14A.3.43 For hospital wards with natural ventilation, these levels can be achieved if the external noise level does not exceed 55 dB $L_{Aeq,1h}$ and 50 dB $L_{Aeq,1h}$ during the day and night respectively.

### *CAP1616a Airspace Change: Environmental requirements technical annex*

14A.3.44 This guidance document[10] produced in 2017 by the Civil Aviation Authority for airspace change sponsors providing guidance on the seven-stage airspace change process used for permanent changes to the published airspace design. The document guides the user through each stage and describes what will happen at each stage of it, and why.

14A.3.45 CAP 1616a forms a technical annex to this document and gives an outline of relevant methodologies for use in environmental assessment.

### *BS7445 Description and measurement of environmental noise*

14A.3.46 The aim of this British Standard is to provide authorities with material for the description of noise in community environments. The first part of the standard defines the basic quantities to be used and describes basic procedures for the determination of these quantities. The second part concerns the acquisition of data pertinent to land use, and the third part is a guide to application to noise limits.

## 14A.4 Other International Policy, Standards and Guidance

### *ICAO Convention on International Civil Aviation, Annex 16, Volume 1*

14A.4.1 ICAO has set a number of standards for aircraft noise certification which are contained in Volume 1 of Annex 16 to the Convention on International Civil Aviation[11]. This document sets maximum acceptable noise levels for different aircraft during take-off and landing, categorised for subsonic jet aeroplanes as Chapter 2, 3, 4 and 14.

14A.4.2 Chapter 2 aircraft have been prevented from operating within the EU since 2002, unless they are granted specific exemption, and therefore the vast majority of aircraft fall within Chapter 3, 4 and 14 parameters. These aircraft are quieter than Chapter 2 aircraft.

14A.4.3 Chapter 4 standards have applied to all new aircraft manufactured since 2006. These aircraft must meet a standard of being cumulatively 10 dB quieter than Chapter 3 aircraft.

14A.4.4 Chapter 14 was adopted by the ICAO in 2014. It represents an increase in stringency of 7 dB compared with Chapter 4 and applies to new aircraft submitted for certification after 31st December 2017.

### *Environmental Noise Directive 2002/49/EC*

14A.4.5 The Environmental Noise Directive (END)[12] concerning the assessment and management of environmental noise from transport, came into effect in June 2002. Its aim was to define a common approach across the European Union with the intention of avoiding, preventing or reducing on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise. This involves:

- Informing the public about environmental noise and its effects;
- Preparation of strategic noise maps for large urban areas ('agglomerations'), major roads, major railways and major airports as defined in the END; and

[10] Civil Aviation Authority (2017). CAP1616: Airspace Design: Guidance on the regulatory process for changing airspace design including community engagement requirements, [online]. Available at: https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=8127 [Checked 2/10/2018].
[11] ICAO (2017), Annex 16 to the Convention on International Civil Aviation, Volume 1 8th Edition. ICAO.
[12] European Commission (2002). Directive 2002/49/EC Directive of the European Parliament and of the Council of 25th June 2002 relating to the assessment and management of environmental noise, [online]. Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0049&from=EN [Checked 21/08/2018].

- Preparation of action plans based on the results of the noise mapping exercise.

### *WHO Guidelines for community noise (1999)*

14A.4.6 WHO Guidelines for Community Noise[13] provide a range of aspirational noise targets aimed at protecting the health and well-being of the community. They therefore set out noise targets which represent goals for minimising the adverse effects of noise on health as opposed to setting absolute noise limits for planning purposes.

14A.4.7 For outside areas of dwellings, the WHO Guidelines state that to protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55 dB $L_{Aeq}$ on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50 dB $L_{Aeq}$. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development. The WHO guidance cites a 16 hour period as applicable to the above limits.

14A.4.8 Although the attainment of these steady noise target values is not always achievable in practice, particularly where a dwelling is located close to a busy road or railway, controlling the daytime noise level to 55 dB $L_{Aeq,16h}$ or below in some gardens and amenity areas can sometimes be achieved for developments near roads and railways by the use of screening achieved using other buildings, fences or purpose made noise barriers.

### *WHO Night Noise Guidelines for Europe (2009)*

14A.4.9 Guidance on absolute noise levels at night are given in by the WHO Night Noise Guidelines (NNG)[14]. These report findings from the WHO concerning night noise from transportation sources and its effects on health and sleep. These guidelines acknowledge that the effect of noise on people at night depends not just on the magnitude of noise of a single event but also the number of events. It considers that in the long term, over a year, these effects can be described using the $L_{night,outside}$ index. This is essentially equivalent to the $L_{Aeq,8h}$ index commonly used in the UK, but instead of being based on aircraft activities during the average summer night, is based on the average annual night.

14A.4.10 These guidelines were prepared by a working group set up to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. Although this provides guidance to the European Community in general and has no policy status, it provided a description of then recent research into the health effects of noise and provided guidance on noise targets.

14A.4.11 The following night noise guideline values are recommended by the working group for the protection of public health from night noise:

- Night noise guideline (NNG) $L_{night,outside}$ equal to 40 dB
- Interim target (IT) $L_{night,outside}$ equal to 55 dB

14A.4.12 The NNG is a health based limit to aspire towards whereas the IT represents a feasibility based intermediate target. This is borne out to some extent by the Strategic Noise Mapping work undertaken across European Member States in compliance with the Environmental Noise Directive. For night noise, Member States are required to produce noise maps in terms of the $L_{night,outside}$ index no lower than 50 dB for strategic planning purposes.

14A.4.13 The relationship between night noise exposure and health effects as defined by these WHO guidelines can be summarised as shown in Table 14A-4.

[13] Berglund, B. et al (1999). Guidelines for community noise. [Online]. Available at: http://apps.who.int/iris/bitstream/handle/10665/66217/a68672.pdf?sequence=1&isAllowed=y [Checked: 30/08/2018].
[14] World Health Organisation Europe (2009). Night Noise Guidelines for Europe, [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf [Checked 7/09/ 2018].

*Table 14A-4: WHO guidance on the relationship between night noise exposure and health effects*

| $L_{night,outside}$ | Relationship between night noise exposure and health effects |
|---|---|
| <30 | No effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise |
| 30 – 40 | There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night,outside}$ are harmful to health |
| 40 – 50 | Adverse health effects are observed at the level above 40 dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives |
| >55 | Cardiovascular effects become the major public health concern, which are likely to be less dependent on the nature of the noise |

### WHO Environmental Noise Guidelines for the European Region (2018)

14A.4.14 In October 2018 the WHO published their updated Environmental Noise Guidelines[15] which contain the following recommendations:

14A.4.15 For average noise exposure, the GDG (Guideline Development Group) strongly recommends reducing noise levels produced by aircraft below 45 dB $L_{den}$, as aircraft noise above this level is associated with adverse health effects.

14A.4.16 For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night-time below 40 dB $L_{night}$, as night-time aircraft noise above this level is associated with adverse effects on sleep.

14A.4.17 These WHO guidelines could not be adopted as thresholds without imposing very significant restrictions on the current permitted operations of most major airports. As an example, even a single Airbus A320 or Boeing 737-800 aircraft operating once per night could expose hundreds of people to noise levels in excess of the guideline 40 dB $L_{night}$ value at an airport in a relatively rural location. 10 aircraft events during the daytime (07:00-19:00) period (or smaller numbers in the evening and night periods) could expose a similar number of people to noise levels in excess of the 45 dB $L_{den}$ parameter.

14A.4.18 These guidelines have not yet been adopted as UK policy, and there is no current indication that they will be. In December 2018, the UK Government published the consultation document Aviation 2050, which included the following regarding the WHO Guidelines:

*14A.4.19 "3.106 There is also evidence that the public is becoming more sensitive to aircraft noise, to a greater extent than noise from other transport sources, and that there are health costs associated from exposure to this noise. The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organization (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of an action and recent UK specific evidence which the WHO report did not assess."*

### ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation

14A.4.20 This part of ISO 9613 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$) under meteorological conditions favourable to propagation from sources of known sound emission, downwind propagation.

14A.4.21 The method consists of octave-band algorithms (with nominal mid-band frequencies from 63 Hz to 8 kHz) for calculating the attenuation of sound which originates from a point sound source, or an

[15] World Health Organization Regional Office for Europe (2018). Environmental Noise Guidelines for the European Region. [Online]. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf [Checked: 25/10/2018].

assembly of point sources. The source (or sources) may be moving or stationary. Specific terms are provided in the algorithms for the following physical effects:

- geometrical divergence;
- atmospheric absorption;
- ground effect;
- reflection from surfaces; and
- screening by obstacles.

## 14A.5 Noise Metrics for Assessment of Impacts of Ground Noise

14A.5.1 In the UK, the Independent Commission on Civil Aviation Noise (ICCAN) is a body created to act as an independent, impartial voice on civil aviation noise and how it affects communities. They have recently undertaken a review of aviation noise metrics[16].

14A.5.2 The review notes that metrics aim to quantify noise in a meaningful way and that in terms of trying to determine the effect caused by noise there are two ways to look at noise measurements, the absolute value and the relative change. *"Absolute levels are important from a regulatory point of view, whereas the relative change in noise might be more informative for assessing annoyance, because of the way the human ear perceives sound."*

14A.5.3 The background section reports that *"since the early 1970s, research found that the $L_{Aeq}$ metric was most closely associated with subjective response. The $L_{Aeq,T}$ is a notional continuous A-weighted sound level over a given time period, T, that contains the same sound energy as the actual time varying signal over the same time period"*. Both $L_{den}$ and $L_{night}$ are $L_{Aeq}$ based metrics in addition to others such as $L_{Aeq,16h}$ and $L_{Aeq,8h}$.

*14A.5.4 "Most of these metrics are well-established within the aviation sector, with an extensive existing knowledge base. This makes them useful for research into annoyance, as well as other health and social issues (WHO, Environmental Noise Guidelines for the European Region, 2018)."*

14A.5.5 The review notes that ground noise, which includes noise generated from aircraft such as taxiing or using auxiliary power units while on a stand at a terminal is different in its character and propagation from that of a flying aircraft and was not covered by the review. However a number of the exposure metrics commonly used for ground noise were reported in Table 1 of the review. The entries for metrics used in this assessment are included in Table 14A-5, although it should be noted the entries in the final two columns are specifically in relation to airborne aircraft noise.

*Table 14A-5: Exposure noise metrics based on $L_{Aeq}$*

| Metric | What it is | What if does | Weighting | Presence in UK Legislation, Policy and Standards | Links to effects on annoyance and other health issues |
|---|---|---|---|---|---|
| $L_{Aeq,T}$ | The $L_{eq}$ with the A indicating that the frequencies in the sound have been adjusted using the A weighting curve. | Provides an average value of the A weighted sound energy contained in the sound measured over a period, T. | Yes. The frequencies in the sound have been weighted using the A weighting curve. | Appears in various legislation, policy and standards associated with different time periods (T). | Generally felt to be a good indicator of likely annoyance and other health effects. Values can be influenced by a few very noisy events which could give a similar score to a large number of quieter events. |
| $L_{Aeq,16h}$ | The $L_{Aeq,T}$ averaged over a 16 hour period. | When determined for an average | Yes. The frequencies in the sound have been | Appears in British Standards, such as BS 8233:2014. The | An Exposure Response Function (ERF) exists between this metric and |

[16] ICCAN A review of aviation noise metrics and measurement July 2020
https://iccan.gov.uk/wp-content/uploads/2020_07_16_ICCAN_review_of_aviation_noise_metrics_and_measurement.pdf

| Metric | What it is | What if does | Weighting | Presence in UK Legislation, Policy and Standards | Links to effects on annoyance and other health issues |
|---|---|---|---|---|---|
| | Conventionally that time period is 07:00 hours to 23:00 hours local time. | summer's day between the 16 June and 15 September, it is the main measure of aircraft noise impact | weighted using the A weighting curve. | summer average day value appears in Government policy on aviation noise management. This metric has been used by the UK for examining aircraft noise since 1990. | annoyance. This is thought to have changed over time. Also, some ERFs exist for other health effects. |
| $L_{Aeq,8h}$ | The $L_{Aeq,T}$ averaged over an 8 hour period. Conventionally that time period is 23:00 hours to 07:00 hours local time (i.e. the night period). | When determined for an average summer's night between the 16 June and 15 September, it is one of the measures of aircraft noise impact at night | Yes. The frequencies in the sound have been weighted using the A weighting curve | Appears in British Standards, such as BS 8233:2014. The summer average night value appears in Government policy on aviation noise management | The summer average night value is used to determine the percentage of people expressing self reported sleep disturbance – although strictly, the correct measure to use is $L_{night}$. |
| $L_{night}$ | The $L_{Aeq,8h}$ averaged over the period of one year | Provides a measure of the annual average night noise impact, measured outside. | Yes. The frequencies in the sound have been weighted using the A weighting curve. | Appears in the regulations that transpose EC Directive 2002/49/EC, the Environmental Noise Directive | There is an ERF between this measure and determining the percentage of people expressing self reported sleep disturbance for aircraft noise (and road and rail noise). |
| $L_{den}$ | The annual average $L_{Aeq,T}$, combining $L_{day}$, $L_{evening}$, and $L_{night}$ but with the $L_{evening}$ value weighted by the addition of 5 dB and the $L_{night}$ value weighted by the addition of 10 dB. | Provides a single measure of the overall annual average noise impact. | Yes. The frequencies in the sound have been weighted using the A weighting curve. $L_{evening}$ has been weighted by the addition of 5 dB. $L_{night}$ has been weighted by the addition of 10 dB | Appears in the regulations that transpose EC Directive 2002/49/EC; The Environmental Noise Directive (END) which is translated into English legislation: The Environmental Noise (England) Regulations 2006 (UK) Statutory Instruments, The Environmental Noise (England) Regulations, 2006, as well as for the devolved nations. | There is an ERF between this measure and annoyance for aircraft noise (and road and rail noise). Also, some ERFs with other health effects. |
| $L_{Aeq,30mins}$ | The $L_{Aeq,T}$ averaged over a 30 minute period. | Provides a measure of the average noise impact in a 30-minute period. | Yes. The frequencies in the sound have been weighted using the A weighting curve. | Appears in Building Bulletin 93 – Acoustic design of schools: performance standards. | Some links with the impact of noise on teaching and learning. |
| $L_{Aeq,1h}$ | The $L_{Aeq,T}$ averaged over a 1 hour period | Provides a measure of the average noise impact in a 1-hour period. For aircraft noise, sometimes used to describe the impact during the period 06:00 – 07:00. | Yes. The frequencies in the sound have been weighted using the A weighting curve. | Can be found in BS 4142:2014+A1:2019 and BS 8233:2014. The value in the period 06:00 – 07:00 is sometimes used a control metric at some airports | No formal relationships exist. |

# 14A.6 Derivation of Effect Scales Used

### *Ground Noise – Residential Receptors*

14A.6.1 Regulation (EU) No 598/2014 under Annex I requires that air traffic noise impact will be described, at least, in terms of noise indicators $L_{den}$ and $L_{night}$ which are defined and calculated in accordance with Annex I to Directive 2002/49/EC. While this often is limited to air noise, ground noise can also be considered in this way.

14A.6.2 Consideration has been given to the significance of the change under the various options considered from the baseline. This considers both the resulting noise levels and the changes in noise levels. A consequence of this approach is that it puts emphasis on those newly affected, as they will experience the greatest changes, when considering the overall number significantly adversely affected.

14A.6.3 The classification and significance of effects is evaluated with reference to definitive standards, accepted criteria and legislation where available. This is supplemented by professional opinion and professional judgement.

14A.6.4 For the $L_{den}$ and $L_{night}$ noise indicators the significance of effect has been determined by separately rating both the absolute noise levels and the change in noise level as set out below. The individual ratings are then combined to determine the significance of any effects.

14A.6.5 While there is considerable research into the effects of aircraft noise, this is largely in relation to airborne aircraft. In the absence of specific research in relation to ground noise the same approach has been taken as for air noise. The absolute noise values and associated impact criteria for residential receptors that have been developed are given in Table 14A-6. They commence with a negligible band which applies to noise levels that lie below a low threshold, specifically 45 dB $L_{den}$ and 40 dB $L_{night}$, as WHO 2018 states that aircraft noise above these levels is associated with adverse health effects. The subsequent bands are defined by values that are required to be reported under Directive 2002/49/EC.

*Table 14A-6: Noise Impact Criteria (absolute) – residential*

| Scale Description | Annual dB $L_{den}$ | Annual dB $L_{night}$ |
|---|---|---|
| Negligible | <45 | <40 |
| Very Low | 45 – 49.9 | 40 – 44.9 |
| Low | 50 – 54.9 | 45 – 49.9 |
| Medium | 55 – 64.9 | 50 – 54.9 |
| High | 65 – 69.9 | 55 – 59.9 |
| Very High | ≥70 | ≥60 |

14A.6.6 Taking $L_{den}$, the value of 55 dB is where WHO 2018 reports evidence of an effect on reading skills and oral comprehension in children. This value is also comparable to the level of 54 dB $L_{Aeq,16h}$ which is now used in the UK as marking the approximate onset of significant community annoyance. The value of 55 dB $L_{den}$ has therefore been assigned to medium impact, as it relates to the start of these effects.

14A.6.7 Taking the value of 65 dB $L_{den}$, this is where WHO 2018 reports an association between those exposed and those considering themselves highly annoyed of 45.5%. Such a noise level is also comparable with the level of 63 dB $L_{Aeq,16h}$ widely used in the UK for eligibility for acoustic insulation, following Government guidance, and is also used for eligibility at Dublin under the North Runway Permission. The value of 65 dB $L_{den}$ has therefore been assigned to the start of a high impact.

14A.6.8 For the night period the value of 45 dB $L_{night}$ has been assigned to low impact. This follows from the approach in the UK where the Government proposed the value as the Lowest Observed Adverse Effect Level, and this received broad support.

14A.6.9 The level of 50 dB $L_{night}$ is described as the desirable level in the Noise Action Plan for Dublin Airport 2019 – 2023[17]. This value has therefore been assigned to the level above which medium impact arises.

14A.6.10 The higher level of 55 dB $L_{night}$ has been assigned to the level above which high impact arises. This follows from the WHO Night Noise Guidelines 2009 (NNG 2009)[18] which describe it as the threshold at which "Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed". The noise level is also comparable with the level of 55 dB $L_{Aeq,8h}$ commonly used at airports in the UK for eligibility for sound insulation schemes.

14A.6.11 The scale to be used to assess the change in noise level is given in Table 14A-7. The thresholds are derived from the difference contour bands recommended in CAP1616a. A semantic scale of this type, following the format of examples given in the Institute of Environmental Management and Assessment guidelines, has been applied in previous air noise assessments and accepted in Public Inquiries for airport developments in the UK and Ireland, for example the application for the North Runway at Dublin Airport. The same approach was followed in the Heathrow 3rd Runway Preliminary Environmental Impact Report (PEIR).

*Table 14A-7: Noise Impact Criteria (relative)*

| Scale Description | Change in noise level, dB(A) |
|---|---|
| Negligible | 0 – 0.9 |
| Very Low | 1 – 1-9 |
| Low | 2 – 2.9 |
| Medium | 3 – 5.9 |
| High | 6 – 8.9 |
| Very High | ≥9 |

14A.6.12 The effect of a change in noise level tends to increase with the absolute level of noise experienced at a receptor. If, for example, the night-time noise level at a dwelling were to change from 45 dB to 50 dB $L_{night}$, the overall effect for the occupants would be less than if the night-time noise level were to increase by the same amount from 55 dB to 60 dB $L_{night}$.

14A.6.13 The EPA Draft Guidelines advises that adherence to a systematic method of description can be of considerable assistance and includes in a Table 3.3 relevant terms that can be used to consistently describe specific effects. In terms of describing the significance of effects the terms range from imperceptible to profound, and they have been used here.

14A.6.14 There is no clearly accepted method of how to rate the magnitude of the effect of a change in the absolute ground noise level and the associated change in noise level. Some guidance however has been provided in the UK's National Planning Practice Guidance (NPPG) which states:

*"In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise may result in a significant adverse effect occurring even though little or no change in behaviour would be likely to occur."*

14A.6.15 The magnitude of an effect from changing between one scenario and another (e.g. baseline to future with the Relevant Action) has been established by considering both the absolute noise level in the higher of the two scenarios and the relative change in noise level that occurs at a given receptor.

14A.6.16 Table 14A-8 shows how the absolute and relative impacts are interpreted into magnitude of effect. This considers the criteria presented above, other guidance and professional judgement. The effect rating scale is taken from the EPA Draft EIAR Guidelines.

[17] Fingal County Council Noise Action Plan for Dublin Airport 2019 - 2023 - December 2018 https://www.fingal.ie/sites/default/files/2019-04/NAP%20Final.pdf

[18] World Health Organisation Europe NIGHT NOISE GUIDELINES FOR EUROPE - 2009 https://www.euro.who.int/__data/assets/pdf_file/0017/43316/E92845.pdf

*Table 14A-8: Summary of magnitude of effect – noise*

| Absolute Noise Level Rating | Change in Noise Level Rating | | | | | |
|---|---|---|---|---|---|---|
| | Negligible | Very Low | Low | Medium | High | Very High |
| Negligible | Imperceptible | Imperceptible | Imperceptible | Not Significant | Slight | Moderate |
| Very Low | Imperceptible | Imperceptible | Not Significant | Slight | Moderate | Significant |
| Low | Imperceptible | Not Significant | Slight | Moderate | Significant | Significant |
| Medium | Not Significant | Slight | Moderate | Significant | Significant | Very Significant |
| High | Slight | Moderate | Significant | Significant | Very Significant | Profound |
| Very High | Moderate | Significant | Significant | Very Significant | Profound | Profound |

14A.6.17 A potential significant effect (adverse or beneficial) would be considered to arise if in Table 14A-8 the magnitude of the effect was rated as significant or higher.

### Ground Noise – Non-Residential Receptors

14A.6.18 For non-residential receptors a similar, although simplified, approach has been used. Absolute levels rated as medium have been derived from the relevant guidance documents. These are given in Table 14A-9. The impact on each non-residential receptor has been rated as significant if the absolute noise level is above this threshold and the change in noise level is at least 3 dB(A), i.e. it is rated medium or higher.

14A.6.19 For schools the medium threshold has been based on the guidance in Building Bulletin 93, specifically that the internal noise levels for classrooms and teaching spaces that it contains can be achieved with natural ventilation if the external noise level does not exceed 55 dB $L_{Aeq,30min}$. Reviewing the distribution of flights at Dublin Airport it has been estimated that this criterion corresponds to approximately 55 dB $L_{den}$, which is the level where WHO 2018 reports evidence of an effect on reading skills and oral comprehension in children.

14A.6.20 For residential healthcare facilities, the medium thresholds have based on the guidance in Health Technical Memorandum 08-01, specifically that the internal noise levels for hospital wards that it contains can be achieved with natural ventilation if the external noise level does not exceed 55 dB $L_{Aeq,1h}$ and 50 dB $L_{Aeq,1h}$ during the day and night respectively. Reviewing the distribution of flights at Dublin Airport it has been estimated that these criteria correspond to approximately 55 dB $L_{den}$ and 45 dB $L_{night}$ respectively.

14A.6.21 For places of worship the medium threshold is the same as that for residential dwelling has on the basis that the British Standard BS8233:2014 recommends comparable internal noise levels for both types of spaces.

Table 14A-9: Ground Noise Impact Criteria (absolute) – non-residential

| Receptor Type | Threshold for Medium Absolute Effect |
|---|---|
| Schools (08:00-16:00) | 55 dB $L_{Aeq,30m}$ (approx. 55 dB $L_{den}$) |
| Residential Healthcare Facilities – Day (07:00-23:00) | 55 dB $L_{Aeq,1h}$ (approx. 55 dB $L_{den}$) |
| Residential Healthcare Facilities – Night (23:00-07:00) | 50 dB $L_{Aeq,1h}$ (approx. 45 dB $L_{night}$) |
| Places of Worship | 55 dB $L_{den}$ |

# 14B. Ground noise modelling methodology

## 14B.1 Introduction

14B.1.1 This appendix of the Environmental Impact Assessment Report (EIAR) describes the modelling methodology for the ground noise predictions.

## 14B.2 Assessment Scenarios

14B.2.1 A number of different scenarios have been considered for this assessment. Firstly, the 2018 Baseline scenario has been assessed, based on what actually occurred in 2018. Then for each of the future years 2022 and 2025, an assessment has been carried out of the following 3 scenarios:

- Baseline, i.e. with North Runway Permission conditions in place
- Relevant Action, i.e. with Conditions 3(d) and 5 of the North Runway Permission removed
- Apron 5H, i.e. as Relevant Action with the assumption that the separate Apron 5H application is successful, in order to evaluate the potential cumulative effect. The Apron 5H application has no effect on the total number of aircraft, but re-distributes some of them to the new stands on the proposed Apron 5H.

14B.2.2 The Relevant Action and the Apron 5H scenarios are based on the latest forecast aircraft movements with the North Runway conditions removed. Due to the profound impact on the aviation industry worldwide of the Covid-19 pandemic, activity is now forecast to reach 32 mppa by 2025, so the presence of Condition 3 of the Terminal 2 Permission (which limits Dublin Airport to 32 mppa) has no effect.

14B.2.3 For each scenario, an assessment has been carried out using the following metrics. These are all based on the $L_{Aeq}$ parameter, which considers the total noise energy over the measurement period.

- $L_{den}$, being the average annual 24-hour day, with a penalty of 5 dB applied to noise occurring in the evening (19:00-23:00), and a penalty of 10 dB applied to noise occurring in the night (23:00-07:00).
- $L_{night}$, being the average annual night (23:00-07:00)
- $L_{Aeq,16h}$, being the average summer (16 June to 15 September inclusive) day (07:00-23:00)
- $L_{Aeq,8h}$, being the average summer (16 June to 15 September inclusive) night (23:00-07:00)

## 14B.3 Study Area

14B.3.1 The extents of the study area are contained within a rectangle that extends approximately 3.5 km to the west, 5 km to the east, 4.5 km to the north and 3 km to the south of the centre of the existing main runway at Dublin Airport.

## 14B.4 Ground Noise Sources

14B.4.1 There are a number of potential sources of ground noise, however this assessment has focussed on the only the sources that make significant contributions to the overall ground noise produced at Dublin Airport, when assessed as a long-term average. This is in accordance with *EU Commission Directive 2015/996 Establishing common noise assessment methods according to Directive 2002/49/EC of the European Parliament and of the Council* which states "*Where noise generating activities associated with airport operations do not contribute materially to the overall population exposure to aircraft noise and associated noise contours, they may be excluded.*" The directive states that such excluded activities could include helicopters and engine testing, both of which are not considered here.

14B.4.2 The sources considered are aircraft taxiing between the stands and the runways, and the running of Auxiliary Power Units (APUs) on stands.

14B.4.3 The potential sources of noise from aircraft on the ground that have not been considered as part of this assessment are discussed below:

- Start of roll. This refers to the noise produced by aircraft on the runway while stationary, immediately before departing. Although the aircraft is physically on the ground, this noise source is considered as part of the air noise assessment.
- Reverse thrust. This refers to the noise produced by aircraft immediately after landing, when the engines are sometimes used in order to slow the aircraft down. Although the aircraft is physically on the ground, this noise source is considered as part of the air noise assessment.
- Engine testing. This refers to the noise produced by aircraft running engines for testing and maintenance purposes. When engines are run at high power, this can cause very high noise levels near the test location. However, this only occurs 1-2 times per day on average, and only during daytime hours. This is considered negligible in the context of the overall airport ground noise. Engine testing at lower power levels also occurs on stands. This occurs more frequently than high power testing, but still relatively rarely compared to the number of aircraft movements, and the noise levels are typically not higher than other activities such as taxiing.
- Aircraft parking on remote stands. The modelling work assumes that all aircraft taxi to one of the main stands and then use their APU for a time on the stand. In practice, a small number of aircraft park in other areas, such as Aircraft Park C to the north of the airfield. For Aircraft Park C in particular, aircraft are towed rather than taxiing when travelling to this area. Details of the exact usage of various non-stand locations were not available, although it is known to be a small percentage of the total aircraft and therefore would have a minimal effect on the overall noise environment.
- Other ground based activities that occur rarely and/or produce low noise levels relative to aircraft taxiing or APUs, such as ground support vehicles or de-icing.

14B.4.4 As noted above, the Apron 5H application has no effect on the total number of aircraft, so the majority of the excluded sources described above are not affected by that application in any event, for example start of roll and reverse thrust as the numbers of arrivals and departures are unaltered.

## 14B.5 Software

14B.5.1 The assessment of ground noise has been undertaken using the latest version of the Datakustik CadnaA environmental noise prediction software (Version 2020). This has used the methodology set out in ISO 9613-2:1996. This assumes that the wind is blowing from each source to each receptor and so is a worst case for each receptor.

## 14B.6 Model Overview

14B.6.1 As a basis for the model a layout drawing of the airport site was provided by daa and imported into the software. Terrain data (i.e. ground height) was included in the model, in the form of a Digital Elevation Model (DEM) derived from topographic mapping. Buildings were included in the model based on the drawings supplied by daa for those on the airport site, and based on building outlines derived from satellite imagery for buildings outside the airport site. Heights were assigned to the airport buildings, such as the terminals and hangars, based on the drawings supplied by daa. In practice some of the airport buildings are complex shapes and were simplified in the model, but this is not considered to have any significant effect on the accuracy of the model. A standard height of 7 m was assumed for residential buildings.

14B.6.2 The aircraft ground operations are represented in the noise modelling software by noise sources at locations across the airport. The source locations represent stand locations or segments of an aircraft's taxi route.

14B.6.3 Each activity, such as taxiing after an arrival, is modelled by assigning a noise level and duration to one or more locations. These are then added for all aircraft activities to give a noise level for each source. This information is then fed into the noise modelling software which computes the noise level at each receiver location, for each metric considered.

## 14B.7 Aircraft Activity

### *Aircraft Types*

14B.7.1 For the purpose of this assessment, aircraft were split into two categories; "Typical" and "Large" aircraft. The large aircraft, consisting of twin-aisle jet aircraft such as the Airbus A330 or Boeing 767 or larger, were considered separately as they have higher noise levels and also typically use different taxi routes for certain operations. The typical aircraft, while primarily being made up of the Airbus A320 and Boeing 737-800, also include smaller jet aircraft and propeller aircraft. Although these aircraft are significantly quieter once airborne, they are often found to be of a similar noise level when carrying out ground operations. The full list of aircraft operational codes and modelled aircraft categories are given in Table 14B-1.

*Table 14B-1: Aircraft Classification for Ground Noise Modelling*

| Dublin Airport Operational Code | Modelled Aircraft Category | Dublin Airport Operational Code | Modelled Aircraft Category | Dublin Airport Operational Code | Modelled Aircraft Category |
|---|---|---|---|---|---|
| 100 | TYPICAL | 773 | LARGE | 76Y | LARGE |
| 141 | TYPICAL | 779 | LARGE | 77L | LARGE |
| 142 | TYPICAL | 781 | LARGE | 77W | LARGE |
| 223 | TYPICAL | 788 | LARGE | 77X | LARGE |
| 290 | TYPICAL | 789 | LARGE | 7M2 | TYPICAL |
| 313 | LARGE | 14Z | TYPICAL | 7M8 | TYPICAL |
| 318 | TYPICAL | 31Y | LARGE | A26 | TYPICAL |
| 319 | TYPICAL | 32A | TYPICAL | ABF | LARGE |
| 320 | TYPICAL | 32B | TYPICAL | ABX | LARGE |
| 321 | TYPICAL | 32D | TYPICAL | ABY | LARGE |
| 322 | TYPICAL | 32N | TYPICAL | AN6 | TYPICAL |
| 332 | LARGE | 32Q | TYPICAL | AN7 | TYPICAL |
| 333 | LARGE | 33F | LARGE | ANF | LARGE |
| 339 | LARGE | 738F | TYPICAL | AR1 | TYPICAL |
| 343 | LARGE | 73C | TYPICAL | AR8 | TYPICAL |
| 345 | LARGE | 73E | TYPICAL | AT4 | TYPICAL |
| 359 | LARGE | 73G | TYPICAL | AT6 | TYPICAL |
| 380 | LARGE | 73H | TYPICAL | AT7 | TYPICAL |
| 733 | TYPICAL | 73J | TYPICAL | ATP | TYPICAL |
| 734 | TYPICAL | 73P | TYPICAL | ATR | TYPICAL |
| 735 | TYPICAL | 73W | TYPICAL | BBJ | TYPICAL |
| 736 | TYPICAL | 73Y | TYPICAL | BE2 | TYPICAL |
| 737 | TYPICAL | 74Y | LARGE | BE4 | TYPICAL |
| 738 | TYPICAL | 75F | TYPICAL | BEH | TYPICAL |
| 739 | TYPICAL | 75T | TYPICAL | BEJ | TYPICAL |
| 744 | LARGE | 75W | TYPICAL | CC8 | TYPICAL |
| 752 | TYPICAL | 75X | TYPICAL | CCJ | TYPICAL |
| 763 | LARGE | 76V | LARGE | CCX | TYPICAL |
| 764 | LARGE | 76W | LARGE | CGX | TYPICAL |
| 772 | LARGE | 76X | LARGE | CJ1 | TYPICAL |

| Dublin Airport Operational Code | Modelled Aircraft Category | Dublin Airport Operational Code | Modelled Aircraft Category | Dublin Airport Operational Code | Modelled Aircraft Category |
|---|---|---|---|---|---|
| CJ2 | TYPICAL | FDJ | TYPICAL | Q85 | TYPICAL |
| CJ3 | TYPICAL | G28 | TYPICAL | Q86 | TYPICAL |
| CJ8 | TYPICAL | GJ4 | TYPICAL | S20 | TYPICAL |
| CJM | TYPICAL | GJ5 | TYPICAL | SF3 | TYPICAL |
| CL3 | TYPICAL | GJ6 | TYPICAL | SU9 | TYPICAL |
| CL6 | TYPICAL | GR2 | TYPICAL | SWM | TYPICAL |
| CN2 | TYPICAL | GRS | TYPICAL | X11 | TYPICAL |
| CN7 | TYPICAL | GS4 | TYPICAL | X13 | TYPICAL |
| CNJ | TYPICAL | GS5 | TYPICAL | X51 | TYPICAL |
| CNT | TYPICAL | GS6 | TYPICAL | X52 | TYPICAL |
| CR2 | TYPICAL | GS7 | TYPICAL | X70 | TYPICAL |
| CR9 | TYPICAL | H25 | TYPICAL | X75 | TYPICAL |
| CRK | TYPICAL | H28 | TYPICAL | X83 | TYPICAL |
| CS1 | TYPICAL | H29 | TYPICAL | X84 | TYPICAL |
| CS3 | TYPICAL | H40 | TYPICAL | X94 | TYPICAL |
| D20 | TYPICAL | IL7 | LARGE | X98 | TYPICAL |
| D38 | TYPICAL | L35 | TYPICAL | Y08 | TYPICAL |
| DA1 | TYPICAL | L45 | TYPICAL | Y58 | TYPICAL |
| DA2 | TYPICAL | L55 | TYPICAL | Y59 | TYPICAL |
| DA5 | TYPICAL | L60 | TYPICAL | Y67 | TYPICAL |
| DA9 | TYPICAL | L75 | TYPICAL | Y72 | TYPICAL |
| DF2 | TYPICAL | M1F | TYPICAL | Y73 | TYPICAL |
| DF3 | TYPICAL | M82 | TYPICAL | Y77 | TYPICAL |
| DF7 | TYPICAL | P18 | TYPICAL | Y82 | TYPICAL |
| DF8 | TYPICAL | PAG | TYPICAL | Y83 | TYPICAL |
| DF9 | TYPICAL | PL2 | TYPICAL | Y89 | TYPICAL |
| DH4 | TYPICAL | Q00 | TYPICAL | Y93 | TYPICAL |
| DH8 | TYPICAL | Q12 | TYPICAL | Y98 | TYPICAL |
| E3L | TYPICAL | Q22 | TYPICAL | Y99 | TYPICAL |
| E70 | TYPICAL | Q34 | TYPICAL | Z03 | TYPICAL |
| E75 | TYPICAL | Q35 | TYPICAL | Z06 | TYPICAL |
| E90 | TYPICAL | Q36 | TYPICAL | Z12 | TYPICAL |
| E92 | TYPICAL | Q67 | TYPICAL | Z13 | TYPICAL |
| E95 | TYPICAL | Q69 | TYPICAL | Z14 | TYPICAL |
| EM4 | TYPICAL | Q70 | TYPICAL | Z15 | TYPICAL |
| EP1 | TYPICAL | Q76 | TYPICAL | Z16 | TYPICAL |
| EP3 | TYPICAL | Q80 | TYPICAL | Z17 | TYPICAL |
| ER3 | TYPICAL | Q81 | TYPICAL | Z18 | TYPICAL |
| ER4 | TYPICAL | Q82 | TYPICAL | Z20 | TYPICAL |
| ERJ | TYPICAL | Q83 | TYPICAL | Z21 | TYPICAL |
| F50 | TYPICAL | Q84 | TYPICAL | | |

## Number of Aircraft Movements

14B.7.2 The number of modelled aircraft movements in each scenario is given in Table 14B-2 for each relevant time period.

14B.7.3 Helicopters and military aircraft have been excluded from this assessment as they perform less than 1% of the aircraft operations at Dublin Airport and therefore do not materially contribute to the noise produced. This is consistent with previous work at Dublin Airport.

*Table 14B-2: Modelled Aircraft Movements by Period*

| Scenario | Aircraft Category | Aircraft Movements | | | | |
|---|---|---|---|---|---|---|
| | | Annual | | | 92-Day Summer | |
| | | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| 2018 Baseline | TYPICAL | 149936 | 38367 | 22844 | 52142 | 7382 |
| | LARGE | 14143 | 1996 | 5052 | 4972 | 1373 |
| 2022 Baseline | TYPICAL | 144269 | 40941 | 18196 | 51391 | 5049 |
| | LARGE | 15272 | 1300 | 2924 | 4598 | 811 |
| 2022 Relevant Action or Apron 5H | TYPICAL | 142969 | 40616 | 24370 | 50940 | 6762 |
| | LARGE | 14622 | 975 | 5199 | 4328 | 1443 |
| 2025 Baseline | TYPICAL | 148704 | 41650 | 18547 | 52744 | 5139 |
| | LARGE | 20174 | 1302 | 2603 | 5951 | 721 |
| 2025 Relevant Action or Apron 5H | TYPICAL | 147728 | 41325 | 26357 | 52383 | 7303 |
| | LARGE | 19524 | 976 | 4881 | 5680 | 1352 |

## Runway Usage

14B.7.4 The runway usage for 2018 has been obtained from the individual aircraft movement data for the relevant year. A summary of the overall runway split for the 2018 annual period is given in Table 14B-3.

*Table 14B-3: 2018 Annual Usage*

| Runway | Arrivals | Departures |
|---|---|---|
| 10 | 23.3% | 24.1% |
| 28 | 72.2% | 71.4% |
| 16 | 3.8% | 2.4% |
| 34 | 0.6% | 2.1% |

14B.7.5 Once the North Runway is operational the cross runway (16/34) will continue to be used, however only for essential use (e.g. when there are strong crosswinds) as stated in Condition 4 of the North Runway Permission. Specifically, for the purposes of noise modelling the future usage of the cross runway is assumed to be 1% of aircraft movements, with the remaining 99% of movements on the two main runways. 0.75% of aircraft movements are forecast to use Runway 16 with the remaining 0.25% on Runway 34. The modelled future runway usage over a given year is summarised in Table 14B-4 below, based on the average runway usage over the last 10 years and allowing for the expected reduction in cross runway usage.

*Table 14B-4: Future Runway Usage*

| Runway | Arrivals | Departures |
|---|---|---|
| 10L/10R | 29% | 29% |
| 28L/28R | 70% | 70% |
| 16 | 0.75% | 0.75% |
| 34 | 0.25% | 0.25% |

14B.7.6 Once the North Runway is operational Dublin Airport will operate during the daytime (07:00 – 23:00) in accordance with Conditions 3a-3c per the mode of operation Option 7b, as detailed in the Environmental Impact Statement Addendum, Section 16 as received by the planning authority on the 9th day of August, 2005. This provides that:

a. "the parallel runways (10R-28L and 10L-28R) shall be used in preference to the cross runway, 16-34,

b. when winds are westerly, Runway 28L shall be preferred for arriving aircraft. Either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control,

c. when winds are easterly, either Runway 10L or 10R as determined by air traffic control shall be preferred for arriving aircraft. Runway 10R shall be preferred for departing aircraft,

except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports."

14B.7.7 In practice it is expected that, unless capacity requires mixed mode, the runways will operate in segregated mode during the daytime with arrivals using either Runway 10L or Runway 28L and departures using either Runway 10R or Runway 28R depending on wind direction.

14B.7.8 Any movements by Code F aircraft are an exception to this, as they will always use the North Runway. It is also proposed that departures by Category A & B aircraft heading south during westerly operations will use the South Runway, and those heading north during easterly operations will use the North Runway.

14B.7.9 A method of determining mixed mode runway usage on the main runways (North and South) for modelling purposes has been developed. The modelled runway usage has been determined on an hourly basis.

14B.7.10 Most of the time the runways will operate in segregated mode, i.e. one runway for all arrivals, the other for all departures. However, there will be occasions during peak hours when runways will need to operate in some degree of mixed mode, i.e. both runways used simultaneously for arrivals and/or departures. The change from segregated to mixed mode and back to segregated mode will be determined by air traffic control (ATC) and once changed to a particular mode the airport is likely to operate in that mode for at least two hours.

14B.7.11 Activity switches from segregated mode to mixed mode where activity is such that any of the three following single runway capacity limits are exceeded:

- More than 35 arrivals in one hour.
- More than 44 departures in one hour.
- More than 48 movements (combined arrivals and departures) on one runway in one hour.

14B.7.12 In mixed mode, where each individual runway handles both arrivals and departures, departures will operate using the compass departure principle. This means that if a departure is using a route that turns to the north then the North Runway will be used, and conversely if it is using a route that turns to the south, the South Runway will be used.

14B.7.13 For westerly operations when in mixed mode as few arrivals as possible will use 28R, while not exceeding the single runway capacity limit of 48 combined arrivals and departures on runway 28L. For easterly operations when in mixed mode as few arrivals as possible will use 10R, while not exceeding the single runway capacity limit of 48 combined arrivals and departures on runway 10L.

14B.7.14 During the night-time period (23:00 – 07:00) for the future Baseline scenarios the south runway is the preferred runway. For the Relevant Action and Apron 5H scenarios the south runway is the preferred runway in the core night period (00:00-06:00). Between 23:00 and 00:00 and between 06:00-07:00 the runway usage follows the same principles as in the daytime, i.e. Option 7b.

14B.7.15 The total number of modelled flights using each runway is given for each scenario and relevant assessment period in the tables below.

*Table 14B-5: Aircraft Movements by Runway, Annual Day*

| *Scenario* | *Number of Aircraft Movements by Runway, Annual Day (07:00-19:00)* | | | | | |
|---|---|---|---|---|---|---|
| | *10L (North)* | *28R (North)* | *10R (South)* | *28L (South)* | *16* | *34* |
| 2018 Baseline | 0 | 0 | 41,923 | 117,351 | 3,299 | 1,506 |
| 2022 Baseline | 26,479 | 50,722 | 19,788 | 60,957 | 1,197 | 399 |
| 2022 Relevant Action or Apron 5H | 23,557 | 55,953 | 22,144 | 54,361 | 1,182 | 394 |
| 2025 Baseline | 27,933 | 54,213 | 21,042 | 64,003 | 1,265 | 422 |
| 2025 Relevant Action or Apron 5H | 24,913 | 59,908 | 23,590 | 57,170 | 1,253 | 418 |

*Table 14B-6: Aircraft Movements by Runway, Annual Evening*

| *Scenario* | *Number of Aircraft Movements by Runway, Annual Evening (19:00-23:00)* | | | | | |
|---|---|---|---|---|---|---|
| | *10L (North)* | *28R (North)* | *10R (South)* | *28L (South)* | *16* | *34* |
| 2018 Baseline | 0 | 0 | 9,015 | 29,526 | 1,570 | 252 |
| 2022 Baseline | 6,973 | 12,965 | 5,277 | 16,604 | 317 | 106 |
| 2022 Relevant Action or Apron 5H | 6,879 | 12,737 | 5,183 | 16,376 | 312 | 104 |
| 2025 Baseline | 7,077 | 13,211 | 5,379 | 16,855 | 323 | 108 |
| 2025 Relevant Action or Apron 5H | 6,983 | 12,983 | 5,284 | 16,627 | 318 | 106 |

*Table 14B-7: Aircraft Movements by Runway, Annual Night*

| Scenario | Number of Aircraft Movements by Runway, Annual Night (23:00-07:00) | | | | | |
|---|---|---|---|---|---|---|
| | 10L (North) | 28R (North) | 10R (South) | 28L (South) | 16 | 34 |
| 2018 Baseline | 0 | 0 | 4,155 | 19,897 | 2,396 | 1,448 |
| 2022 Baseline | 0 | 0 | 6,125 | 14,784 | 158 | 53 |
| 2022 Relevant Action or Apron 5H | 2,073 | 7,051 | 6,502 | 13,647 | 222 | 74 |
| 2025 Baseline | 0 | 0 | 6,133 | 14,805 | 159 | 53 |
| 2025 Relevant Action or Apron 5H | 2,359 | 7,061 | 6,700 | 14,805 | 235 | 78 |

*Table 14B-8: Aircraft Movements by Runway, Summer Day*

| Scenario | Number of Aircraft Movements by Runway, Summer Day (07:00-23:00) | | | | | |
|---|---|---|---|---|---|---|
| | 10L (North) | 28R (North) | 10R (South) | 28L (South) | 16 | 34 |
| 2018 Baseline | 0 | 0 | 9,582 | 47,026 | 3 | 503 |
| 2022 Baseline | 9,282 | 17,671 | 6,955 | 21,521 | 420 | 140 |
| 2022 Relevant Action or Apron 5H | 8,445 | 19,060 | 7,582 | 19,628 | 415 | 138 |
| 2025 Baseline | 9,701 | 18,682 | 7,321 | 22,404 | 440 | 147 |
| 2025 Relevant Action or Apron 5H | 8,838 | 20,197 | 8,001 | 20,448 | 435 | 145 |

*Table 14B-9: Aircraft Movements by Runway, Summer Night*

| Scenario | Number of Aircraft Movements by Runway, Summer Night (23:00-07:00) | | | | | |
|---|---|---|---|---|---|---|
| | 10L (North) | 28R (North) | 10R (South) | 28L (South) | 16 | 34 |
| 2018 Baseline | 0 | 0 | 342 | 7,144 | 757 | 512 |
| 2022 Baseline | 0 | 0 | 1,700 | 4,102 | 44 | 15 |
| 2022 Relevant Action or Apron 5H | 575 | 1,956 | 1,804 | 3,787 | 62 | 21 |
| 2025 Baseline | 0 | 0 | 1,699 | 4,102 | 44 | 15 |
| 2025 Relevant Action or Apron 5H | 654 | 1,956 | 1,856 | 4,102 | 65 | 22 |

## Taxi Routes

14B.7.16 When using the North Runway most aircraft will not use the full length on departure, and instead join the runway from the 1st intermediate taxiway. The exceptions are Code E and Code F aircraft, which will typically use the full runway length. All departures on the existing South Runway are assumed to use the full runway length.

14B.7.17 To develop the modelled taxi routes it was necessary to rationalise the stands into groups, with the same taxi route being followed for all stands in the same group. This grouping is described in Table 14B-10 where the stand numbers are taken from the Dublin Airport Aircraft Parking/Docking Chart[1]. The proposed Apron 5H development involves stands 101-104 being replaced.

*Table 14B-10: Aircraft Stand Groups*

| Stand Number | Modelled Stand Group | Stand Number | Modelled Stand Group | Stand Number | Modelled Stand Group |
|---|---|---|---|---|---|
| 101 | NORTHEAST | 141 | NORTH | 409 | PIER4 |
| 102 | NORTHEAST | 142 | NORTH | 410 | PIER4 |
| 103 | NORTHEAST | 143 | NORTH | 411 | SOUTH |
| 104 | NORTHEAST | 200 | PIER2 | 412 | SOUTH |
| 107 | PIER1 | 201 | PIER2 | 413 | SOUTH |
| 108 | PIER1 | 202 | PIER2 | 414 | SOUTH |
| 109 | PIER1 | 203 | PIER2 | 415 | SOUTH |
| 110 | PIER1 | 205 | PIER2 | 416 | SOUTH |
| 111 | PIER1 | 206 | PIER2 | 417 | SOUTH |
| 118 | PIER1 | 207 | PIER2 | 418 | SOUTH |
| 119 | PIER1 | 311 | PIER3 | 600 | WEST |
| 120 | PIER1 | 312 | PIER3 | 601 | WEST |
| 121 | PIER1 | 313 | PIER3 | 602 | WEST |
| 122 | PIER1 | 314 | PIER3 | 603 | WEST |
| 123 | PIER1 | 315 | PIER3 | 604 | WEST |
| 124 | PIER1 | 316 | PIER3 | 605 | WEST |
| 125 | PIER1 | 317 | PIER3 | 606 | WEST |
| 126 | PIER1 | 318 | PIER3 | 607 | WEST |
| 127 | PIER1 | 400 | PIER4 | 610 | WEST |
| 130 | TRIANGLE | 401 | PIER4 | 611 | WEST |
| 131 | TRIANGLE | 402 | PIER4 | 612 | WEST |
| 132 | TRIANGLE | 403 | PIER4 | 613 | WEST |
| 133 | TRIANGLE | 404 | PIER4 | 614 | WEST |
| 137 | NORTH | 405 | PIER4 | 615 | WEST |
| 138 | NORTH | 406 | PIER4 | 616 | WEST |
| 139 | NORTH | 407 | PIER4 | 617 | WEST |
| 140 | NORTH | 408 | PIER4 | | |

14B.7.18 With the stands rationalised, typical taxi routes for the different aircraft categories from each runway end to each stand group were developed through discussion with daa. There are 216 potential different routes in total allowing for the runway ends, stand groups, and arrivals and departures. All of the modelled taxi routes are shown in Figure 14B-1. An example of a single route is shown in Figure 14B-2.

[1] http://iaip.iaa.ie/iaip/Published%20Files/AIP%20Files/AD/Chart%20Files/EIDW/EI_AD_2_EIDW_24-2_en.pdf

*Figure 14B-1: Modelled taxi routes, all*

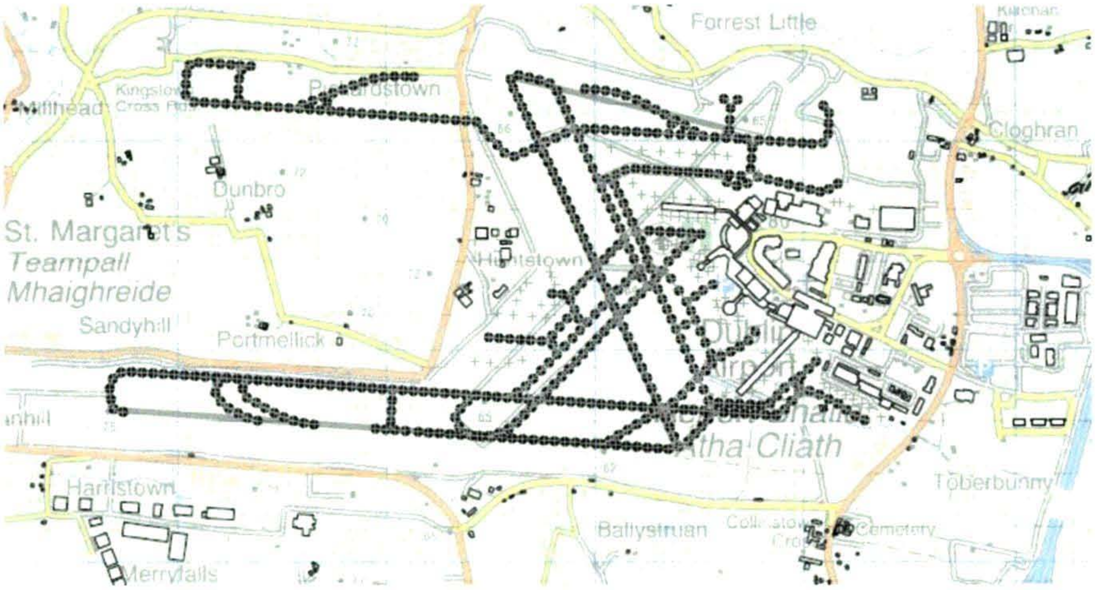
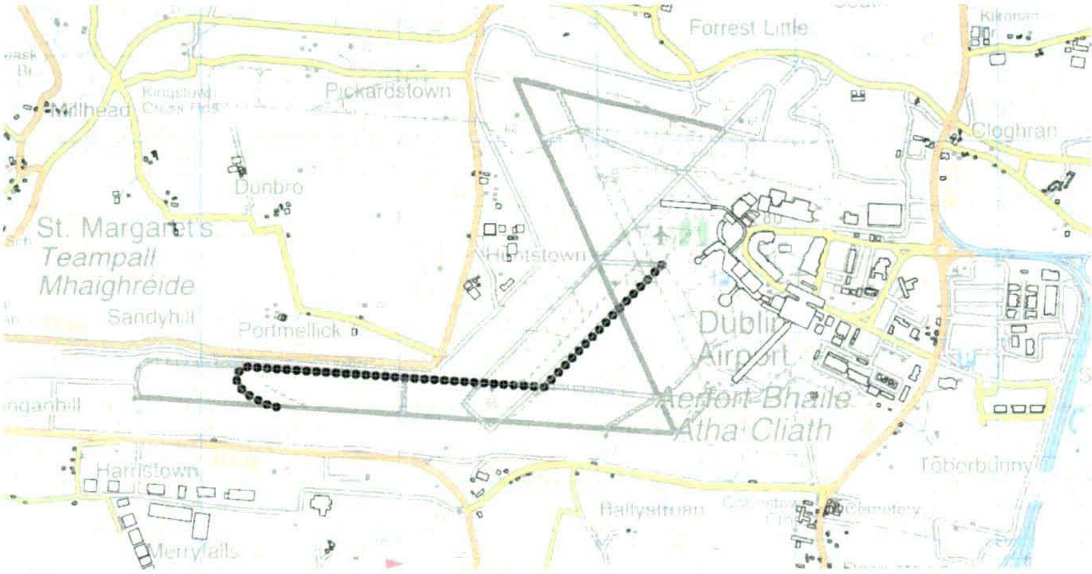



*Figure 14B-2: Modelled taxi route, typical aircraft, runway 28L arrival to Pier 2 stand group*




## Stand Usage

14B.7.19 For 2018, the log of aircraft movements supplied included the stand used by each aircraft. Aircraft logged as using Light Aircraft Park B, HP1, or HP2, were distributed equally among the stands 101-104 for modelling purposes. In a small number of cases (<1%) the stand used was not clear from the data, and in those cases the movements were distributed equally among all stands for modelling purposes.

14B.7.20 For the future Baseline and Relevant Action scenarios, the relative stand usage for a given aircraft type and runway was assumed to remain the same as 2018.

14B.7.21 For the Apron 5H scenarios, the aircraft modelled as using the existing stands 101-104, and an additional 12 arrivals and 12 departures per day, were equally distributed between the 10 new Apron 5H stands. The number of aircraft modelled as using all other stands was reduced pro-rata such that the total aircraft movements were unchanged and match that forecast.

14B.7.22 The modelled number of aircraft using each stand is given for each scenario in the following tables.

*Table 14B-11: Modelled Aircraft Movements by Stand Group, 2018 Baseline*

| Modelled Stand Group | Aircraft Movements, 2018 Baseline | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 1,289 | 1,391 | 2,055 | 589 | 542 |
| NORTHEAST | 3,819 | 641 | 375 | 1,152 | 103 |
| PIER1 | 59,542 | 16,869 | 8,971 | 20,644 | 2,595 |
| PIER2 | 23,961 | 7,051 | 2,792 | 8,482 | 869 |
| PIER3 | 21,005 | 2,809 | 3,605 | 7,219 | 1,359 |
| PIER4 | 32,634 | 7,208 | 5,926 | 11,429 | 1,961 |
| SOUTH | 7,510 | 1,605 | 1,648 | 2,624 | 626 |
| TRIANGLE | 13,590 | 2,182 | 546 | 4,604 | 174 |
| WEST | 729 | 607 | 1,977 | 371 | 526 |

*Table 14B-12: Modelled Aircraft Movements by Stand Group, 2022 Baseline*

| Modelled Stand Group | Aircraft Movements, 2022 Baseline | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,260 | 863 | 432 | 1,144 | 120 |
| NORTHEAST | 3,342 | 885 | 442 | 1,173 | 123 |
| PIER1 | 58,603 | 15,516 | 7,758 | 20,566 | 2,153 |
| PIER2 | 23,221 | 6,148 | 3,074 | 8,149 | 853 |
| PIER3 | 18,832 | 4,986 | 2,493 | 6,609 | 692 |
| PIER4 | 31,418 | 8,319 | 4,159 | 11,026 | 1,154 |
| SOUTH | 7,394 | 1,958 | 979 | 2,595 | 272 |
| TRIANGLE | 11,227 | 2,972 | 1,486 | 3,940 | 412 |
| WEST | 2,244 | 594 | 297 | 788 | 82 |

*Table 14B-13: Modelled Aircraft Movements by Stand Group, 2022 Relevant Action*

| Modelled Stand Group | Aircraft Movements, 2022 Relevant Action | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,220 | 850 | 604 | 1,129 | 168 |
| NORTHEAST | 3,301 | 871 | 619 | 1,158 | 172 |
| PIER1 | 57,887 | 15,277 | 10,861 | 20,301 | 3,014 |
| PIER2 | 22,937 | 6,053 | 4,304 | 8,044 | 1,194 |
| PIER3 | 18,601 | 4,909 | 3,490 | 6,524 | 968 |
| PIER4 | 31,034 | 8,191 | 5,823 | 10,884 | 1,616 |
| SOUTH | 7,304 | 1,928 | 1,370 | 2,562 | 380 |
| TRIANGLE | 11,089 | 2,927 | 2,081 | 3,889 | 577 |
| WEST | 2,217 | 585 | 416 | 777 | 115 |

*Table 14B-14: Modelled Aircraft Movements by Stand Group, 2022 Apron 5H*

| Modelled Stand Group | Aircraft Movements, 2022 Apron 5H | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,094 | 817 | 581 | 1,089 | 162 |
| NORTHEAST | 9,336 | 2,464 | 1,752 | 3,080 | 457 |
| PIER1 | 55,623 | 14,680 | 10,436 | 19,580 | 2,907 |
| PIER2 | 22,040 | 5,817 | 4,135 | 7,758 | 1,152 |
| PIER3 | 17,874 | 4,717 | 3,354 | 6,292 | 934 |
| PIER4 | 29,821 | 7,870 | 5,595 | 10,497 | 1,558 |
| SOUTH | 7,018 | 1,852 | 1,317 | 2,471 | 367 |
| TRIANGLE | 10,656 | 2,812 | 1,999 | 3,751 | 557 |
| WEST | 2,130 | 562 | 400 | 750 | 111 |

*Table 14B-15: Modelled Aircraft Movements by Stand Group, 2025 Baseline*

| Modelled Stand Group | Aircraft Movements, 2025 Baseline | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,451 | 878 | 432 | 1,199 | 120 |
| NORTHEAST | 3,537 | 900 | 443 | 1,229 | 123 |
| PIER1 | 62,033 | 15,777 | 7,769 | 21,560 | 2,153 |
| PIER2 | 24,580 | 6,252 | 3,078 | 8,543 | 853 |
| PIER3 | 19,934 | 5,070 | 2,497 | 6,928 | 692 |
| PIER4 | 33,257 | 8,458 | 4,165 | 11,559 | 1,154 |
| SOUTH | 7,827 | 1,991 | 980 | 2,720 | 272 |
| TRIANGLE | 11,884 | 3,022 | 1,488 | 4,130 | 412 |
| WEST | 2,375 | 604 | 297 | 826 | 82 |

*Table 14B-16: Modelled Aircraft Movements by Stand Group, 2025 Relevant Action*

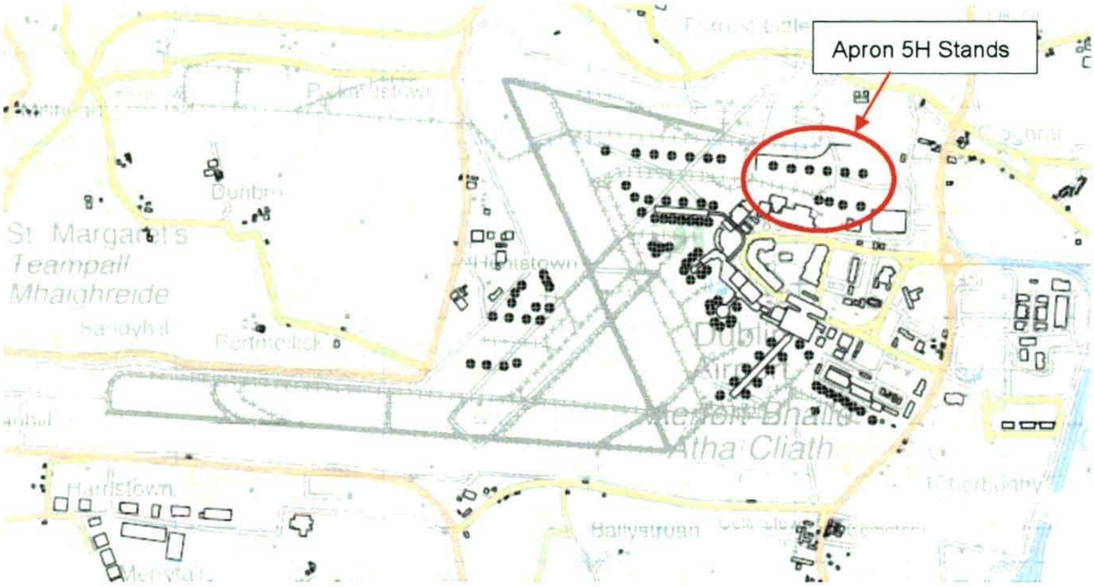
| Modelled Stand Group | Aircraft Movements, 2025 Relevant Action | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,417 | 864 | 638 | 1,186 | 177 |
| NORTHEAST | 3,503 | 886 | 654 | 1,216 | 181 |
| PIER1 | 61,436 | 15,538 | 11,474 | 21,328 | 3,179 |
| PIER2 | 24,343 | 6,157 | 4,547 | 8,451 | 1,260 |
| PIER3 | 19,742 | 4,993 | 3,687 | 6,854 | 1,022 |
| PIER4 | 32,937 | 8,330 | 6,152 | 11,434 | 1,705 |
| SOUTH | 7,752 | 1,961 | 1,448 | 2,691 | 401 |
| TRIANGLE | 11,769 | 2,977 | 2,198 | 4,086 | 609 |
| WEST | 2,353 | 595 | 439 | 817 | 122 |

*Table 14B-17: Modelled Aircraft Movements by Stand Group, 2025 Apron 5H*

| Modelled Stand Group | Aircraft Movements, 2025 Apron 5H | | | | |
|---|---|---|---|---|---|
| | Annual | | | 92-Day Summer | |
| | Day (07:00-19:00) | Evening (19:00-23:00) | Night (23:00-07:00) | Day (07:00-23:00) | Night (23:00-07:00) |
| NORTH | 3,290 | 832 | 615 | 1,146 | 171 |
| NORTHEAST | 9,588 | 2,425 | 1,791 | 3,138 | 468 |
| PIER1 | 59,153 | 14,961 | 11,048 | 20,607 | 3,072 |
| PIER2 | 23,439 | 5,928 | 4,378 | 8,165 | 1,217 |
| PIER3 | 19,008 | 4,808 | 3,550 | 6,622 | 987 |
| PIER4 | 31,713 | 8,021 | 5,923 | 11,048 | 1,647 |
| SOUTH | 7,464 | 1,888 | 1,394 | 2,600 | 388 |
| TRIANGLE | 11,332 | 2,866 | 2,116 | 3,948 | 588 |
| WEST | 2,265 | 573 | 423 | 789 | 118 |

14B.7.23 The modelled stands for the scenarios are shown in Figure 14B-3, with the Apron 5H stands highlighted. Stands 101-104, which are used in other scenarios, are not shown as they overlap with the southern Apron 5H stands.

*Figure 14B-3: Modelled stand locations*




## 14B.8 Aircraft Activity Locations and Noise Levels

### Noise Source Locations - APU

14B.8.1 APUs are assumed to only be run on aircraft stands. These are modelled at the locations given in the Dublin Airport Aircraft Parking/Docking Chart. Apron 5H stand locations were taken from plans supplied by daa.

### Noise Source Locations – Taxi

14B.8.2 For the modelled taxi routes, source locations were assigned at 50 m intervals along each taxi route.

### Reference Activity Noise Levels and Durations

14B.8.3 Reference noise levels and durations for each aircraft category for each activity were derived from reviewing available data from other studies, as well as on-site measurements of taxiing noise. Specifically, results from the following other ground noise studies were used to inform this assessment:

- "Heathrow's North-West Runway Air and Ground Noise Assessment", prepared by AMEC Environment & Infrastructure UK Limited, 2014
- Environmental Statement supporting London City Airport's most recent planning application (London Borough of Newham planning reference 13/01228/FUL), prepared by Bickerdike Allen Partners, 2015.

14B.8.4 The relevant results from these studies have been converted to sound power level, where necessary, and are reproduced in Table 14B-18 below.

*Table 14B-18: Summary of Noise Level Data from Other Assessments*

| Activity | Aircraft | Sound Power Level, dB(A) | Source |
|---|---|---|---|
| APU | Propeller Aircraft (typically Dash-8) | 122 | London City Airport |
| APU | A319/A320 | 118 | Heathrow |
| APU | Boeing 777 | 118 | Heathrow |
| APU | Airbus A380 | 123 | Heathrow |
| Taxi | Propeller Aircraft (typically Dash-8) | 129 | London City Airport |
| Taxi | A319/A320 | 128 | Heathrow |
| Taxi | Boeing 777 | 132 | Heathrow |
| Taxi | Airbus A380 | 132 | Heathrow |

14B.8.5 Measurements have also been taken of activities at Dublin Airport by BAP in 2019. The results from this survey were sound power levels of 128-129 dB(A) for Airbus A320/Boeing 737-800 aircraft taxiing. This is consistent with the results from the Heathrow and London City Airport assessments.

14B.8.6 The assumptions used in this assessment are given in Table 14B-19. The durations are based on advice from daa regarding typical activity. It is noted that at a number of stands, Fixed Electrical Ground Power (FEGP) is typically used, and therefore the assumed durations of APU usage are likely to be conservative from a noise perspective.

*Table 14B-19: Reference Noise Levels for Ground Noise Assessment*

| Activity | Aircraft Category | Sound Power Level, dB(A) | Duration (s) |
|---|---|---|---|
| APU Usage - Arrivals | Typical | 119 | 600 |
| | Large | 123 | 600 |
| APU Usage - Departures | Typical | 119 | 900 |
| | Large | 123 | 900 |
| Taxi | Typical | 128 | 5[1] |
| | Large | 132 | 5[1] |

[1] Source locations for taxi routes have a 50 m spacing. With an assumed speed of 10 m/s this equates to 5 s at each location.

## 14B.9 Population and Demographics Assessment Methodology

### *Dwelling and Population Data*

14B.9.1 Dwelling data has been acquired from GeoDirectory for 2019 Q2. The same dataset has been used for all assessment scenarios in order to aid comparison between scenarios.

14B.9.2 An assessment of not yet built dwellings, which have already been granted planning permission, has been carried out. This has utilised information on permitted developments provided by Tom Phillips and Associates (TPA) which has been compared to the data from GeoDirectory, as a number of the developments are progressing on site. This resulted in a separate permitted dwellings database.

14B.9.3 Population data has been estimated using the average dwelling occupancy by small area. This has been obtained for 2016 based on Census data from the Central Statistics Office[2]. It has then been determined into which of the small areas each of the dwellings falls, based upon which they have been assigned the average dwelling occupancy for the area. This approach is in line with that used for the last round of Noise Mapping.

14B.9.4 An assessment of zoned land has also been undertaken. This did not identify any areas which are designated for residential use within the study area.

### *Community Buildings*

14B.9.5 Noise sensitive community buildings have been identified through a review of the GeoDirectory data. For the purposes of this assessment noise sensitive education buildings include nurseries, schools, colleges and universities, but not day-care or creches. Noise sensitive healthcare buildings include healthcare facilities where people may have an overnight stay such as hospitals or nursing homes, but not GP surgeries or dentists.

### *Noise prediction*

14B.9.6 Each dwelling and community building has been included in the noise model as a receptor. A representative set of receptors has been created for each permitted development based on site plans and other publicly available information. Noise levels have been predicted at each of these receptor locations.

[2] http://www.cso.ie/px/pxeirestat/Statire/SelectVarVal/Define.asp?maintable=EP008

# 14C. Ground Noise Modelling Results and Figures

## 14C.1 Introduction

14C.1.1 This appendix of the Environmental Impact Assessment Report (EIAR), prepared by Bickerdike Allen Partners LLP, presents the results of the ground noise modelling. The modelling methodology is described in Appendix 14B.

## 14C.2 Assessment Scenarios

14C.2.1 The following scenarios have been included in the ground noise assessment:

- 2018 Baseline
- 2022 Baseline
- 2022 Relevant Action
- 2022 Apron 5H
- 2025 Baseline
- 2025 Relevant Action
- 2025 Apron 5H

## 14C.3 Assessment Metrics

14C.3.1 For each assessment scenario, the following metrics have been assessed:

- $L_{den}$, the average annual 24-hour noise level with a 5 dB penalty applied during the evening (19:00-23:00) and a 10 dB penalty applied during the night (23:00-07:00)
- $L_{night}$, the average annual noise level at night (23:00-07:00)
- $L_{Aeq,16h}$, the average summer noise level during the 16-hour day (07:00-23:00)
- $L_{Aeq,8h}$, the average summer noise level during the night (23:00-07:00)

14C.3.2 "Summer" in the above list refers to the 92-day period between 16 June and 15 September inclusive. This typically corresponds to the busiest period of the year.

## 14C.4 Assessment Results

### *Figures*

14C.4.1 For each assessment scenario and metric, the results are first presented in a series of figures, showing contours on an Ordnance Survey base map. Table 14C-1 provides a reference to aid finding a specific figure.

*Table 14C-1: Contour Figure References*

| Scenario | Metric and Figure Reference | | | |
|---|---|---|---|---|
| | $L_{den}$ | $L_{night}$ | $L_{Aeq,16h}$ | $L_{Aeq,8h}$ |
| 2018 Baseline | 14C-1 | 14C-2 | 14C-3 | 14C-4 |
| 2022 Baseline | 14C-5 | 14C-6 | 14C-7 | 14C-8 |
| 2022 Relevant Action | 14C-9 | 14C-10 | 14C-11 | 14C-12 |
| 2022 Apron 5H | 14C-13 | 14C-14 | 14C-15 | 14C-16 |
| 2025 Baseline | 14C-17 | 14C-18 | 14C-19 | 14C-20 |
| 2025 Relevant Action | 14C-21 | 14C-22 | 14C-23 | 14C-24 |
| 2025 Apron 5H | 14C-25 | 14C-26 | 14C-27 | 14C-28 |

## Contour Dwelling and Population Counts

14C.4.2 For each assessment scenario and metric, the tables below present the number of dwellings and people within each contour. The dwelling and population counts are presented in two categories:

- Existing dwellings
- Permitted dwellings, i.e. those with planning permission that are not yet built

14C.4.3 Also considered were zoned dwellings, i.e. those that are expected to be built in areas zoned for residential development, however there were none of these in any of the assessed contours.

14C.4.4 All of the counts below are cumulative, i.e. the people within a 60 dB contour would also be counted as within the corresponding 50 dB contour. Table 14C-2 provides a reference to aid finding a specific result.

*Table 14C-2: Contour Dwelling and Population Count Table References*

| Metric | Result Item and Table Reference | | | |
|---|---|---|---|---|
| | Existing Dwelling Counts | Permitted Dwelling Counts | Existing Population Counts | Permitted Population Counts |
| $L_{den}$ | Table 14C-3 | Table 14C-7 | Table 14C-11 | Table 14C-15 |
| $L_{night}$ | Table 14C-4 | Table 14C-8 | Table 14C-12 | Table 14C-16 |
| $L_{Aeq,16h}$ | Table 14C-5 | Table 14C-9 | Table 14C-13 | Table 14C-17 |
| $L_{Aeq,8h}$ | Table 14C-6 | Table 14C-10 | Table 14C-14 | Table 14C-18 |

*Table 14C-3: Existing Dwelling Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Existing Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 9,376 | 8,527 | 10,541 | 10,536 | 8,739 | 10,988 | 11,016 |
| ≥ 55 | 155 | 113 | 679 | 616 | 133 | 767 | 834 |
| ≥ 60 | 19 | 19 | 25 | 25 | 20 | 26 | 26 |
| ≥ 65 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-4: Existing Dwelling Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Existing Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 1,359 | 262 | 3,620 | 3,674 | 246 | 3,893 | 3,917 |
| ≥ 50 | 29 | 23 | 35 | 35 | 23 | 38 | 38 |
| ≥ 55 | 9 | 2 | 12 | 12 | 2 | 12 | 12 |
| ≥ 60 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-5: Existing Dwelling Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Existing Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 893 | 2,643 | 2,632 | 2,580 | 3,162 | 3,113 | 3,088 |
| ≥ 54 | 48 | 104 | 104 | 106 | 188 | 189 | 195 |
| ≥ 57 | 21 | 28 | 27 | 27 | 28 | 28 | 28 |
| ≥ 60 | 9 | 12 | 12 | 16 | 17 | 17 | 21 |
| ≥ 63 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-6: Existing Dwelling Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Existing Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 3,118 | 505 | 4,509 | 4,607 | 440 | 4,732 | 4,792 |
| ≥ 48 | 150 | 42 | 181 | 201 | 41 | 210 | 221 |
| ≥ 51 | 28 | 17 | 30 | 30 | 16 | 32 | 32 |
| ≥ 54 | 11 | 9 | 16 | 16 | 9 | 16 | 16 |
| ≥ 57 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| ≥ 60 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-7: Permitted Dwelling Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Permitted Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 532 | 474 | 654 | 654 | 490 | 654 | 654 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-8: Permitted Dwelling Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Permitted Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 0 | 0 | 209 | 180 | 0 | 332 | 299 |
| ≥ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-9: Permitted Dwelling Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Permitted Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 0 | 30 | 30 | 36 | 54 | 54 | 54 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-10: Permitted Dwelling Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Permitted Dwelling Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 344 | 0 | 365 | 365 | 0 | 398 | 398 |
| ≥ 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-11: Existing Population Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Existing Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 26,361 | 23,826 | 29,994 | 29,983 | 24,518 | 31,323 | 31,430 |
| ≥ 55 | 379 | 324 | 1,892 | 1,773 | 389 | 2,160 | 2,362 |
| ≥ 60 | 56 | 56 | 75 | 75 | 60 | 75 | 75 |
| ≥ 65 | 6 | 3 | 6 | 6 | 3 | 6 | 6 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-12: Existing Population Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Existing Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 3,424 | 631 | 9,843 | 9,995 | 578 | 10,521 | 10,623 |
| ≥ 50 | 78 | 62 | 96 | 96 | 62 | 102 | 102 |
| ≥ 55 | 29 | 6 | 35 | 35 | 6 | 35 | 35 |
| ≥ 60 | 0 | 0 | 3 | 3 | 0 | 3 | 3 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-13: Existing Population Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Existing Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 2,219 | 7,419 | 7,397 | 7,296 | 8,796 | 8,683 | 8,649 |
| ≥ 54 | 130 | 308 | 308 | 315 | 563 | 575 | 595 |
| ≥ 57 | 62 | 80 | 80 | 80 | 80 | 80 | 9680 |
| ≥ 60 | 29 | 35 | 35 | 35 | 51 | 51 | 51 |
| ≥ 63 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-14: Existing Population Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Existing Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 8,154 | 1,260 | 12,276 | 12,558 | 1,080 | 12,926 | 13,109 |
| ≥ 48 | 368 | 114 | 540 | 603 | 111 | 630 | 665 |
| ≥ 51 | 75 | 49 | 83 | 83 | 46 | 86 | 86 |
| ≥ 54 | 34 | 29 | 47 | 47 | 29 | 47 | 47 |
| ≥ 57 | 6 | 3 | 6 | 6 | 3 | 6 | 6 |
| ≥ 60 | 3 | 0 | 3 | 3 | 0 | 3 | 3 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-15: Permitted Population Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Permitted Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 1,653 | 1,448 | 2,096 | 2,096 | 1,508 | 2,096 | 2,096 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-16: Permitted Population Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Permitted Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 0 | 0 | 592 | 514 | 0 | 982 | 875 |
| ≥ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-17: Permitted Population Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Permitted Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 0 | 96 | 96 | 115 | 165 | 165 | 165 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-18: Permitted Population Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Permitted Population Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 1,031 | 0 | 1,089 | 1,089 | 0 | 1,196 | 1,196 |
| ≥ 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

## Community Building Counts

14C.4.5 For each assessment scenario and metric, the tables below present the number of community buildings within each contour. The following community buildings have been assessed:

- Education Buildings
- Residential Healthcare Facilities
- Religious Buildings

14C.4.6 All of the areas and counts below are cumulative, i.e. the buildings within a 60 dB contour would also be counted as within the corresponding 50 dB contour. Table 14C-19 provides a reference to aid finding a specific result.

*Table 14C-19: Community Building Count Table References*

| Metric | Result Item and Table Reference | | |
|---|---|---|---|
| | Education Buildings | Residential Healthcare Facilities | Religious Buildings |
| $L_{den}$ | Table 14C-20 | Table 14C-24 | Table 14C-28 |
| $L_{night}$ | Table 14C-21 | Table 14C-25 | Table 14C-29 |
| $L_{Aeq,16h}$ | Table 14C-22 | Table 14C-26 | Table 14C-30 |
| $L_{Aeq,8h}$ | Table 14C-23 | Table 14C-27 | Table 14C-31 |

*Table 14C-20: Education Building Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Education Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 4 | 5 | 7 | 7 | 6 | 7 | 7 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-21: Education Building Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Education Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-22: Education Building Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Education Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 0 | 0 | 0 | 0 | 1 | 1 | 1 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-23: Education Building Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Education Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-24: Residential Healthcare Facility Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Residential Healthcare Facility Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 2 | 1 | 2 | 2 | 2 | 2 | 2 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-25: Residential Healthcare Facility Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Residential Healthcare Facility Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-26: Residential Healthcare Facility Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Residential Healthcare Facility Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 1 | 0 | 0 | 0 | 1 | 1 | 1 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-27: Residential Healthcare Facility Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Residential Healthcare Facility Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 1 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-28: Religious Building Counts, $L_{den}$ Metric*

| Metric Value, dB $L_{den}$ | Scenario and Religious Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 50 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 75 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-29: Religious Building Counts, $L_{night}$ Metric*

| Metric Value, dB $L_{night}$ | Scenario and Religious Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 50 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 55 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 65 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 70 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-30: Religious Building Counts, $L_{Aeq,16h}$ Metric*

| Metric Value, dB $L_{Aeq,16h}$ | Scenario and Religious Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 66 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 69 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

*Table 14C-31: Religious Building Counts, $L_{Aeq,8h}$ Metric*

| Metric Value, dB $L_{Aeq,8h}$ | Scenario and Religious Building Count | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2018 Baseline | 2022 Baseline | 2022 Relevant Action | 2022 Apron 5H | 2025 Baseline | 2025 Relevant Action | 2025 Apron 5H |
| ≥ 45 | 0 | 0 | 1 | 1 | 0 | 1 | 1 |
| ≥ 48 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 51 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 54 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 57 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| ≥ 63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

# 14D. Ground Noise Baseline Survey

## 14D.1 Introduction

14D.1.1 This appendix of the Environmental Impact Assessment Report (EIAR), prepared by Bickerdike Allen Partners LLP (BAP), describes the survey work undertaken to measure the baseline noise conditions in the vicinity of Dublin Airport, where the surrounding noise environment is affected primarily by transport noise from the local road network and from airport operations. It also describes survey work undertaken to inform the reference noise levels used in the assessment.

14D.1.2 Due to the ongoing COVID-19 pandemic and its impact on the transport network, the noise conditions at the present time are likely to be unrepresentative of the normal baseline noise conditions. This effect is expected to be temporary, although the precise timescale is uncertain. Because of this, survey work undertaken by AWN Consulting Ltd. (AWN) in 2016 has been used in lieu of current baseline noise monitoring.

14D.1.3 The baseline noise surveys comprised a combination of long-term unattended and short-term attended noise monitoring, carried out at locations around Dublin Airport to establish the prevailing ambient and background noise conditions during both the daytime and night-time.

14D.1.4 An attended survey was also undertaken by BAP in 2019 to measure aircraft taxi noise levels for use in the modelling of current and future ground noise scenarios.

## 14D.2 Methodology

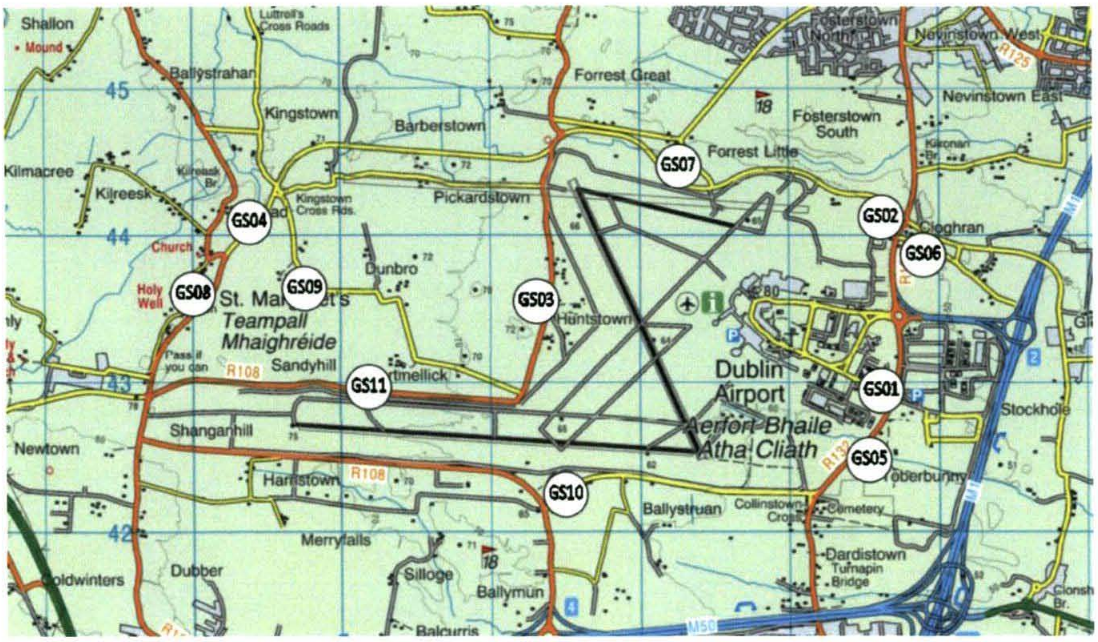
14D.2.1 The survey work described here comprises three discrete elements; the long-term and short-term surveys undertaken by AWN in 2016; and the aircraft taxi noise survey undertaken by BAP in 2019.

14D.2.2 The survey locations and dates are summarised in Table 14D-1, with the locations illustrated in Figure 14D-1. Baseline noise monitoring locations were selected to obtain representative ambient and background noise levels close to the airport. Because ground noise sources are restricted to the airport site, the area covered is more focused compared to the air noise baseline receptor set.

*Table 14D-1: Ground noise baseline survey locations and dates*

| Receptor | Survey | Location | Dates of Survey |
|---|---|---|---|
| GS01 | Short-term | Cloghran House car park off the R132, E of airport | 2016/07/25 – 2016/07/28 |
| GS02 | Short-term | Creche off Naul Road, NE of airport | 2016/07/25 – 2016/07/28 |
| GS03 | Short-term | Residential properties on the R108, W of airport | 2016/07/25 – 2016/07/28 |
| GS04 | Short-term | Field off the R122 at St. Margaret's, W of airport | 2016/07/25 – 2016/07/28 |
| GS05 | Long-term | daa owned site on the R132, SE of airport | 2016/08/02 – 2016/08/10 |
| GS06 | Long-term | daa owned site on Old Stockhole Lane, NE of airport | 2016/08/02 – 2016/08/10 |
| GS07 | Long-term | Field adjacent to Cooks Road and Forest Road, N of airport | 2016/08/24 – 2016/09/01 |
| GS08 | Long-term | Field adjacent to St. Margaret's School, W of airport | 2016/07/28 – 2016/07/29 |
| GS09 | Long-term | daa owned site on Dunbro lane, W of airport | 2016/08/10 – 2016/08/17 |
| GS10 | Long-term | daa owned site on Old Airport Road, S of airport | 2016/08/11 – 2016/08/17 |
| GS11 | Aircraft Taxi | Airport perimeter road, facing taxiways S5 and S6 | 2019/10/02 |

*Figure 14D-1: Ground noise baseline survey locations*




14D.2.3 All attended noise monitoring measurements were undertaken in general accordance with the British Standard BS 7445 Description and measurement of environmental noise. This comprised locations with free field conditions and 15 minute measurement samples (unless stated otherwise) taken at the specified locations. Repeat measurements were made at each location on a given day or night. The microphone of the noise monitor was located approximately 1.5 m above ground level with the monitor mounted on a tripod and away from any reflective surfaces. Observations were made of the noise climate prevailing at the time. These attended measurements include the noise contribution of aircraft activity as well as non-aircraft related activities. This procedure is commonly used to obtain attended environmental noise information, supplemented where possible with unattended noise measurement data. Details of the sound level meters used for each survey are available on request.

14D.2.4 During the unattended surveys noise measurements were obtained over a period of around three weeks at each location. Unattended measurements comprised a series of continuous 15 minute measurement samples (unless stated otherwise) over the full survey period. The noise monitors were located in environmental cases with the microphones connected via extension cables. The microphones were fitted with windshields and attached to tripods so they were positioned approximately 1.5 m above local ground level.

14D.2.5 For the aircraft taxi noise survey, $L_{eq,T}$ measurements were taken, both in terms of the overall A-weighted level and also for individual octave bands. Each measurement typically lasted around 90 seconds and was taken at a fixed position on the airport perimeter road, approximately 70 m from the junction of taxiway S6 and taxiway S. This was the primary exit from the runway used by R28 arrivals on the day of the survey.

## 14D.3 Results

### *Short-Term Noise Monitoring*

14D.3.1 A summary of average values for each measurement location is given in Table 14D-2. Detailed results are provided in Table 14D-3**Error! Reference source not found.** to Table 14D-6**Error! Reference source not found.**.

*Table 14D-2: Short-term noise monitoring daytime results summary*

| Metric | | Location | | | |
|---|---|---|---|---|---|
| | | GS01 | GS02 | GS03 | GS04 |
| **Daytime (07:00 to 23:00)** | $L_{Aeq,T}$ (dB) | 59 | 57 | 56 | 70 |
| | $L_{AF90}$ (dB)[1] | 55 | 53 | 44 | 51 |
| **Night-time (23:00 to 07:00)** | $L_{Aeq,T}$ (dB) | 54 | 53 | 52 | 64 |
| | $L_{AF90}$ (dB)[1] | 49 | 48 | 41 | 49 |

[1] Average of $L_{AF90,15min}$ measurements

*Table 14D-3: Location GS01,short-term noise monitoring results summary*

| Date | Start | $L_{Aeq,15min}$ (dB) | $L_{AF90,15min}$ (dB) | Notes |
|---|---|---|---|---|
| 2016/07/25 | 10:30 | 60 | 56 | Car park activity. Plant noise from public house. Aircraft arrivals and departures. |
| | 14:05 | 59 | 56 | |
| | 15:37 | 58 | 54 | |
| 2016/07/27 | 10:21 | 58 | 54 | |
| | 11:50 | 57 | 53 | |
| | 23:07 | 53 | 48 | Road traffic along Swords Road dominant. M1 traffic in distance. Airport ground and air noise. |
| 2016/07/28 | 05:25 | 54 | 50 | |

*Table 14D-4: Location GS02,short-term noise monitoring results summary*

| Date | Start | $L_{Aeq,15min}$ (dB) | $L_{AF90,15min}$ (dB) | Notes |
|---|---|---|---|---|
| 2016/07/25 | 12:37 | 56 | 52 | Road traffic along Naul Road. Construction activity nearby. Aircraft arrivals and departures. |
| | 14:28 | 56 | 53 | |
| | 16:16 | 56 | 54 | |
| 2016/07/27 | 10:43 | 59 | 54 | |
| | 12:12 | 56 | 51 | |
| 2016/07/28 | 23:34 | 52 | 47 | Road traffic along Naul Road. Aircraft arrivals and departures. Aircraft ground noise from nearby hangars. |
| | 05:51 | 53 | 48 | |

*Table 14D-5: Location GS03,short-term noise monitoring results summary*

| Date | Start | $L_{Aeq,15min}$ (dB) | $L_{AF90,15min}$ (dB) | Notes |
|---|---|---|---|---|
| 2016/07/25 | 13:12 | 56 | 45 | Road traffic along R108. Aircraft arrivals and departures. |
| | 14:49 | 56 | 44 | |
| | 16:37 | 57 | 46 | Grass cutting to rear of property. |
| 2016/07/27 | 11:04 | 53 | 44 | Work activities in adjacent yard. |
| | 12:33 | 55 | 43 | |
| 2016/07/28 | 23:56 | 52 | 41 | Road traffic along R108. Aircraft arrivals and departures. |
| | 06:17 | 51 | 40 | |

*Table 14D-6: Location GS04,short-term noise monitoring results summary*

| Date | Start | $L_{Aeq,15min}$ (dB) | $L_{AF90,15min}$ (dB) | Notes |
|---|---|---|---|---|
| 2016/07/25 | 13:38 | 70 | 51 | Road traffic along L3132. Aircraft overflights. Birdsong and horses in field. |
| | 15:12 | 70 | 54 | |
| 2016/07/27 | 09:53 | 70 | 50 | |
| | 11:25 | 69 | 49 | |
| | 12:53 | 69 | 49 | |
| 2016/07/28 | 00:16 | 62 | 48 | Road traffic along L3132. Aircraft overflights. |
| | 06:42 | 66 | 49 | |

## Long-Term Noise Monitoring

14D.3.2 Noise levels for the long-term surveys have been presented in terms of the $L_{Aeq,T}$ and $L_{AF90,T}$ metrics for the 16 hour daytime (07:00-23:00) and 8 hour night-time (23:00-07:00) periods.

14D.3.3 $L_{Aeq,T}$ is commonly used to denote the ambient noise level and signifies the average noise level which is equivalent in energy terms to that produced by the various fluctuating noise levels that occur in the measurement period.

14D.3.4 $L_{AF90,T}$ is commonly used to denote the prevailing background noise level and specifically, denotes the level of noise which is exceeded for 90% of the time.

14D.3.5 A summary of average values for each measurement location is given in Table 14D-7**Error! Reference source not found.**. Detailed results are provided in Table 14D-8 to Table 14D-13 alongside time history graphs in

[1] Average of $L_{AF90,15min}$ measurements

14D.3.6 Figure 14D-2 to Figure 14D-7.

14D.3.7 The results indicate that the general ambient noise level around Dublin Airport lies in the range of 50 to 70 dB $L_{Aeq,16h}$ during the daytime with an underlying background noise level in the range of 45 to 55 dB $L_{AF90}$. The wide range of ambient noise levels indicate that this is dependent on the proximity to local noise sources, for example airborne aircraft, road traffic, or local schools.

14D.3.8 During the night, ambient noise levels are generally around 3 – 5 dB lower than during the day and background noise levels are typically 5 – 10 dB lower. Road traffic noise remains is a significant factor, with roadside locations tending to have higher ambient noise levels.

*Table 14D-7: Long-term noise monitoring results summary*

| Metric | Location | | | | | |
|---|---|---|---|---|---|---|
| | GS05 | GS06 | GS07 | GS08[2] | GS09 | GS10 |
| $L_{Aeq,16h}$ (dB) | 71 | 53 | 58 | 65 | 59 | 66 |
| $L_{AF90,day}$ (dB)[1] | 50 | 49 | 52 | 51 | 47 | 55 |
| $L_{Aeq,8h}$ (dB) | 68 | 50 | 56 | 57 | 54 | 63 |
| $L_{AF90,night}$ (dB)[1] | 45 | 45 | 48 | 38 | 39 | 48 |

[1] Average of $L_{AF90,15min}$ measurements between 07:00 – 23:00

[2] 5 minute base measurement period

*Table 14D-8: Location GS05, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB)[1] | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB)[1] |
|---|---|---|---|---|
| 2016/08/02 | 72 | 48 | 69 | 46 |
| 2016/08/03 | 72 | 53 | 69 | 46 |
| 2016/08/04 | 71 | 50 | 67 | 43 |
| 2016/08/05 | 71 | 48 | 68 | 44 |
| 2016/08/06 | 71 | 49 | 68 | 46 |
| 2016/08/07 | 72 | 51 | 68 | 47 |
| 2016/08/08 | 71 | 50 | 68 | 46 |
| 2016/08/09 | 71 | 50 | 66 | 44 |
| 2016/08/10 | 71 | 50 | - | - |
| **Range** | 71 – 72 | 48 – 53 | 66 – 69 | 43 – 47 |
| **Average** | 71 | 50 | 68 | 45 |

[1] Average of $L_{AF90,15min}$ measurements

*Figure 14D-2: Location GS05, long-term noise monitoring time history*

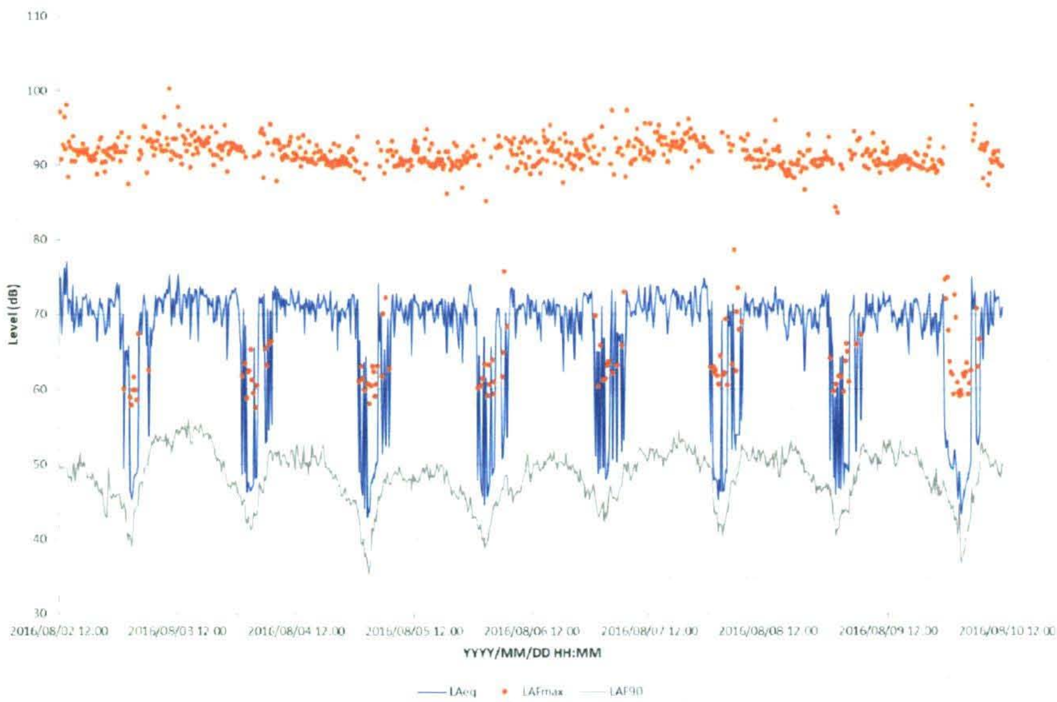


*Table 14D-9: Location GS06, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB) | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB) [1] |
|---|---|---|---|---|
| 2016/08/02 | 54 | 48 | 52 | 48 |
| 2016/08/03 | 57 | 54 | 50 | 47 |
| 2016/08/04 | 50 | 47 | 46 | 40 |
| 2016/08/05 | 50 | 47 | 49 | 44 |
| 2016/08/06 | 54 | 50 | 51 | 48 |
| 2016/08/07 | 56 | 52 | 52 | 47 |
| 2016/08/08 | 51 | 48 | 48 | 44 |
| 2016/08/09 | 51 | 47 | 48 | 43 |
| 2016/08/10 | 50 | 46 | - | - |
| **Range** | 50 – 57 | 46 – 54 | 46 – 52 | 40 – 48 |
| **Average** | 53 | 49 | 50 | 45 |

[1] Average of $L_{AF90,15min}$ measurements

*Figure 14D-3: Location GS06, long-term noise monitoring time history*

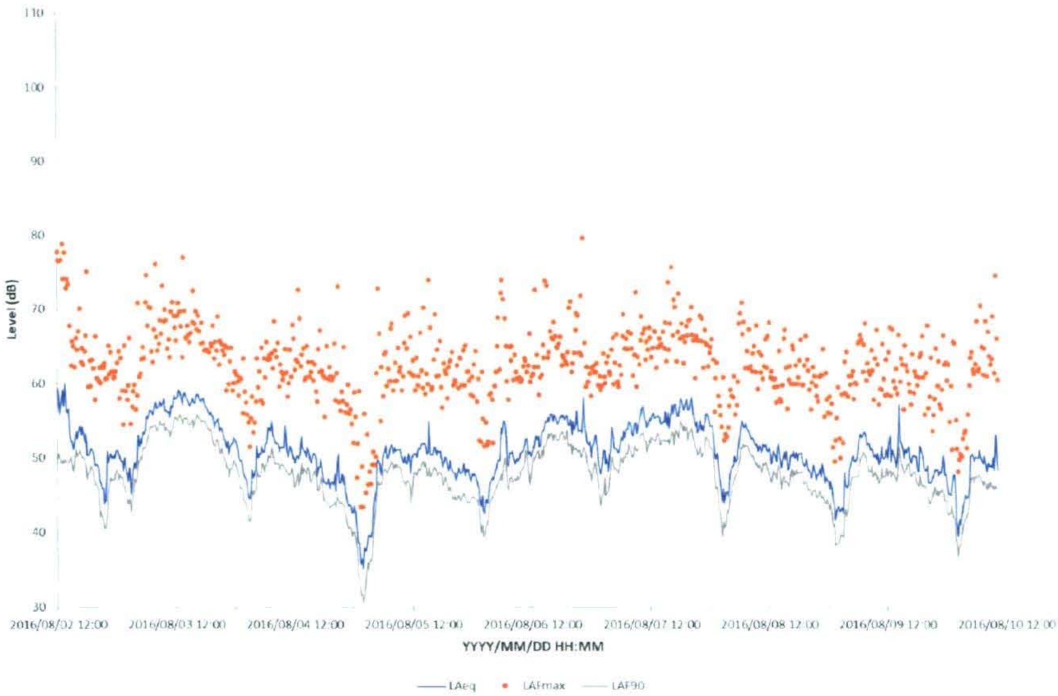


*Table 14D-10: Location GS07, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB) | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB) [1] |
|---|---|---|---|---|
| 2016/08/24 | 56 | 50 | 56 | 50 |
| 2016/08/25 | 57 | 52 | 58 | 50 |
| 2016/08/26 | 59 | 53 | 55 | 48 |
| 2016/08/27 | 55 | 49 | 47 | 41 |
| 2016/08/28 | 52 | 46 | 56 | 46 |
| 2016/08/29 | 58 | 53 | 56 | 49 |
| 2016/08/30 | 60 | 54 | 55 | 48 |
| 2016/08/31 | 62 | 53 | 57 | 49 |
| 2016/09/01 | 59 | 55 | - | - |
| **Range** | 52 – 62 | 46 – 55 | 47 – 58 | 41 – 50 |
| **Average** | 58 | 52 | 56 | 48 |

[1] Average of $L_{AF90,15min}$ measurements

*Figure 14D-4: Location GS07, long-term noise monitoring time history*

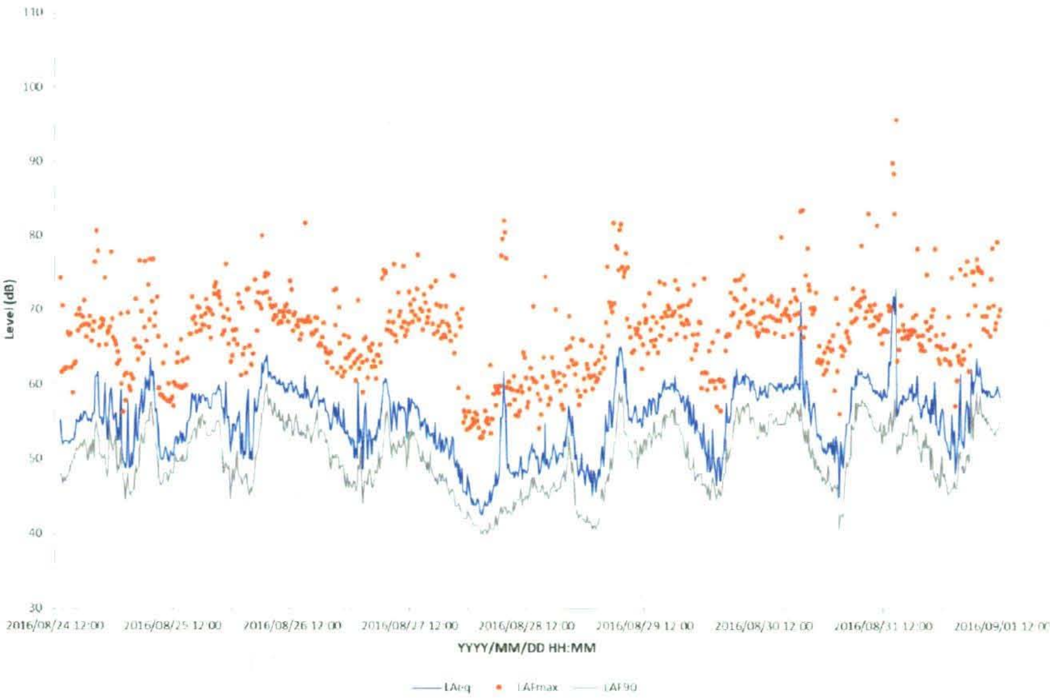



*Table 14D-11: Location GS08, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB) | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB) [1] |
|---|---|---|---|---|
| 2016/07/28 | 65 | 51 | 57 | 38 |
| 2016/07/29 | 65 | 51 | - | - |
| **Range** | - | - | - | - |
| **Average** | 65 | 51 | 57 | 38 |

[1] Average of $L_{AF90,5min}$ measurements

Note – 5 minute base measurement period for this location

*Figure 14D-5: Location GS08, long-term noise monitoring time history*

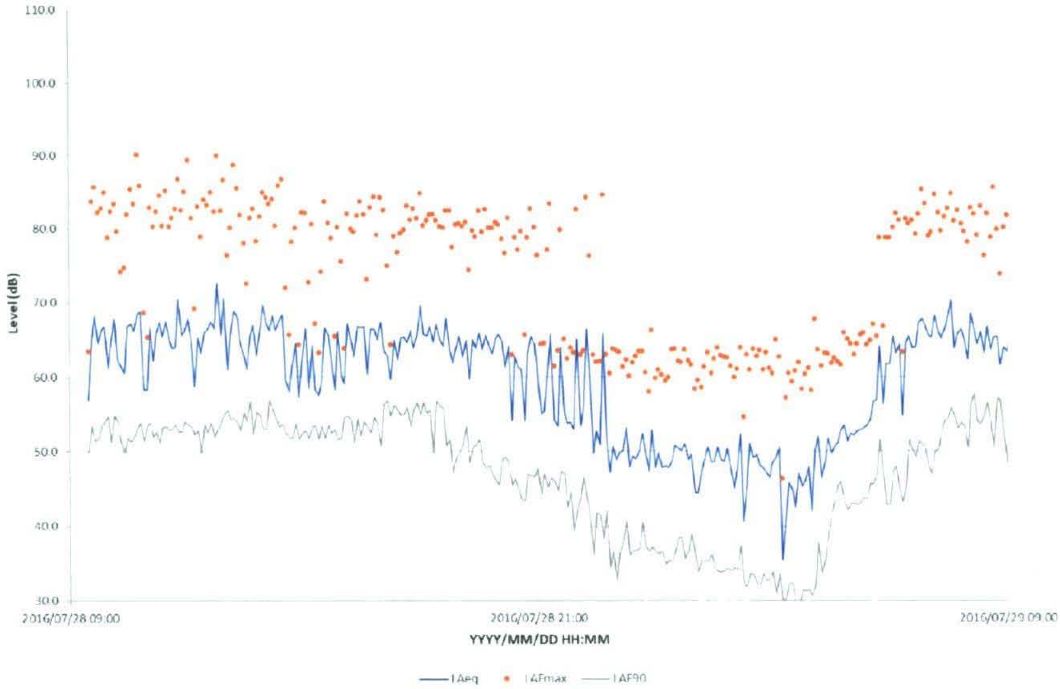



*Table 14D-12: Location GS09, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB) | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB)[1] |
|---|---|---|---|---|
| 2016/08/10 | 60 | 48 | 55 | 43 |
| 2016/08/11 | 60 | 49 | 54 | 40 |
| 2016/08/12 | 61 | 49 | 53 | 39 |
| 2016/08/13 | 59 | 43 | 53 | 33 |
| 2016/08/14 | 58 | 40 | 53 | 37 |
| 2016/08/15 | 57 | 46 | 55 | 41 |
| 2016/08/16 | 57 | 48 | 53 | 40 |
| 2016/08/17 | 58 | 50 | - | - |
| **Range** | 57 – 61 | 40 – 50 | 53 – 55 | 33 – 43 |
| **Average** | 59 | 47 | 54 | 39 |

[1] Average of $L_{AF90,15min}$ measurements

*Figure 14D-6: Location GS09, long-term noise monitoring time history*

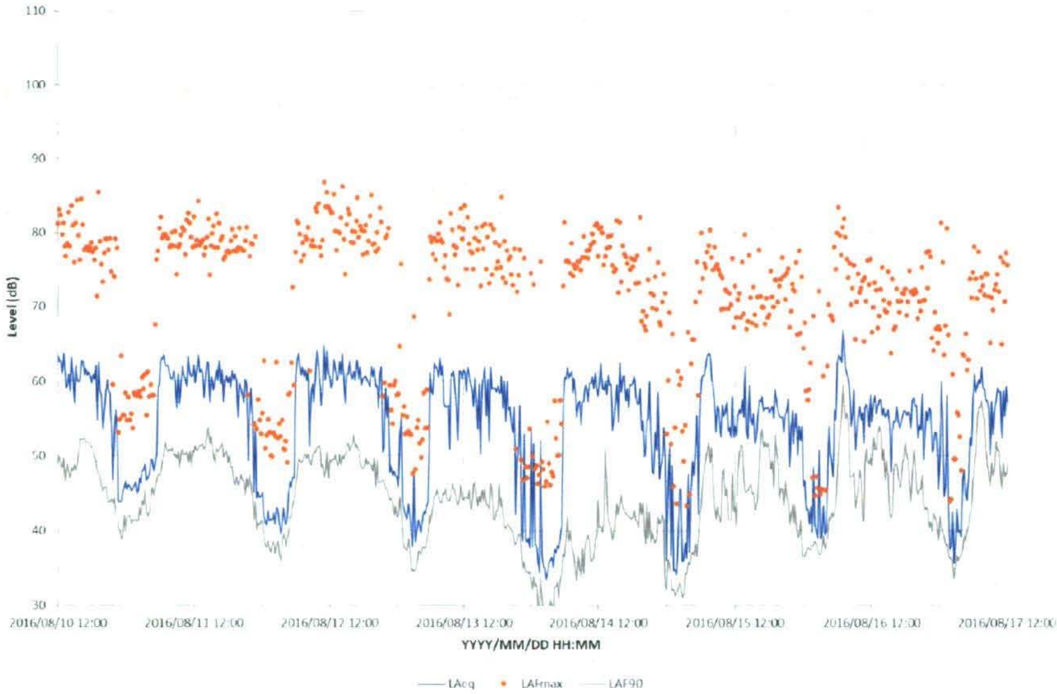
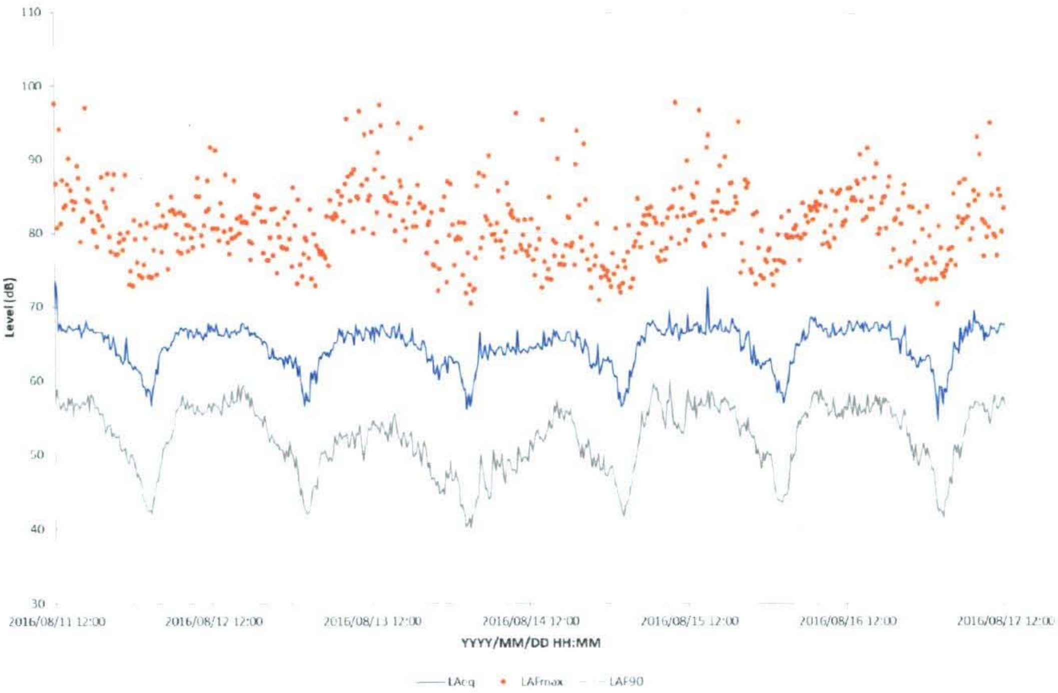



*Table 14D-13: Location GS10, long-term noise monitoring results summary*

| Date | $L_{Aeq,16h}$ (dB) | $L_{AF90,day}$ (dB) | $L_{Aeq,8h}$ (dB) | $L_{AF90,night}$ (dB)[1] |
|---|---|---|---|---|
| 2016/08/11 | 67 | 56 | 63 | 48 |
| 2016/08/12 | 66 | 56 | 62 | 48 |
| 2016/08/13 | 66 | 51 | 62 | 45 |
| 2016/08/14 | 65 | 51 | 64 | 49 |
| 2016/08/15 | 67 | 56 | 64 | 50 |
| 2016/08/16 | 67 | 56 | 63 | 49 |
| 2016/08/17 | 67 | 56 | - | - |
| **Range** | 65 – 67 | 51 – 56 | 62 – 64 | 45 – 50 |
| **Average** | 66 | 55 | 63 | 48 |

[1] Average of $L_{AF90,15min}$ measurements

*Figure 14D-7: Location GS10, long-term noise monitoring time history*




## *Aircraft Taxi Noise Survey*

14D.3.9 The results of the aircraft taxi noise survey are summarised in Table 14D-14 by aircraft type. The results comprise the average overall A weighted noise levels and the average octave band noise levels by aircraft type. Movements by Airbus A320 and Boeing 737-800 type aircraft constitute the bulk of operations at Dublin Airport, and this is reflected in the data.

14D.3.10 The sound power level, $L_{WA}$, of each aircraft type taxiing after arriving has been estimated by using the measured $L_{eq,T}$ levels and assuming monopole source propagation over the distance of 70 m. The resulting levels are included in the table.

*Table 14D-14: Location GS11, aircraft taxi noise survey results by aircraft type*

| A/C | No. | $L_{WA}$ | $L_{eq}$ | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | A | 31.5 Hz | 63 Hz | 125 Hz | 250 Hz | 500 Hz | 1 kHz | 2 kHz | 4 kHz | 8 kHz |
| Airbus A220 | 1 | 123 | 75 | 66 | 68 | 71 | 65 | 65 | 70 | 71 | 66 | 61 |
| Airbus A320 | 14 | 128 | 81 | 69 | 76 | 79 | 72 | 70 | 74 | 75 | 73 | 67 |
| Airbus A321 | 1 | 130 | 82 | 68 | 76 | 80 | 72 | 72 | 77 | 77 | 73 | 67 |
| Airbus A330 | 2 | 135 | 87 | 75 | 79 | 78 | 86 | 78 | 80 | 80 | 80 | 70 |
| Boeing 737-800 | 15 | 129 | 81 | 77 | 80 | 80 | 75 | 71 | 76 | 75 | 74 | 71 |
| Boeing 787 | 1 | 129 | 81 | 73 | 76 | 76 | 80 | 75 | 73 | 75 | 74 | 66 |
| Embraer E190 | 1 | 127 | 79 | 72 | 73 | 77 | 72 | 72 | 73 | 71 | 72 | 71 |
| Learjet 60 | 1 | 121 | 73 | 63 | 61 | 62 | 62 | 59 | 64 | 69 | 65 | 61 |

# 14E. Ground Noise Glossary

## 14E.1 Acoustic Terms



### *Sound*

14E.1.1 Sound is a form of energy that is transmitted away from its source through a medium such as air by longitudinal pressure waves. The human ear can detect the small changes in pressure associated with sound and this manifests as the sense of hearing.

### *Decibel*

14E.1.2 The decibel (dB) is the unit used to describe the magnitude of sound. It is a logarithmic ratio between a measured level and a reference level, typically sound pressure level against a reference pressure level of 20 μPa.

14E.1.3 The decibel scale effectively compresses a wide range of values to a more manageable range of numbers; the threshold of hearing occurs at approximately 0 dB (corresponding to the reference value of 20 μPa) and the threshold of pain is around 120 dB (corresponding to a value of 20 Pa).

14E.1.4 The sound power of 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 (W). The sound power level $L_w$ is expressed in decibels, referenced to $10^{-12}$ Watts.

### *Frequency*

14E.1.5 Frequency is equivalent to musical pitch. It is the rate of vibration of the air molecules that transmit the sound and is measured as the number of cycles per second or Hertz (Hz).

14E.1.6 The human ear is sensitive to sound in the range 20 Hz to 20 kHz. This frequency range is normally divided up into discrete bands for engineering use. The most common 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 further divided into three. The bands are named by their centre frequency value.

### *A-Weighting*

14E.1.7 The sensitivity of the human ear is frequency dependent. Mid-frequency sound tends to be perceived as louder than very low- or high-frequency sound even when the decibel values are equal. Sound levels are therefore often frequency weighted to give an overall single figure value in dB(A) that accounts for the response of the human ear at different frequencies.

### *Ambient Noise*

14E.1.8 Ambient noise, usually expressed using the $L_{Aeq,T}$ metric, is commonly understood to include all sound at any particular site over a defined period of time, regardless of whether the sound is actually defined as noise.

### *Background Noise*

14E.1.9 Background noise, usually expressed using the $L_{A90,T}$ metric, is the steady sound attributable to less prominent and mostly distant sound sources above which clearly identifiable specific noise sources intrude.

## Sound Transmission in the Open Air

14E.1.10 Most sources of sound can be characterised as a single point in space. Sound energy is radiated out in all directions and spreads over the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, for each doubling of distance from a point source the sound pressure level is reduced by 6 dB.

14E.1.11 Road traffic noise is a notable exception to this rule, as it approximates to a line source. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

## Factors Affecting Sound Transmission in the Open Air

### Reflection

14E.1.12 When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber, or plasterboard, they are reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

### Screening

14E.1.13 If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. Although this reduction is limited by diffraction of the sound around the edges of the screen, it can still provide valuable noise attenuation. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land immediately beyond by around 10 dB. The best results are obtained when a screen is situated close to the source or close to the receiver.

### Meteorological Effects

14E.1.14 Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradients are variable and difficult to predict.

## Noise Metrics

14E.1.15 Where noise levels vary with time, it is necessary to express the sound level over a period of time in statistical terms. Some commonly used descriptors follow.

### $L_{Aeq,T}$

14E.1.16 $L_{Aeq,T}$, 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.

14E.1.17 $L_{Aeq,16h}$ 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.

### $L_{den}$

14E.1.18 $L_{den}$, 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:

$$L_{den} = 10 \times Log\left(\frac{12}{24} \times 10^{\left(\frac{L_{day}}{10}\right)} + \frac{4}{24} \times 10^{\left(\frac{L_{eve}+5}{10}\right)} + \frac{8}{24} \times 10^{\left(\frac{L_{night}+10}{10}\right)}\right)$$

14E.1.19 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).

### $L_{A90,T}$

14E.1.20 $L_{A90,T}$ is the A-weighted sound pressure level exceeded for 90% of the time over a defined period, T, and is normally used to describe background noise.

### $L_{Amax,T}$

14E.1.21 $L_{Amax,T}$ is the maximum A-weighted sound pressure level measured in a defined period, T. Normally given 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.

### SEL

14E.1.22 SEL is the sound exposure level which is a measure of the total sound energy from an event such as an aircraft movement. The SEL value is the notional constant sound level that has the same amount of energy in 1 second as the original noise event has in total. This is equal to $L_{Aeq,T}$ + 10Log(T).

## 14E.2 Aviation Terms

### ANCA

14E.2.1 ANCA, the Aircraft Noise Competent Authority, is the body responsible for ensuring that noise generated by aircraft activity at Dublin Airport is assessed in accordance with EU and Irish legislation.

### FAA

14E.2.2 The Federal Aviation Administration (FAA) is the regulatory body for civil aviation in the United States. The FAA produces AEDT, the industry standard modelling software for aircraft noise.

### AEDT

14E.2.3 The Aviation Environmental Design Tool (AEDT) is the industry standard software for the evaluation of aircraft noise in the vicinity of airports based on aircraft type, operation, route, flight profile and terrain.

### NMT

14E.2.4 A noise monitoring terminal (NMT) is a fixed or mobile station with the appropriate instrumentation to measure aircraft noise in the vicinity of an airport on a long-term basis.

### NFTMS

14E.2.5 A noise and flight track monitoring system (NFTMS) comprises a network of NMTs that record and correlate noise data with individual flights by use of other airport logged flight telemetry, such as radar data.

### Start of roll

14E.2.6 The position on a runway where aircraft commence their take-off procedure.

### *Runway arrival threshold*

14E.2.7 The beginning of the portion of the runway usable for landing.

### *APU*

14E.2.8 An auxiliary power unit (APU) is a small engine, often located in the tail of the aircraft, that provides power to electrical systems independently from ground support equipment. It is often run on the stand during boarding and disembarking where an external GPU or FEGP are unavailable.

### *GPU or MGPU*

14E.2.9 A ground power unit (GPU) or mobile ground power unit (MGPU) is an external power source to the aircraft which may be used in place of the APU.

### *FEGP*

14E.2.10 Fixed electrical ground power (FEGP) may be installed on individual aircraft stands. This allows aircraft to 'plug in' while on the stand and negates the need to run an APU or GPU.