125
Very Significant	0	0
Profound	0	0

Table 25: Air Noise (L_{den}) People by Magnitude of effect – 2035 Proposed vs 2035 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. The numbers of each of these above the thresholds given in the EIAR for the 2035 Proposed (+1 dB(A)) Scenario are given in Table 26, where they are compared with the numbers for the 2035 Permitted (+1 dB(A)) Scenario.

Scenario	No. Receptors Above Threshold for Medium Absolute Effect		
	Schools	Residential Healthcare Facilities	Places of Worship
2035 Proposed (+1 dB(A))	8	4	4
2035 Permitted (+1 dB(A))	9	4	5

Table 26: Schools, residential healthcare facilities and places of worship in 2035 L_{den} contours

The increases for the individual non residential receptors are all less than 3 dB(A) and would not be rated as significant.

4.3.6 2035 L_{night} – Predicted Levels 1 dB(A) Higher

Figure 11 shows L_{night} noise contours for the 2035 Proposed (+1 dB(A)) Scenario and Figure 12 the corresponding contours for the 2035 Permitted (+1 dB(A)) Scenario.

For the 2035 scenarios L_{night} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (+1 dB(A)) Scenario are given by contour in Table 27 along with the areas of the contours. The results for the Proposed (+1 dB(A)) Scenario are given by contour in Table 28 along with the areas of the contours.

Scenario		2035 Permitted (+1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	168.5	31,067	94,093	39,015	118,516
45	76.7	7,339	22,903	13,562	42,172
50	30.3	2,008	5,968	5,630	17,528
55	10.2	100	273	100	273
60	3.2	7	22	7	22
65	1.1	0	0	0	0

Table 27: Areas, number of dwellings and population in 2035 Permitted L_{night} contours

Scenario		2035 Proposed (+1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	317.0	49,318	147,259	58,686	176,075
45	137.6	13,595	40,260	20,609	61,730
50	57.3	3,081	8,672	8,042	24,024
55	19.9	455	1,432	2,022	6,343
60	6.5	18	56	18	56
65	2.2	0	0	0	0

Table 28: Areas, number of dwellings and population in 2035 Proposed L_{night} contours

The 2035 Proposed (+1 dB(A)) Scenario is compared with the 2035 Permitted (+1 dB(A)) Scenario in Table 29. The table includes all people in existing residential receptors who are exposed to at least 40 dB L_{night} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	6,456	17,822
Not Significant	13,920	46,287
Slight	4,365	33,774
Moderate	6,681	23,183
Significant	205	10,833
Very Significant	3	515
Profound	0	156

Table 29: Air Noise (L_{night}) People by Magnitude of effect – 2035 Proposed vs 2035 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. Of these, only residential healthcare facilities are highly sensitive to noise at night. The numbers of each of these above the thresholds given in the EIAR for the 2035 Proposed (+1 dB(A)) Scenario are given in Table 30, where they are compared with the numbers for the 2035 Permitted (+1 dB(A)) Scenario.

Scenario	No. Residential Healthcare Facilities Above Threshold for Medium Absolute Effect
2035 Proposed (+1 dB(A))	4
2035 Permitted (+1 dB(A))	2

Table 30: Schools, residential healthcare facilities and places of worship in 2035 L_{night} contours

For 3 of these residential healthcare facilities in the 2025 Proposed (+1 dB(A)), the increases for the individual receptors are greater than 3 dB(A) and would be rated as significant.

4.3.7 2035 L_{den} – Predicted Levels 1 dB(A) Lower

Figure 13 shows L_{den} noise contours for the 2035 Proposed (-1 dB(A)) Scenario and Figure 14 the corresponding contours for the 2035 Permitted (-1 dB(A)) Scenario.

For the 2035 scenarios L_{den} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (-1 dB(A)) Scenario are given by contour in Table 31 along with the areas of the contours. The results for the Proposed (-1 dB(A)) Scenario are given by contour in Table 32 along with the areas of the contours.

Scenario		2035 Permitted (-1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	302.2	47,668	143,324	56,715	171,279
50	130.1	12,727	37,968	19,741	59,438
55	53.2	2,662	7,474	7,636	23,009
60	18.2	370	1,189	1,026	3,280
65	5.9	17	54	17	54
70	2.0	0	0	0	0

Table 31: Areas, number of dwellings and population in 2035 Permitted L_{den} contours

Scenario		2035 Proposed (-1 dB(A))			
Contour L_{den}	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
45	375.0	59,490	176,393	69,109	205,974
50	158.0	16,833	49,577	23,937	71,302
55	64.7	3,575	10,086	8,259	24,350
60	23.6	571	1,716	2,168	6,695
65	7.9	33	101	33	101
70	2.7	0	0	0	0

Table 32: Areas, number of dwellings and population in 2035 Proposed L_{den} contours

The 2035 Proposed (-1 dB(A)) Scenario is compared with the 2035 Permitted (-1 dB(A)) Scenario in Table 33. The table includes all people in existing residential receptors who are exposed to at least 45 dB L_{den} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	5,618	111,914
Not Significant	5,205	33,253
Slight	6,343	16,197
Moderate	2,490	1,110
Significant	87	53
Very Significant	0	0
Profound	0	0

Table 33: Air Noise (L_{den}) People by Magnitude of effect – 2035 Proposed vs 2035 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. The numbers of each of these above the thresholds given in the EIAR for the 2035 Proposed (-1 dB(A)) Scenario are given in Table 34, where they are compared with the numbers for the 2035 Permitted (-1 dB(A)) Scenario.

Scenario	No. Receptors Above Threshold for Medium Absolute Effect		
	Schools	Residential Healthcare Facilities	Places of Worship
2025 Proposed (+1 dB(A))	8	3	3
2025 Permitted (+1 dB(A))	6	3	2

Table 34: Schools, residential healthcare facilities and places of worship in 2035 L_{den} contours

The increases for the individual non residential receptors are all less than 3 dB(A) and would not be rated as significant.

4.3.8 2035 L_{night} – Predicted Levels 1 dB(A) Lower

Figure 15 shows L_{night} noise contours for the 2035 Proposed (-1 dB(A)) Scenario and Figure 16 the corresponding contours for the 2035 Permitted (-1 dB(A)) Scenario.

For the 2035 scenarios L_{night} contours, the number of dwellings and the estimated population that they contain have been determined. This has been done based on the existing dwellings and population excluding consented developments, and also based on the existing dwellings and population allowing for consented developments and land zoned for residential development. The results for the Permitted (-1 dB(A)) Scenario are given by contour in Table 35 along with the areas of the contours. The results for the Proposed (-1 dB(A)) Scenario are given by contour in Table 36 along with the areas of the contours.

Scenario		2035 Permitted (-1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	123.3	15,543	46,806	22,554	68,242
45	53.0	5,341	16,809	10,744	33,645
50	19.9	778	2,266	3,590	11,323
55	6.5	65	172	65	172
60	2.0	2	6	2	6
65	0.8	0	0	0	0

Table 35: Areas, number of dwellings and population in 2035 Permitted L_{night} contours

Scenario		2035 Proposed (-1 dB(A))			
Contour L_{night} (dB)	Area (km^2)	Excluding Consented Developments		Including Consented Developments	
		Dwellings	Population.	Dwellings	Population
40	226.8	29,934	89,223	37,875	113,623
45	99.3	6,952	20,721	13,731	41,529
50	39.0	1,803	4,784	4,289	12,492
55	12.7	113	362	113	362
60	4.2	8	25	8	25
65	1.5	0	0	0	0

Table 36: Areas, number of dwellings and population in 2035 Proposed L_{night} contours

The 2035 Proposed (-1 dB(A)) Scenario is compared with the 2035 Permitted (-1 dB(A)) Scenario in Table 37. The table includes all people in existing residential receptors who are exposed to at least 40 dB L_{night} in at least one of the scenarios. People who are exposed to negligible absolute noise levels in both scenarios are assessed as not being subject to significant effects and so have not been included.

Magnitude of effect	No. people with Beneficial Effect	No. people with Adverse Effect
Imperceptible	1,641	8,396
Not Significant	1,485	35,913
Slight	7,056	12,092
Moderate	3,936	13,105
Significant	170	8,044
Very Significant	0	252
Profound	0	100

Table 37: Air Noise (L_{night}) People by Magnitude of effect – 2035 Proposed vs 2035 Permitted

In addition to the consideration of residential properties, other potential receptors of high sensitivity are included in the EIAR assessment, specifically schools, residential healthcare facilities and places of worship. Of these, only residential healthcare facilities are highly sensitive to noise at night. The numbers of each of these above the thresholds given in the EIAR for the 2035 Proposed (-1 dB(A)) Scenario are given in Table 38, where they are compared with the numbers for the 2035 Permitted (-1 dB(A)) Scenario.

Scenario	No. Residential Healthcare Facilities Above Threshold for Medium Absolute Effect
2025 Proposed (-1 dB(A))	4
2025 Permitted (-1 dB(A))	1

Table 38: Schools, residential healthcare facilities and places of worship in 2035 L_{night} contours

For 3 of these residential healthcare facilities in the 2035 Proposed (-1 dB(A)), the increases for the individual receptors are greater than 3 dB(A) and would be rated as significant.

4.4 Discussion

Compared to the exposures detailed in replacement Chapter 13 of the EIAR Supplement, those for the corresponding Permitted and Proposed scenarios where the noise is 1 dB(A) higher are consequently higher, and those for the corresponding Permitted and Proposed scenarios where the noise is 1 dB(A) lower are consequently lower.

In terms of significance for residential receptors the situation using the L_{den} metric is summarised in Table 39. This details the total number of people experiencing significant effects, either beneficial or adverse. In each of 2025 and 2035, although the absolute numbers vary, the relationship between those with beneficial and adverse effect is generally consistent under each of the scenarios.

Year / Scenario	No. of People with Significant Effect (L_{den})	
	Beneficial	Adverse
2025 Proposed	7,060	119
2025 Proposed (+1 dB(A))	8,487	186
2025 Proposed (-1 dB(A))	4,374	113
2035 Proposed	104	104
2035 Proposed (+1 dB(A))	110	125
2035 Proposed (-1 dB(A))	87	53

Table 39: Significant Effects by Scenario (L_{den})

In terms of significance for residential receptors the situation using the L_{night} metric is summarised in Table 40. This details the total number of people experiencing significant effects, either beneficial or adverse. In each of 2025 and 2035, although the absolute numbers vary, the relationship between those with beneficial and adverse effect is consistent under each of the scenarios.

Year / Scenario	No. of People with Significant Effect (L_{night})	
	Beneficial	Adverse
2025 Proposed	6,424	10,109
2025 Proposed (+1 dB(A))	9,163	12,575
2025 Proposed (-1 dB(A))	3,846	7,807
2035 Proposed	185	9,456
2035 Proposed (+1 dB(A))	208	11,504
2035 Proposed (-1 dB(A))	170	8,396

Table 40: Significant Effects by Scenario (L_{night})

When is comes to non residential receptors, the findings for the additional scenarios are consistent with those in the EIAR, which changes that would not be rated as significant when considering L_{den} metric, but increases for 3 properties that would be rated as significant when considering the L_{night} metric.

5.0 ISSUE 3 – BASELINE YEARS

5.1 ABP Request and Clarification

The request from ABP was as follows:

… it is presumed the annual and 92 day summer period numbers of ATMs were lower prior to 2018.

Consequently, you are requested to comment on why:

a) the baseline figures for 2019 were not used for the purposes of analysis.

b) When prior to 2018 were the annual and 92 day summer period numbers of ATMs last more than 25% below those in 2018, and

c) If the numbers of ATMs were last more than 25% below those in 2018 after the Northern runway came into use, what would be the difference in terms of the number of dwellings and persons likely to experience an increase in Lnight to over 50 dBA and 55 dBA compared to the numbers presented in the EIAR.

daa sought clarification on this and in their letter of 26 May 2023 ABP responded that:

Regarding the clarity on the 25% of ATMs on the North Runway, request 3 (c) (i) has been rephrased as follows:

> *I. Assuming the fleet mix stays the same but the assumed numbers of ATMs at night are 25% below those in 2018, what would be the difference in terms of the a) number of dwellings and b) persons likely to experience an increase in L_{night} to over 50 dBA and 55 dBA compared to the numbers presented in the EIAR.*

5.2 Response a) 2019 Baseline Figures Not Used for Purposes of Analysis

When undertaking environmental assessment, the approach is to set out the current situation and then to consider what may happen in the future with or without the change being sought. This allows changes that are going to happen irrespective of the change being sought to be accounted for. Information on the current and past situations is included to provide context but is not part of the analysis. Information on past activity, both in 2018 and 2019 was included in the 2020 EIAR.

5.3 Response b) Movements last 25% below 2018

2014 was the last year in which the movements at night were at least 25% below those in 2018. This is detailed in Table 41 below which includes historic movements for the annual period and the 92 day summer period.

Year / Scenario	Night Movements	
	Annual	Summer
2018	27,896	8,755
2018 minus 25%	*20,922*	*6,566*
2017	27,287	8,689
2016	24,753	7,800
2015	22,546	7,073
2014	19,576	6,253

Table 41: Past Night Movements

5.4 Response c)

To determine the number of dwellings and persons likely to experience an increase in noise at night, the number exposed under the scenarios of interest has first been determined. These are the Permitted Scenario, the Proposed Scenario, and Proposed Reduced Scenario. The latter is based on the Proposed Scenario but with the number of movements factored down so they are equal to 25% below the number in 2018, while keeping the fleet mix constant. This results in a similar number of movements to the Permitted Scenario but retains the use of the North Runway for part of the night.

For each of these scenarios the number of dwellings and the estimated population have been determined based on the existing dwellings and population excluding consented developments. This is so that the increases subsequently computed reflect the changes in noise, rather than introduction of new dwellings and associated population. The dwelling results are given by contour in Table 42 and the population results in Table 43.

The contour results are all cumulative, e.g. any dwellings inside a 55 dB contour are also included in the totals for any lower value contour.

Contour L_{night} (dB)	Dwellings Excluding Consented Developments					
	2025 Permitted	2025 Proposed	2025 Proposed Reduced	2035 Permitted	2035 Proposed	2035 Proposed Reduced
40	52,493	56,532	31,206	22,110	37,765	21,357
45	10,424	15,630	6,725	6,270	10,104	4,750
50	3,138	3,113	1,592	973	2,318	1,071
55	115	466	78	79	372	47
60	17	26	6	4	13	3
65	0	0	0	0	0	0

Table 42: Exposed Dwellings at Night by Scenario and Contour

Contour L_{night} (dB)	Population Excluding Consented Developments					
	2025 Permitted	2025 Proposed	2025 Proposed Reduced	2035 Permitted	2035 Proposed	2035 Proposed Reduced
40	160,430	168,472	92,902	66,841	112,987	63,987
45	31,419	46,331	19,969	19,626	29,900	13,827
50	9,972	8,766	4,152	2,852	6,390	2,935
55	315	1,463	233	212	1,197	145
60	48	80	19	13	41	10
65	0	0	0	0	0	0

Table 43: Exposed Population at Night by Scenario and Contour

Considering the dwellings exposed to at least 50 dB L_{night} in 2025 the totals are similar for the Permitted and Proposed scenarios. This is despite the greater number of movements in the Proposed Scenario and is due to the differing distribution of dwellings in the areas overflown. Due to the reduced number of movements the total for the Proposed Reduced Scenario is lower. In terms of population the highest total is for the Permitted Scenario, with the lowest for the Proposed Reduced Scenario.

Considering the dwellings exposed to at least 55 dB L_{night} in 2025 the total is highest for the Proposed Scenario, in part due to the greater number of movements compared to the Permitted Scenario. Due to the reduced number of movements the total for the Proposed Reduced Scenario is the lowest. The population totals have the same pattern.

Considering the dwellings exposed to at least 50 dB L_{night} in 2035 the totals are similar for the Permitted and Proposed Reduced scenarios. This differs from the situation in 2025 and is due to contours being smaller in 2035 meaning they contain reduced areas which have different dwelling distributions. The population totals follow the same pattern.

Considering the dwellings exposed to at least 55 dB L_{night} in 2035 the total is highest for the Proposed Scenario, in part due to the greater number of movements compared to the Permitted Scenario. Due to the reduced number of movements the total for the Proposed Reduced Scenario is the lowest. The population totals follow the same pattern.

The number of dwellings and people forecast to experience an increase in their L_{night} level to over 50 dB(A) and over to over 55 dB(A) has been determined. This has been determined by comparing the exposures of the Permitted and Proposed scenarios in the latest EIAR update, and by comparing the exposures of the Permitted and Proposed Reduced scenarios. The additional night exposure is given in Table 44.

Scenario	No. of Dwellings with Increase in L_{night} to Over		Population with Increase in L_{night} to Over	
	50 dB(A)	55 dB(A)	50 dB(A)	55 dB(A)
2025 Proposed	1,692	387	4,895	1,245
2025 Proposed Reduced	387	46	1,139	134
2035 Proposed	1,511	567	4,128	1,398
2035 Proposed Reduced	324	29	1,064	88

Table 44: Additional Night Exposure Compared to Permitted Scenario

The results show that there are dwellings and populations whose exposure increases in both years under either the Proposed Scenario or the Proposed Reduced Scenario although the numbers are smaller in the case of the latter.

A point to note is that there is a difference in the distribution of the noise at night between the Permitted Scenario and the Proposed and Proposed Reduced scenarios. Under the Permitted Scenario departures to west use the South Runway at night but many of these relocate to the North Runway in the Proposed and Proposed Reduced scenarios. This consequently benefits dwellings and populations overflown by departures to the west from the South Runway. In particular this affects Blanchardstown and the surrounding communities which are relatively densely populated compared to other areas overflown.

This change in use of the runways means that there are also dwellings and populations experiencing a decrease between the scenarios. This can be clearly seen by looking at the dwellings exposed to 50 dB L_{night} in 2025. As shown in Table 42 the totals are similar for the Permitted and Proposed scenarios at just over 3,100 however as shown in Table 44 almost 1,700 dwellings become newly exposed to this level under the Proposed Scenario. Consequently, a similar number of dwellings benefit and decrease to below 50 dB L_{night}.

Nick Williams
for Bickerdike Allen Partners LLP

David Charles
Partner

APPENDIX 1
GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time. Some commonly used descriptors follow.

Noise Metric	Description
$L_{Aeq,T}$	$L_{Aeq,T}$, or the equivalent continuous A-weighted sound pressure level, is the most widely used noise metric. It is an energy average and is defined as the level of a notional sound which would deliver the same A-weighted sound energy as the actual variable sound over a defined period of time, T. $L_{Aeq,16h}$ and $L_{Aeq,8h}$ are commonly used to describe the daytime period (07:00 to 23:00) and night-time period (23:00 to 07:00) respectively. In the context of aircraft noise, these are typically averaged over the summer period (92 days from June 16th to September 15th inclusive) and are referred to as the summer day and summer night values.
L_{den}	L_{den}, or the day-evening-night noise indicator, is a long-term average (usually annual in the context of aircraft noise) 24 hour $L_{Aeq,T}$ value where a 10 dB penalty is applied to noise at night and a 5 dB penalty is applied to noise in the evening. It is defined by the following formula: $$L_{den} = 10 \times Log\left(\frac{12}{24} \times 10^{\left(\frac{L_{day}}{10}\right)} + \frac{4}{24} \times 10^{\left(\frac{L_{eve}+5}{10}\right)} + \frac{8}{24} \times 10^{\left(\frac{L_{night}+10}{10}\right)}\right)$$ Where: L_{day} is the A-weighted long-term average sound level for the 12 hour daytime period (07:00 to 19:00), L_{eve} is the A-weighted long-term average sound level for the 4 hour evening period (19:00 to 23:00), and L_{night} is the A-weighted long-term average sound level for the 8 hour night-time period (23:00 to 07:00).
$L_{Amax,T}$	$L_{Amax,T}$ is the maximum A-weighted sound pressure level measured in a defined period, T. Normally associated with a time weighting, F (fast, $L_{AFmax,T}$) or S (slow, $L_{ASmax,T}$), which is related to the sampling speed of the measurement instrument. It is sometimes used independently of a time period, for example when describing the maximum value of a single aircraft flyover.