An tÚdarás Inniúil um Thorann Aerárthaí

Aircraft Noise Competent Authority

NOISE ABATEMENT OBJECTIVE REPORT

November 2026



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GLOSSARY OF TERMS

Term	Description
ANCA	Aircraft Noise Competent Authority
AEDT	Aviation Environmental Design Tool
ANP	Aircraft Noise and Performance
ACI	Airport Council International
ANNE	Aviation Night Noise Effects
ATM	Air Traffic Movements
CSO	Central Statistics Office
daa	Airport authority for Dublin Airport
Decibel (dB)	The decibel (dB) is a logarithmic unit of measurement that expresses the magnitude of a physical quantity relative to a specified or implied reference level. Decibels are used for a wide variety of measurements including acoustics, and for audible sound A-weighted decibels (dB (A)) are commonly used.
ECAC	European Civil Aviation Conference
EEA	European Environment Agency
EU	European Union
END	Environmental Noise Directive 2020/367
ENR	European Communities (Environmental Noise) Regulations 2018 (as amended)
FAA	Federal Aviation Administration
FCC	Fingal Country Council
FDP	Fingal Development Plan
HA	Highly Annoyed
HSD	Highly Sleep Disturbed
IA	Infrastructure Application F23A/0781
ICAO	International Civil Aviation Organization
L_{day}	The A-weighted average sound level over the 12-hour day period of 07:00 - 19:00
L_{den}	The day, evening, night level, L_{den} is a logarithmic composite of the L_{day}, $L_{evening}$, and L_{night} levels but with 5 dB(A) being added to the $L_{evening}$ value and 10 dB(A) being added to the L_{night} value.
$L_{evening}$	The A-weighted average sound level over the 4-hour evening period of 19:00 - 23:00
L_{night}	The A-weighted average sound level over the 8-hour night period of 2300 – 0700
LOAEL	Lowest Observed Adverse Effect Level
NAO	Noise Abatement Objective
NAP	Noise Action Plan
NDP	National Development Plan
NMT	Noise Monitoring Terminals
NRPP	North Runway Planning Permission F04A/1755
NRRA	North Runway Relevant Action F20A/0668
NTK	Noise and Track Keeping (NTK) monitoring system.
The Act of 2019	Aircraft Noise (Dublin Airport) Regulation Act 2019
The Aircraft Noise Regulation	Regulation EU 598/2014
RD	Regulatory Decision
ZPAP	Zero Pollution Action Plan

OVERVIEW AND INTRODUCTION TO THE NOISE ABATEMENT OBJECTIVE

The Noise Abatement Objective (NAO) is a policy to support noise management decisions at Dublin Airport. It is also a plan to ensure that aircraft noise at Dublin Airport is managed in the context of sustainable development.

The NAO has a number of characteristics under relevant legislation and guidance:

- In accordance with Regulation 598/2014 and the ICAO Balanced Approach it is required to be identified and defined in order to assist in determining the extent of any noise problem at an airport;
- It is an objective of Regulation 598/2014 to facilitate the achievement of specific noise abatement objectives at the level of individual airports;
- Under the Aircraft Noise (Dublin Airport) Act 2019, ANCA is required to review the effectiveness of existing noise mitigation measures and operating restrictions on an annual basis and take action as would be, in ANCA's opinion, effective towards achieving the NAO, where the NAO is not being achieved; and
- In accordance with Regulation 598/2014, measures to address noise cannot be more restrictive than is necessary to achieve the environmental noise abatement objective set for that airport.

Accordingly, the policy and expected outcomes defined by the NAO provide the basis for identifying noise problems and identifying and determining measures to address those problems. Under Regulation EU 598/2014 and the Aircraft Noise (Dublin Airport) Regulation Act 2019, those measures must include consideration of (a) the foreseeable effect of a reduction of aircraft noise at source, (b) land-use planning and management; (c) noise abatement operational procedures; and (d) operating restrictions, not as a first resort, but only after consideration of the other measures of the Balanced Approach.

Many of the measures requiring consideration cannot be adopted by ANCA. They can require consideration and action from a range of stakeholders that have a remit which can influence the impact of aircraft noise on human health around Dublin Airport and expected outcomes of the NAO. As well as ANCA, these include airlines, local planning and development authorities, air navigation service provider, and the airport authority. The expected outcomes can be used by all of these stakeholders to support noise management decisions. Only ANCA can adopt operating restrictions, and it can only do so when other noise management and mitigation measures cannot achieve the expected outcomes. The NAO therefore serves an important role not only in guiding ANCA in the performance of its functions, but in enabling other stakeholders to perform any of their functions that affect aircraft noise in a coordinated way.

The NAO is an amendment to the 2022 NAO, which was prepared in 2021 for public consultation. The 2022 NAO was measured and tested against forecasts provided by Dublin Airport which were based on an assessment of the noise situation reflecting noise performance and validation based on activity in 2018 and 2019.

The noise situation at Dublin Airport in 2021 has changed significantly. Since the 2022 NAO was defined, the north runway was commissioned, with flight paths and runway operations changing as a result. The airport's fleet mix has changed following the Covid-19 pandemic and there has also been noise-sensitive development in areas affected by airport noise. The current noise situation at Dublin Airport is presented in the Noise Action Plan (NAP) 2024-2028 which details the regulatory framework and processes for managing aircraft noise at Dublin Airport. Fingal County Council undertook a period of public consultation in relation to the draft NAP 2024-2028 in September 2024. Public submissions were made to ANCA regarding achievement of the NAO target outcomes and requesting amendments to the NAO. Action No. 3 of the NAP subsequently requires that a review of the Noise Abatement Objective for Dublin

Airport be carried out "to support sustainable community and airport development in accordance with relevant plans and policies".

Section 9 also of the Act of 2019 obliges ANCA to ensure that the Noise Abatement Objective (NAO) is defined, restated, or amended where a noise problem has been identified, before any noise mitigation measures are identified or considered. A noise problem was identified following the making of the IA in accordance with Act of 2000.

The review has been carried out having regard for the wider policy landscape affecting Dublin Airport and its surroundings. It considers the current state of evidence with respect to the effects of aviation noise on health, and how the noise situation at Dublin Airport has changed alongside its surroundings. Each of the five parts of the 2022 NAO are reviewed in the context of the current and forecast noise situation at the airport to determine whether the NAO would benefit from revision in order better support management of noise at the airport. The considerations made in preparing and proposing the amendments to the 2022 NAO are set out in this Report. These considerations have been used to determine whether amendments are considered appropriate or necessary. The amended NAO was the subject of a public consultation between May and September 2026. ANCA's responses to the matters raised regarding the amended NAO are set out thematically in a consultation report.

Following the process of public consultation, amendments have been made to the accompanying NAO Guidance Note. These amendments are as follows:

- The NAO Guidance Note now provides for the reporting of noise exposure based on the dwellings, population and noise sensitive buildings occupied in 2023 alongside the latest information to allow ANCA to have regard for changes in aircraft noise alongside changes in the local population when reviewing the noise situation; and
- Request the provision of noise insulated buildings to be reported to ANCA as part of reporting noise exposure.

PART 1 - EXECUTIVE SUMMARY

Planning application F23A/0781 for infrastructure and an increase to the permitted passenger capacity of Dublin Airport (**the Application**) has initiated a statutory aircraft noise assessment process by the Aircraft Noise Competent Authority (**ANCA**) under the Aircraft Noise (Dublin Airport) Regulation Act 2019 (**the Act of 2019**). Section 9 of the Act of 2019 obliges ANCA to ensure that the Noise Abatement Objective (NAO) is defined, restated, or amended where a noise problem has been identified, before any noise mitigation measures are identified or considered.

In addition, Action 3 of the Noise Action Plan for Dublin Airport 2024–2028 (**NAP**) requires Fingal County Council (FCC) to review the NAO, informed by the current noise situation and the policy context set out in the NAP. The review forms an essential part of the overall regulatory framework governing the management of aircraft noise at Dublin Airport.

This document proposes changes to the NAO for Dublin Airport 2022 ('the 2022 NAO') and has been conducted by ANCA which is a separate Directorate of FCC. An amended NAO for Dublin Airport ('the 2026 NAO') is proposed by ANCA in support of functions under the Act of 2019 and the European Communities (Environmental Noise) Regulations 2018 (as amended) (**ENR**).

An NAO is a policy objective for managing the effects of aircraft noise emissions on the surrounding communities and environment at an airport. It is a plan to ensure that any growth at the airport occurs in the most sustainable manner possible, with respect to aircraft noise. It may be used to guide the decisions that are needed to manage the aircraft noise aspects of future aircraft operations at and around an airport.

This review considers the noise situation at Dublin Airport and the content and context as relevant to the Application and as provided by the NAP which includes a description of relevant policies.

The review has been carried out having regard for the wider policy landscape affecting Dublin Airport and its surroundings. It has considered the current state of evidence with respect to the effects of aviation noise on health, and how the noise situation at Dublin Airport has changed alongside its surroundings.

The review recommends that:

1. The NAO retains its current five-part structure having regard for best practice;
2. That the policy objective of the NAO remains committed to the principle of limiting and reducing the adverse and harmful effects of aircraft noise over time and that this should be achieved as part of the sustainable development of Dublin Airport;
3. Changes in the noise situation should be limited to those that have demonstratable wider economic and social benefits, and that only cost-effective, practicable and sustainable measures are implemented to achieve this objective;
4. The measurable outcomes set by the NAO remain linked to the harmful effects of aircraft noise quantifiable by the number of people highly annoyed and highly sleep disturbed by aircraft noise. These outcomes, measurable through the number of people exposed to the L_{den} and L_{night} metrics, remain best aligned with the wider regulatory framework and health evidence for aircraft noise assessment;
5. The expected outcomes of the NAO will continue to be measured as progressive reductions in the number of people highly annoyed and highly sleep disturbed by aircraft noise;
6. The expected outcomes are re-baselined against the noise situation in 2023 rather than 2019. This reflects 2023 as being the most recent situation provided in the (NAP) and representative of the airport in its current form following the opening of its North Runway in 2022. It also has regard to the fleet modernisation that has occurred since 2019;

7. The measurable outcomes set by the 2026 NAO, in the form of the expected percentage reduction in the population highly annoyed and highly sleep disturbed are made more stringent than those they replace in the 2022 NAO;
8. The expected outcome that compares the number of people exposed to 65 dB L_{den} and 55 dB L_{night} against the noise situation in 2019 is replaced by a requirement to monitor the number of dwellings, schools and hospitals exposed to noise above 65 dB L_{den} and 55 dB L_{night}, with the expectation that measures will be used to mitigate and/or limit the number of dwellings, schools and hospitals exposed in each relevant year under ENR;
9. A measurable outcome that tracks the areas exposed to aircraft noise above 55 dB L_{den} and 50 dB L_{night} has been added with the expectation that these areas will reduce compared to 2023 in each relevant year under ENR;
10. The effectiveness of the noise mitigation measures and operating restrictions (if any) on achieving the NAO will continue to be monitored annually; and
11. The 2022 NAO is amended to include specific guidance on what must be demonstrated to support its evaluation as part of ongoing monitoring or as part of an assessment under the Act of 2019.

PART 2 - REVIEW OF THE NOISE ABATEMENT OBJECTIVE (NAO) FOR DUBLIN AIRPORT

1 Introduction

A Noise Abatement Objective is a policy objective for managing the effects of aircraft noise emissions on the surrounding communities and environment at an airport. It is a plan to ensure that any growth at the airport occurs in the most sustainable manner possible, with respect to aircraft noise. An NAO may be used to guide the decisions that are needed to manage the aircraft noise aspects of future aircraft operations at and around an airport.

In 2022, following consultation, ANCA defined an NAO for Dublin Airport. The NAO was defined in response to a potential noise problem resulting from Planning Application F20A/0668, which sought to amend Conditions 3(d) and 5 of the North Runway Planning Permission (NRPP)[1]. This planning application was referred to as the North Runway Relevant Action (NRRA)[2].

The approach taken to the development of the 2022 NAO, and considerations made in the definition of it were documented in the NAO Report for Dublin Airport (the 'NAO Report'). This report described how the 2022 NAO had been developed having regard for wider international, regional and local legislation, policies, standards and guidance. The 2022 NAO Report also provided discussion with respect to each part of the NAO, identifying relevant considerations that had been applied in its definition.

The 2022 NAO for Dublin Airport is defined over five parts:

1) **A Policy Objective** – the overarching policy statement which sets out the high-level noise-related outcomes to be achieved at Dublin Airport.

2) **An Explanation of the Policy Objective** – which provides further description of how the policy objective is to be applied as part of decision making.

3) **Measurable criteria** – how the NAO is to be measured and the metrics that are to be used as part of its measurement.

4) **Expected Outcomes** – based on the policy objective and the measurable criteria, the expected outcomes that are to be achieved.

5) **Monitoring** – how the expected outcomes set by the NAO are to be monitored.

The Application was submitted by the airport authority for Dublin Airport (daa) in December 2023 with the proposed development comprising of two core aspects:

- a proposal to increase airport passenger numbers requiring an uplift in Dublin Airport's current passenger cap of 32mppa to 40mppa; and
- the provision of airport infrastructure to support and facilitate increased passenger numbers and support the delivery of high-quality international connectivity.

ANCA determined through the provisions of Section 34B(1)(a) of the Act of 2000 that the proposed development, the subject of the Application contained a proposal requiring the assessment for the need for a noise-related action, and

[1] Planning ref. F04A/1755; PL 06F.217429

[2] Planning ref. F20A/0668; ABP-314485

issued a notice to the planning authority to this effect pursuant to 34B(2) of the Act of 2000. On 01 March 2024, the applicant (daa) was directed to provide additional information to facilitate a detailed assessment of the potential aircraft noise impact of the development as proposed. The information specified in the Direction by ANCA was received from the applicant during November 2025.
Following assessment of the Application and the information provided by the applicant a noise problem was identified at Dublin Airport. Under the Act of 2019, ANCA must apply the Balanced Approach and ensure that the '*noise abatement objective is, as appropriate, defined, restated or amended, taking into account, as appropriate, Article 8 of, and Annex V to, the Environmental Noise Directive*' where a noise problem has been identified. This requires ANCA to have regard for the NAP to ensure that that noise situation at Dublin Airport has been assessed in accordance with the ENR and END.

In addition, in 2024, Fingal County Council published the Noise Action Plan for Dublin Airport 2024 – 2028 (**the NAP**). The NAP presents the noise situation at Dublin Airport in 2021 and 2023, assessed in accordance with the European Communities (Environmental Noise) Regulations 2018 (S.I. No. 549 of 2018) (as amended) (**the ENR**) and the Environmental Noise Directive 2002/49/EC (**the END**). The NAP also provides forecasts for how the noise situation may evolve during the period of the plan, having regard for potential developments at Dublin Airport.
As such, Action 3 of the NAP requires *'… a review of the Noise Abatement Objective for Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies.'*

In accordance with the Act of 2019, this report presents a review of the 2022 NAO for Dublin Airport. This review is supported by Appendix A – '*Analysis of changes in population and aircraft noise exposure around Dublin Airport since 2006*', prepared by Noise Consultants Limited.

Part 2 of this NAO Review Report is structured as follows:

- **Section 2** considers any changes in the policy and/or regulatory framework affecting aircraft noise management at Dublin Airport since the NAO was defined in 2022;
- **Section 3** considers the relevance of the five-part general structure adopted within the NAO; and
- **Section 4 to 6** considers the scope for restating and/or amending the contents of each part of the NAO.

2 Policy and Legislative Background

Section 3 of the NAO Report of 2022 describes the relevant policy and legislative background in relation to aircraft noise and the sustainable development of Dublin Airport. The most recent overview of this can be found in Section 4 of the NAP. Some changes to policy have occurred since the NAO was established in 2022 with further changes signalled but yet to occur. These are summarised as follows:

- National Aviation Policy is now under review;
- The first revision to the National Planning Framework was published in April 2025;
- The Department of Transport - Statement of Strategy, and Implementation Plan was published on 30 September 2025;
- The Minister of Transport has announced Cabinet approval to progress Dublin Airport Passenger Cap legislation;
- The Programme for Government was published in April 2025; and
- The Government has published the General Scheme for the Dublin Airport (Passenger Capacity) Bill 2026 which sets out the legislative approach to be taken to meet the commitment made in the Programme for Government to work with stakeholders with the objective of lifting the passenger capacity limit at Dublin Airport. The legislation seeks to ensure the sustainable development of Dublin airport through compliance with applicable EU law, while balancing the rights of local residents with the objectives of Ireland's National Aviation Policy and the needs of business and tourism.

Following review, it is concluded that there have been no material changes to the policy and the legislative framework that underpin the NAO since 2022.

Section 4.3 of the 2022 NAO Report highlighted that a key theme of the policy review was the need to balance future development of Dublin Airport with wider environmental considerations i.e. sustainable development. Since the NAO was defined in 2022, Dublin Airport's North Runway has commenced operation, the Airport has recovered from the Covid-19 pandemic and the daa have brought forward planning applications which seek to increase passenger numbers.

This highlights the need for the NAO to consider the growth potential for Dublin Airport in the context of appropriate but challenging, achievable noise outcomes.

3 General Structure and Approach to the Setting of the NAO

The NAO is currently defined over five parts as summarised in Part 2 of this document. In 2024, Airport Council International (ACI) Europe published guidance on the application of the ICAO Balanced Approach to Airport Noise Management. The ACI report[3] provides guidance on the development of a noise abatement objective.

This guidance aligns with the approach taken in structuring and setting out the NAO in 2022, as described in the NAO Report. The guidance describes six key elements for a noise abatement objective. These are set out below.

Element	Description	Considered by ANCA 2022 NAO
Objective statement	Having identified a noise problem, this statement should detail the ambition against a stated baseline. This can either be visionary or focused.	Yes Part 1, Policy Objective
What this means	Explanatory text should clarify that overall impacts will be within the envelope set by the situation in the baseline/forecast period, but not necessarily for individual residents/communities. It should identify the impacts being considered, e.g., annoyance or sleep disturbance. It should clarify the general expectation and timeframe within which effects will be limited, reduced, removed, or improved.	Yes Part 2, Explaining the Objective
How will progress be measured	This should set out the mechanism and assumptions used to calculate outcomes of interest. For example, the specific noise contours used to determine health impacts or whether population databases and wind direction splits will be standardised.	Yes Part 3, Measurable Criteria
What are the expected outcomes	This should detail the specific outcomes of interest and the expected change over the lifetime of the objective (or if visionary the interim target or goal).	Yes Part 4, Expected Outcomes
How will progress be audited and reported	This should set out how data will be independently verified and reported to interested stakeholders.	Yes Part 5, Monitoring
How often will the objective be reviewed	This should detail the frequency with which the objective will be reviewed. For example, it could be every 5 or 10 years in line with the noise action plan cycles.	No

The elements set out in the ACI Europe guidance follow, and broadly align, with the approach taken in structuring the NAO in 2022. The only exception to this is that the NAO does not currently describe or define how often it will be reviewed. The NAP contains an action to review the NAO, which was identified through the process of noise action planning under ENR. Furthermore, under the Act of 2019, ANCA is required to review the NAO as part of the process of aircraft noise regulation.

With respect to how often the NAO shall be reviewed, it is concluded that this is best achieved, and triggered, through the noise action planning process under ENR, when appropriate, rather than setting this within the NAO itself. This approach has already been adopted in the current NAP.

[3] https://store.aci.aero/product/guidance-on-the-application-of-the-icao-balanced-approach-to-aircraft-noise-management/

The structure of the NAO remains appropriate and reflects emerging guidance. No changes to the structure of the NAO are therefore proposed.

The NAO has therefore been reviewed with reference to its existing five-part structure. This commences in Section 4.

3.1 Role of the NAO Report

ANCA held a public consultation on the NAO during 2021/2022. The accompanying NAO Report provided background to the definition of the NAO, setting out relevant considerations with respect to wider legislation, policy and guidance. The NAO Report was not intended to be, and was not described as, a guidance document to support of the application of the NAO.

The structure of the NAO remains relevant. It is concluded that a guidance note on the application of the NAO should be made available, to enable stakeholders to understand how the NAO will be used and applied.

In reviewing each part of the NAO in the following sections, it highlighted where guidance is required. This guidance is provided in the form of an NAO Guidance Note.

4 Policy Objective and Explanation

The policy objective of the 2022 NAO is to:

> *"Limit and reduce the long-term adverse effects of aircraft noise on health and quality of life, particularly at night, as part of the sustainable development of Dublin Airport."*

The explanatory text to the 2022 NAO states that:

> *"Noise from Dublin Airport should be limited and reduced in line with principles of sustainable development. As Dublin Airport grows, the long-term adverse effects on human health and quality of life should progressively reduce over the lifetime of this NAO. The Balanced Approach will be used to ensure that cost-effective, practicable and sustainable measures are implemented to achieve this objective."*

The principles that underpin the policy objective remain valid. These principles are underpinned by wider policy statements in Ireland.

A policy objective which focuses on limiting and reducing the adverse effects of aircraft noise on health and quality of life, in line with sustainable development principles, remains consistent with the objectives of the EU Regulation 598/2014 (**the Aircraft Noise Regulation**), the ENR, END and wider EU noise policy such as Zero Pollution Action Plan (ZPAP). As highlighted in Section 2, there has been no material change in the legislative and policy context that underpin the regulatory framework since the NAO was defined in 2022.

The key principles and outcomes of the policy objective are further underlined by the European Environment Agency (EEA)[4] who highlight the *"urgent need for additional efforts to reduce environmental noise and its effects on human health, the environment and the economy.".* This further underlines the principles of ensuring that as airport activity increases, its effects must be managed.

Section 2 of NAP demonstrates that since the NAO was consulted on and defined in 2022 there have been significant changes at Dublin Airport through the opening of the North Runway, changes to North Runway flight paths, and increasing airport activity following recovery from the Covid-19 pandemic. Furthermore, the NAP identifies concurrent development applications which could affect the noise situation at Dublin Airport during the period of the NAP and beyond, through further operational changes and additional aircraft movements. This includes the determination of the NRRA, and Infrastructure Application (IA) planning applications.

In this context, an NAO which seeks to achieve a balance between airport growth and limiting and reducing the adverse effects of aircraft noise remains an appropriate policy objective. However, the Health Evidence Review[5] identifies studies which have examined changes in aircraft noise exposure, particularly where populations are newly affected or become increasingly affected following airport developments. These studies indicate heightened annoyance compared to 'steady state' conditions. This is known as a 'change effect'. These studies indicate that such heightened annoyance may last for a couple of years, or longer, after a particular change or increase in activity has occurred. This indicates that decisions on airport developments need to be mindful of the effect of an ever-changing aircraft noise situation and the impact this may have.

It remains appropriate for the policy objective of the NAO to limit and reduce the adverse effects of aircraft noise on health and quality of life, in line with sustainable development principles. However, it is considered appropriate that this policy should be delivered in a manner which provides assurance as to how aircraft noise impacts are managed,

[4] European Environment Agency, EEA Report 05/2025: Environmental Noise in Europe 2025
[5] Clark. C, State of the evidence for aviation noise effects on health and wellbeing, 2026

and how they will be limited and mitigated in line with the Airport's development and growth. This means that as the airport grows, or changes are brought forward through airport development that may affect the noise situation, efforts are made to limit and mitigate adverse effects in a sustainable manner.

The NAO should therefore provide the basis for the development of noise-related measures and mitigation that do not only limit and reduce noise impacts but provide assurance to communities and the airport operator with respect to the amount of aircraft noise experienced, and the mitigation that will be provided in line with how the airport is forecast to grow. This also means limiting change in the noise situation to only what is considered sustainable and identifying appropriate mitigation measures and restrictions in that context.

The 2022 NAO currently highlights night-time impacts as an area of focus. The Heath Evidence Review is supportive of this approach, highlighting that night-time noise is more likely to result in adverse health effects than noise impacts during the day due to effect on restorative sleep. This is discussed further in Section 6 when considering the expected outcomes of the NAO, and whether outcomes in relation to sleep disturbance may need to be more stringent than for annoyance.

4.1 Amendments following Review

The following amendments are therefore proposed to the NAO's policy objective and its explanation:

Proposed Policy Objective
Limit and reduce the long-term adverse effects of aircraft noise on health and quality of life, particularly at night, through measures that mitigate impacts and provide certainty to the communities and the airport operator as part of the sustainable development of Dublin Airport.

Proposed Explanation of the Policy Objective
The harmful effects of noise from Dublin Airport should be limited and reduced in line with principles of sustainable development. As Dublin Airport grows, the long-term adverse effects on human health and quality of life should be limited and progressively reduced. This should be achieved by providing measures which mitigate impacts, whilst providing assurance to communities as to how aircraft noise impacts are managed, and how they will be limited and mitigated in line with the Airport's development and growth. This is to be achieved by providing clear rules and expectations on measures that will limit, reduce and mitigate impacts. This means limiting changes in the noise situation only to those which are outweighed by the wider economic and consumer benefits of aviation, and prioritising measures which can reduce adverse effects. The Balanced Approach will be used to ensure that the measures adopted to achieve this objective are cost-effective, practicable and sustainable.

5 Measurable Criteria

The measurable criteria described within the NAO are adopted from World Health Organization (WHO) Environmental Noise Guidelines for Europe 2018 (**WHO ENG18**) and the WHO Night Noise Guidelines for Europe 2009 (**WHO NNG**) and reflect the regulatory framework in place for environmental noise management in the EU and Ireland.

The 2022 NAO is primarily measured through the number of people highly sleep disturbed (HSD) and highly annoyed (HA) calculated in line with the methodology described in the Second Schedule of the ENR (as amended), which transposes EU Directive 2020/367, using the L_{den} and L_{night} metrics. These metrics are underpinned by the ENR and END.

The 2022 NAO states that the population HSD and HA are calculated from the WHO ENG18 guideline values of 45 dB L_{den} and 40 dB L_{night}.

In addition to the calculation of population HSD and population HA, the NAO also identifies two further thresholds of measurement of noise exposure: the 55 dB L_{night} and 65 dB L_{den}. The 2022 NAO states that these metrics are *"used to help identify where noise exposure results in the populations experiencing the harmful effects"*. The 55 dB L_{night} is used to signify *"a level of night-time noise exposure described by the WHO as representing a clear risk to health"* with the 65 dB L_{den} signifying *"a large proportion of those living around Dublin Airport can be considered highly annoyed"*.

The calculation and evaluation of these metrics rely on the noise situation and any given noise forecasts being prepared through a process of aircraft noise modelling. To this end, the 2022 NAO currently cites the methodology described in Annex II of the END which is based on European Civil Aviation Conference (ECAC) Doc. 29 4th Edition (or as amended). Having regard for the quality framework set out in Annex II of the END and best practice in place at other major airports in Europe, the 2022 NAO also requires that noise modelling used for purposes of measuring the 2022 NAO be validated using local noise and track keeping (NTK) performance data using the Airport's systems.

The measurable criteria of the 2022 NAO requires that the population exposed to the L_{den} and L_{night} metrics be considered against the most recent population datasets, and the population exposed to aircraft noise in 2019.

In reviewing the 2022 NAO measurable criteria, the following considerations have been identified:

- **Consideration 1:** Whether the L_{den} and L_{night} metrics and the use of the numbers of people highly annoyed (HA) and/or highly sleep disturbed (HSD) remain appropriate metrics in support of a noise abatement objective.
- **Consideration 2:** Whether it remains appropriate for the number of people highly annoyed (HA) and highly sleep disturbed (HSD) to be calculated from 45 dB L_{den} and 40 dB L_{night}.
- **Consideration 3:** Relevance of the 55 dB L_{night} and 65 dB L_{den} as metrics in the NAO.
- **Consideration 4:** Whether additional metrics should be included within the NAO.
- **Considerations 5 and 6:** Any wider considerations in relation to how the noise is evaluated for the purposes of assessing exposure through modelling that must be stipulated with the NAO.
- **Consideration 7:** The status and sophistication of the noise modelling that underpins the NAO.

Each of the above considerations are addressed below.

5.1 Consideration 1

Since the NAO was set in 2022 there have been no substantive changes to the legal and regulatory framework that underpins either the ENR or END. The L_{den} and L_{night} metrics remain the primary metrics for aircraft noise assessment in the EU and Ireland. The EEA have recently summarised the overarching situation with respect to environmental noise in Europe using the L_{den} and L_{night} metrics.

The Health Evidence Review does not provide any strong rationale for the use of alternative metrics to the L_{den} and L_{night}. The review notes that EU Directive 2020/367 provides the opportunity for local studies to be used to quantify the population HA and population HSD providing that *"they are based on high quality and statistically significant studies"*.

The Health Evidence Review also notes that because there are no noise and health studies in Ireland or for Dublin Airport that allow annoyance and sleep disturbance to be determined it remains appropriate for the population HA and HSD to be calculated in line with the methodology set out in the Second Schedule of the ENR, which transposes EU Directive 2020/367, which adopts exposure response relationships from the WHO ENG18.

In the case of sleep disturbance, the Health Evidence Review indicates that in addition to the L_{night} metric there is a role for L_{Amax}-based metrics to be used, along with consideration of 'additional aircraft noise induced awakenings'. These metrics can be used to help describe the potential risk of being awoken from sleep due to aircraft noise events. However, the review also points to uncertainties, assumptions and complexities in the Application and calculation of these metrics. The use of additional aircraft noise induced awakenings information is therefore considered an *"important additional tool for estimating and managing the effects of aviation night-noise"* that could be used when exploring interventions but should not be considered a primary metric for policy making.

Since the 2022 NAO was set, other European airports and their competent authorities have set Noise Abatement Objectives which utilise the population HA and HSD as part of their measurable criteria. In the case of Schiphol, Brussels and Paris Charles de Gaulle Airports, noise abatement objectives have been set based on reductions in the population HA and HSD calculated in line with the WHO ENG18 exposure response functions. The ACI report which provides guidance on the application of the Balanced Approach also cites the use of HSD as a measurable criterion as an example 'focussed' objective.

It is therefore considered that the use of the L_{den} and L_{night} metrics and the calculation of the population HA and HSD remains appropriate for the setting of measurable criteria and expected outcomes as part of the NAO and provides for regulatory alignment between the Act of 2019 and the ENR. For night-time noise, the applied use of the L_{Amax} metric and derivations of metrics from it, such as aircraft noise induced awakenings, can be used as supplementary information in support of assessing the effectiveness of measures and interventions, but not for measuring or defining outcomes with respect to the NAO itself.

5.2 Consideration 2

Although the Second Schedule of ENR, transposing EU Directive 2020/367, adopts the WHO ENG18 exposure response functions (ERFs) it does not define or describe the level of exposure above which the population HA and population HSD shall be calculated from. In the absence of this the NAO utilises the guideline values of 45 dB L_{den} and 40 dB L_{night} as set out in the WHO ENG18 for aircraft noise.

Setting a threshold above which adverse effects on health and quality of life occur for the purposes of policy and decision making is a concept described in the WHO NNG. This is achieved through the setting of a 'Lowest Observed Adverse Effect Level' (**LOAEL**). This concept is also used in English and Northern Irish overarching noise policy. This concept is further discussed in the Heath Evidence Review. The application of the 45 dB L_{den} and 40 dB L_{night} within

the NAO effectively constitutes the setting of a LOAEL for the purposes of measuring aircraft noise outcomes, indicating this is the point above which adverse effects due to annoyance and sleep disturbance become detectable and therefore measurable with respect to the population HA and population HSD metrics.

The 40 dB L_{night} adopted in the 2022 NAO is taken directly from the LOAEL defined in the WHO NNG as carried forward in the WHO ENG18. Based on the WHO NNG, 10% of the population are highly sleep disturbed at 40 dB L_{night}. The Health Evidence Review also identified that a systematic review of subjective sleep disturbance carried out in 2022 covering 15 separate studies also identified that 10% of the population were found to be highly sleep disturbed at 40 dB L_{night}.

Based on the above, there is no material reason to adopt any alternative to the 40 dB L_{night} as the point at which population HSD shall be calculated.

In the case of the 45 dB L_{den}, the Health Evidence Review points out that the WHO ENG18 notes that the 45 dB L_{den} is not a LOAEL in the same way that the 40 dB L_{night} is described as a LOAEL in the WHO NNG. This indicates that it may be appropriate to calculate the population HA from a different value than the 45 dB L_{den} currently adopted.

Other competent authorities when setting noise abatement objectives using population HA and population HSD have calculated these metrics from values higher than then WHO ENG18 guidelines. For example, the Noise Abatement Objective for Schiphol Airport calculates population HA from 48 dB L_{den} but retains the use of the 40 dB L_{night} as the point above which population HSD is calculated. For Paris Charles de Gaulle the NAO, and calculation of population HA, is based on exposure above 55 dB L_{den} with population HSD calculated above 50 dB L_{night}, however this reflects the availability of data describing the noise situation and the minimum reporting thresholds set out by the END, which requires noise exposure to be calculated in 5 dB bands from 55 dB L_{den} and 50 dB L_{night}.

The recently published EEA report also confirms that reporting noise exposure from the night-time END thresholds is likely to understate the overarching effects. It states that:

"Population exposure during the nighttime is significantly lower using the END thresholds. This is because the WHO recommended levels differ by a greater margin in dB compared to those for the day-evening-night period. For example, while the END sets nighttime thresholds at 50dB, the WHO recommends 45dB for road noise, 44dB for rail noise and 40dB for aircraft noise. The most substantial relative underestimation occurs with aircraft noise, as the WHO recommendations for aircraft noise are much more stringent than those for road or railway noise."

The EEA Report goes onto state that: *"To present a more complete health impact assessment, data on populations exposed below a 55dB L_{den} and 50dB L_{night} are needed as negative effects begin at lower levels than those reported under the END. Many individuals are exposed to these lower noise levels (see Section 2.1), which still pose health risks. When applying the more stringent WHO recommendations (see Section 1.3), the estimated health impacts are greater than those presented in the previous section. Estimates based on WHO recommended levels are detailed in the following sections. Overall, including populations exposed to these lower noise levels increases the health burden by approximately 20%, although impacts vary depending on the specific health outcomes and sources"*

The EEA Report highlights this as a limitation of the existing regulatory framework noting that *"Emerging research indicates that negative health effects can begin at much lower levels than the thresholds for reporting of exposure under the END and even the WHO recommendations. Many studies suggest that effect thresholds may be as low as a 45dB L_{den} (Münzel et al., 2025; ETC HE, 2024b)"*

The Health Evidence Review notes that the WHO ENG18 indicates that 10% of the population can be considered highly annoyed at 45 dB L_{den}. However, individual studies underpinning the ENG18 indicate a range in the population highly annoyed of around 2% to 28% due to a range of factors. The Health Evidence Review concludes that *"this*

uncertainty, and the fact that effects clearly vary between contexts, is why the WHO recommend the use of local data to estimate effects".

It is therefore considered that, based on statements by the EEA, it is appropriate to calculate population HA to include data below 55 dB $L_{den.}$ Whilst including population exposed to levels above 45 dB L_{den} may be considered a conservative approach, there is currently no compelling reasons to adopt an alternative value without the benefit of a local study.

In conclusion, consideration of noise exposure above 45 dB L_{den} and 40 dB L_{night} remain appropriate thresholds for the calculation of harmful effects with each representing 10% of the population highly annoyed and highly sleep disturbed respectively.

5.3 Consideration 3

While the 2022 NAO is clear that the population HA and HSD are to be used as the primary measurement of the expected outcomes, the 2022 NAO also sets out exposure above 65 dB L_{den} and 55 dB L_{night} to consider where effects on health and quality of life can be considered significant within specific areas, providing additional tracking of the extent of noise exposure above these levels.

The WHO ENG18 indicates that at levels at and above 65 dB L_{den}, around 50% of the population can be considered highly annoyed. However, the Health Evidence Review highlights that the individual studies informing the ENG18 indicate a range from ~18% to ~82%. In the case of the 55 dB L_{night}, the ENG18 indicates that around 30% of the population may be highly sleep disturbed at this level, while the WHO NNG states the situation is considered increasingly dangerous for public health.

In the UK, values of 63 dB $L_{Aeq,16hr}$ (c. 65 dB L_{den}) and 55 dB $L_{Aeq,8hr}$ (where $L_{Aeq,8hr}$ can be equivalent to L_{night} subject to airport operations) have been used to set noise policy thresholds marking a level of exposure which is considered significant with respect to effects on health and quality of life, and should be avoided. One means of avoiding such effects is through the provision of receptor-based mitigation in the form of noise insulation. In such cases, decisions have required airports to provide a fully funded package of noise insulation measures with associated internal noise level targets. In other words, exposure above these levels of aircraft noise can occur but only where a package of receptor-based mitigation is provided. However, this has not precluded airports bringing forward schemes beyond these thresholds whether this be in the form of a financially assisted or fully funded scheme, particularly in the context of development and expansion proposals. It should be noted that in the UK, such policy thresholds may be influenced by the findings of the ongoing Aviation Night Noise Effects (ANNE) and the Aviation Noise Attitudes Survey (2023-2024).

The use and application of a second threshold of exposure focussing on receptor specific impacts has been adopted in the setting of the NAO for Schiphol Airport. The NAO for Schiphol Airport requires the numbers of dwellings exposed to levels above 58 dB L_{den} and 48 dB L_{night} to be used alongside the calculation of population HA and population HSD. The relevance of the 58 dB L_{den} and 48 dB L_{night} are that they are equivalent to levels of exposure used to restrict the maximum number of dwellings exposed to such levels of aircraft noise around Schiphol Airport. In the case of the 58 dB L_{den}, this is equivalent to the 35 Ke metric, where previous policies and objectives had sought to limit the number of dwellings to no more than 10,000. It is recognised that the use of the 58 dB L_{den} and 48 dB L_{night} for resisting development is a much lower than for other airports. The NAO for Brussels Airport also adopts these metrics. In the case of Schiphol, these metrics are directly linked to wider land use policies that effectively control the number of dwellings permissible above a certain level of aircraft noise exposure.

For Dublin Airport, land use policies in relation to aircraft noise exposure are set out in the Fingal Development Plan 2023 to 2029 (**the FDP**) through the concept of Zoned Lands and corresponding Noise Zones which were first

introduced in 2005, and most recently revised in December 2019. Under the FDP, areas are zoned for development with Noise Zones providing policy in relation to noise assessment and mitigation measures for land in each Noise Zone. The Noise Zones use a combination of the $L_{Aeq,16hr}$ and L_{night} metrics to advise developers and FCC of the acceptability of noise-sensitive development with respect to aircraft noise exposure. Where aircraft noise is above 55 dB L_{night} the objectives of the zones require as a minimum *"Appropriate well-designed noise insulation measures must be incorporated into the development"*. The noise zones do not resist development on night noise alone. However, where the noise zones represent the potential for aircraft noise to be above 63 dB $L_{Aeq,16hr}$ and 55 dB L_{night} the FDP states that the objective is to *"resist new provision for residential development and other noise sensitive uses"* and that *"All noise sensitive developments within this zone may potentially be exposed to high levels of aircraft noise, which may be harmful to health or otherwise unacceptable. The provision of new noise sensitive developments will be resisted."*

Therefore, under the FDP, the 55 dB L_{night} represents a level of aircraft noise exposure where noise insulation measures are considered necessary in new developments. Where exposure could exceed both 55 dB L_{night} and 63 dB $L_{Aeq,16hr}$ (equivalent to approximately 65 dB L_{den}) policies under the FDP require that noise-sensitive development be resisted.

As per other European airports, it is important that policies that seek to resist development and avoid encroachment are monitored. Based on the above and in the context of wider aircraft noise and land use management policies that apply to Dublin Airport, the monitoring of dwellings, schools and hospitals exposed to levels of aircraft noise at and above 65 dB L_{den} and 55 dB L_{night} remain important in this regard and can be tracked through the ENR and Section 21 of the 2019 Act of 2019.

5.4 Consideration 4

Section 5.2 of this review has highlighted thresholds of noise exposure above which adverse effects of health and quality of life can be detected and the overall population HA and population HSD calculated from (i.e. 45 dB L_{den} and 40 dB L_{night}). However, at these thresholds other sources of environmental noise may present more of a problem. Whilst the 45 dB L_{den} and 40 dB L_{night} allow for the calculation of population HA and HSD they do not allow decisions to be made having regard for where aircraft noise is likely to be the dominant source of environmental noise, both in terms of its occurrence and the level of ambient noise events. Furthermore, some airport noise management and mitigation measures and their benefits can only be detected and measured in areas exposed to levels much higher than 45 dB L_{den} and 40 dB L_{night}.

It is considered appropriate that as well as measuring population HA and population HSD, the NAO should incorporate metrics that reflect locations where aircraft noise is a clear characteristic of the area and, as such, adverse effects on health are more likely to be detectable. Communities located within these contours are also more likely to experience noise from most of the airport's operation. The Health Evidence Review highlights that above these thresholds, adverse effects are detectable, and consideration should be given to protecting public health through measures and interventions that reduce noise exposure. In such areas, a broader range of noise management measures and intervention can potentially contribute to reducing adverse effects and can be more detectable in terms of the Airport's 'noise output'.

The NAP highlights changes in the population exposed to the 55 dB L_{den} and 50 dB L_{night} metrics over time. The NAP highlights that since 2006 the number of people exposed above these thresholds has increased considerably alongside increases in airport noise output. These metrics have the benefit of tracking airport noise exposure over a near 20-year period with the size and shape of the 55 dB L_{den} and 50 dB L_{night} contours equating to locations under final approaches and/or the initial stages of departure to and from the Airport where noise abatement procedures can contribute towards noise mitigation. Furthermore, in such locations, consideration of receptor-based interventions such as noise insulation schemes is also appropriate.

Under ENR there is a requirement to address priorities through a process of identifying important areas. Whilst the population HA and population HSD provide a measure of aircraft noise in the context of health, these metrics do not identify any area or group where noise management and mitigation measures should be prioritised.

The area of the 55 dB L_{den} and 50 dB L_{night} noise contours is considered to be an important metric in measuring the noise output of Dublin Airport and in identifying priorities with respect to noise management and mitigation measures.

For these reasons, it is appropriate that the 55 dB L_{den} and 50 dB L_{night} metrics form part of the 2026 NAO.

5.5 Considerations 5 and 6

The modelling of aircraft noise, and its application in informing performance of the aircraft noise climate against the NAO is important for how ANCA performs its functions under the Balanced Approach and the Act of 2019.

There are two wider technical aspects that require consideration in how the noise climate against the NAO is evaluated. These aspects reveal tension between how the noise situation is to be assessed under ENR, and to what extent factors influencing aircraft noise exposure can be managed and assessed through the Balanced Approach. These are the 'modal split and how the 'population' located around the Airport is measured and considered.

Modal Split

Modal split refers to the proportion of time that an airport utilises its runways through its various modes of operation. This is not always in the airport's control, with prevailing winds often dictating the direction aircraft operations occur. The modal split can vary from year to year. In the case of carrying out noise forecasts a modal split must be assumed. Since the opening of the North Runway, operations at Dublin Airport are required to take place in either an easterly or westerly direction due to the infrequent use of the crosswind runway. For forecasting purposes, this has required assumptions to be made as to the degree to which easterly and westerly operations would have occurred in the years prior to the opening of the North Runway.

The 2022 NAO Report referred to a 10-year modal split being required to support forecasting. Under ENR the noise situation is assessed as it occurred in the relevant year. This requires noise exposure to be assessed based on the modal split that occurred in that year. However, annual variations mean that the locations and population exposed to a given level of aircraft noise can vary. This means that the locations and population exposed to aircraft noise as required by ENR may not be fully representative of long-term exposure. The adverse effects of aircraft noise exposure are based on long-term trends and as such the use of noise exposure datasets based on a single year may not necessarily represent this.

As the policy objective of the NAO requires consideration to be given to long-term adverse effects, it is considered appropriate for aircraft noise exposure to be measured based on long-term average conditions rather than based on a given year, as required under ENR.

Taking this into account, a guidance note has been prepared for how modal split shall be considered for the purposes of measuring the NAO. This is provided in the NAO Guidance Note which is designed to accompany the 2026 NAO.

Population

The calculation of population HA and population HSD requires noise exposure to be calculated with reference to and against an authoritative dataset describing the location and number of people living around the airport. Population is dependent on several factors including birth and death rates along with net migration. However, where this population resides is dependent on housing stock and wider development plans.

Land use management is a core pillar of the ICAO Balanced Approach. Whilst land use management allows for development planning and land use compatibility to be considered against aircraft noise exposure, general increases in population that are not facilitated through development cannot be directly controlled. Whilst population growth will lead to development demand, where these developments occur are the subject of development plans and policies such as the FDP which, as explained Section 5.3 incorporates noise management policies through noise zoning.

A core consideration in this regard is the degree to which population increases are considered and whether they are allowed. To this end, the European Commission in their Call for Tenders ENG/2020/OP/0036 'Study on Airport noise Reduction' Tender Specification note, with respect to the application of the END and the Aircraft Noise Regulation, that the number of people exposed to health effects from aircraft noise can increase if the population is allowed build in the surroundings of the airport.

The 2022 NAO states that: *"The calculation of the number of people exposed to aircraft noise shall have regard for the most recent population data available and assessed against the population exposed to aircraft noise in 2019."*.

This statement identifies that when reviewing changes in population exposure, consideration should be given to both the population at the reference point of the NAO and as it is, or forecast to be, in any given year that follows. Under ENR the population in the relevant year must be used to assess the population exposed to aircraft noise, and not a reference year.

The 2022 NAO requires consideration of the population as it was in the NAO reference year of 2019, and in the most recent year. This was to enable ANCA to have regard for changes in noise exposure taking into account changes in aircraft noise based on a reference population and how that population has changed alongside changes in aircraft noise exposure.

Appendix A examines changes in aircraft noise, and changes in the population exposed to it since the first round of ENR in 2006. The analysis presented shows that, except for years where aircraft noise from Dublin Airport was affected by or recovering from Covid-19 travel restrictions, there is evidence that over the period 2006 to 2023, aircraft noise exposure has increased at a rate higher than the corresponding changes in population exposed. However, there are also examples where residential development has led to the exposed population increasing at a rate higher than changes in the aircraft noise itself. The analysis provided in Appendix A shows that should aircraft noise at Dublin Airport remain consistent at 2023 levels, then the population exposed to aircraft noise would continue to increase through the building out and occupation of dwellings on land zoned for residential development. To this end, the NAO must account for development plans and policies with its outcomes set to reflect these. Based on the analysis provided in Appendix A, it is reasonable to expect that in the short to medium term that population growth around Dublin Airport will occur due to residential developments. In the longer term however, any further changes in population would be a consequence of new development plans and/or general population growth.

The Central Statistics Office (CSO) provides population growth estimates which are produced by region and nationally. These show that in the Dublin region, the population is forecast to increase at a rate of approximately 0.3-1.2% per annum over the period 2023-2042. The CSO estimates indicate that population growth over the period to 2031 could occur at a rate of 0.7 – 1.4% per annum however this higher rate reflects development that is planned and zoned.

As ENR requires changes in population to be considered alongside changes in aircraft noise, the NAO should consider population growth in its evaluation. The NAO Guidance Note sets out requirements for considering population growth for the purposes of measurement against the expected outcomes of the NAO.

5.6 Consideration 7

Within the third part of the 2022 NAO, in measuring the objective, noise metrics must be computed using *"a noise model prepared in accordance with the methodology described in Directive 2015/996 (European Civil Aviation Conference (ECAC) Doc.29 4th Edition or as amended). The noise model shall be validated using local noise and track keeping performance data from Dublin Airport's systems."*

The methodology described in Directive 2015/996, as amended by Delegated Directive (EU) 2021/1226, remains part of the wider regulatory framework as Annex II of the END, with validation of the noise modelling using local noise and track keeping performance constituting best practice that ensures that the noise modelling best reflects local experience and impacts.

Fundamentally, for the NAO to be evaluated, and to support any subsequent regulatory decisions, it must be demonstrated that the noise modelling meets the regulatory requirements under the END/ENR and is of sufficient sophistication to support decision-making.

The sophistication and validity of aircraft noise modelling has many considerations. It is necessary to stipulate the standard of modelling and associated evidence that must be provided when evaluating the aircraft noise climate against the NAO and its wider functions. These requirements are described within the NAO Guidance Note.

5.7 Amendments following Review

The following amendments are therefore proposed to the NAO's policy objective and its explanation:

Proposed Measurable Criteria
"The NAO will primarily be measured through the number of people highly sleep disturbed and highly annoyed measured in accordance with the approach recommended by the World Health Organization's Environmental Noise Guidelines 2018 as endorsed by the European Commission through Directive 2020/367 and transposed as the Second Schedule of the European Communities (Environmental Noise) Regulations 2018 (ENR) (as amended). This measure will take into account noise exposure from 45 dB L_{den} and 40 dB L_{night}. These metrics describe those chronically disturbed by aircraft noise and help articulate the effect of aircraft noise on health and quality of life.

The following will also be used to help identify where noise exposure results in the population are experiencing harmful effects. In these areas, noise management interventions are more likely to be detectable. These are:

- *The number of residential dwellings, schools and hospitals exposed to aircraft noise above:*
  - *65 dB L_{den} (representing an area where a large proportion of those living around Dublin Airport can be considered highly annoyed); and*
  - *55 dB L_{night} (a level of night-time noise exposure considered increasingly dangerous for public health by the WHO); and*
- *The areas exposed to 55 dB L_{den} and 50 dB L_{night} representing the locations most affected by aircraft noise and where adverse health outcomes are more likely to present.*

The measurement and calculation of these metrics shall be carried out in accordance with the NAO Guidance Note.

6 Expected Outcomes

The 2022 NAO discusses outcomes that are to be achieved against 2019 as the reference year. 2019 was the last full year of operations prior to the Covid-19 global pandemic and the opening of the North Runway.

The 2022 NAO recognises that population noise exposure and harmful effects would increase with the recovery from the pandemic, however the objective was that the resultant health effects would be less than 2019. The 2022 NAO also states that harmful effects should reduce over the medium to long term. To this end, the 2022 NAO sets outcomes that targets a reduction in harmful effects, with respect to population HA and population HSD measured from 45 dB L_{den} and 40 dB L_{night}, progressively over time by defining percentage reductions in such effects against a 2019 baseline. These reductions are set at 30% by 2030, 40% by 2035 and 50% by 2040 for both population HA and population HSD.

In addition, the 2022 NAO defines two further outcomes that are to be achieved. These require that the number of people exposed to aircraft noise above 55 dB L_{night} and 65 dB L_{den} shall be reduced compared to 2019.

In reviewing this part of the NAO, the following considerations have been identified:

- **Consideration 8:** Whether the reference year of 2019 for NAO remains appropriate.
- **Consideration 9:** Whether the outcome years of 2030, 2035 and 2040 remain relevant or should change.
- **Consideration 10:** Whether the scale of the reductions in the population highly annoyed and highly sleep disturbed remain challenging but achievable in driving decisions on aircraft noise management.
- **Consideration 11:** Whether specific outcomes should be set for the number of dwellings, schools and hospitals exposed above 65 dB L_{den} and 55 dB L_{night}.
- **Consideration 12:** Whether specific outcomes should be set for the proposed 55 dB L_{den} and 50 dB L_{night} metrics.

6.1 Consideration 8

The outcomes set by the 2022 NAO are made with reference to the noise situation in 2019. The NAO Report, drafted in 2021, stated that the use of a 2019 reference year reflected a peak in noise exposure at Dublin Airport therefore reduction targets set from this peak were considered appropriate. The 2019 reference year also reflected the last full year of operations prior to the disruption of the Covid-19 pandemic, and when there were no noise related operating restrictions in place at the Airport.

Key to this consideration is the continuing relevance of the 2019 noise situation as the reference point for the NAO. In reviewing the NAO, ANCA must have regard for the most recent NAP. The NAP presents data for the ENR relevant year of 2021, and for a supplementary year of 2023. As explained in the NAP, due to the impact of travel restrictions associated with the global COVID-19 pandemic and operational changes at the airport, the noise situation for 2021 is not considered representative of the current noise climate at Dublin Airport. The noise situation for 2023 is therefore also reported in the NAP and can be considered more representative of the current noise situation.

When the NAO was consulted on in 2021, it was measured and tested against forecasts provided by Dublin Airport which were based on modelling reflecting noise performance and validation based on activity in 2018 and 2019. This was carried out as part of ANCA's determination of the NRRA. The forecasting prepared in the support of this was carried out prior to the opening of the North Runway, based on assumed airspace designs and reflected a fleet mix

whereby key aircraft types such as the Boeing 737max were grounded and were yet to operate at Dublin Airport in any significant number.

Since the 2022 NAO was set, the North Runway has commenced operations at Dublin Airport with its airspace and operations adjusting accordingly. The noise situation presented in NAP for 2023 is based on the current flight paths and runway operations at Dublin Airport with the situation modelled to consider aircraft flight profiles (i.e. how aircraft approach and depart the airport) based on an analysis of their vertical performance using the Airport's radar. The model used aircraft noise performance data which has also been validated against NMTs around Dublin Airport including those located under North Runway flight paths.

In the context of other European airports, noise abatement objectives have been set having regard for the noise situation in 2023. For example, Schiphol Airport has set an objective to reduce the number of houses and people highly sleep disturbed and highly annoyed against project data based on the noise situation in 2023. This decision also took into account the period of the Airport's NAP with the objective applying and requiring attainment over the period of the plan from 2024 to 2029.

Whilst retaining 2019 as the reference year for the NAO, this provides continuity with respect to changes to the NAO outcomes (as discussed in Section 6.3). It is considered more appropriate that the measurable outcomes for the NAO should be reset against the noise situation in 2023 for the following reasons:

- 2019 relates to a different noise situation preceding the opening of the North Runway and subsequent changes in North Runway flight paths and runway operations in 2022. The noise situation in 2019 does not reflect the current form of airport operations;
- The proposed changes to the NAO policy objective and explanation (described in Section 4.1) specifically require changes to the noise situation to be considered as part of decision-making. In this context, the use of 2019 as a reference for the NAO means that any future changes to the noise situation would be compared to a situation that no longer occurs;
- The noise situation as it occurred in 2019 does not reflect change to the Airport's fleet mix since Covid-19 pandemic; and
- A reference year of 2023 reflects the actual noise situation as reported in the most recent NAP.

6.2 Consideration 9

The NAO set progressive targets to reduce the population HA and population HSD by 30% in 2030, 40% in 2035, and 50% in 2040 compared to the situation in 2019.

Under ENR, strategic noise maps are required every five years. The ENR also requires the preparation of a noise action plan for the Airport every five years, and for this plan be based on the results of the strategic noise maps. The explanatory note to the ENR states that *"the fundamental objective of action plans is the prevention and reduction of environmental noise"*.

The year upon which the strategic noise maps are based is referred to as the 'relevant year'. Under the five-year cycle of the ENR, the next relevant year is 2026 representing the fifth round of the Regulations and each subsequent relevant year every five years thereafter i.e. 2031, 2036, 2041 etc.

It is considered appropriate to align the outcomes of the NAO with the relevant year defined under ENR. This approach allows the NAO and its evaluation to be aligned with the process of strategic noise mapping and noise action planning. This better facilitates future NAPs and their associated actions to consider and focus on whether the NAO is being achieved in line with its expected outcomes.

It is therefore proposed to offset the years within which outcomes are to be delivered under the 2022 NAO to align with the relevant years under ENR, i.e. 2031, 2036, 2041 etc with the evaluation of the NAO carried out in line with the NAO Guidance Note.

6.3 Consideration 10

Separate Reduction Rates for HA and HSD

The NAO currently sets the same reduction rates for population HA and population HSD. The NAO aims to limit and reduce the long-term adverse effects of aircraft noise on health and quality of life "particularly at night".

When considering the scale of reductions in population HA and population HSD set by the NAO, ANCA has considered whether the rate of reduction in population HSD should be higher than defined for population HA in order to better reflect the policy objective.

The Heath Evidence Review highlights that night-time noise exposure is more likely to lead to adverse health outcomes than through exposure to aircraft noise during other times of the day. The NAP also states that night-time noise remains a concern.

Measures that respond to this concern could be prioritised by setting a higher rate of reduction in population HSD than for population HA through the NAO.

The policy objective already provides focus on night-time noise effects with priority given to measures that support the reduction of night-time noise effects in the context of sustainable growth at Dublin Airport.

The review has confirmed the use of population HA and population HSD to measure outcomes in line with the NAO. Whilst the population HSD is based exclusively on night-time noise exposure, the population HA considers exposure during the day, evening and night through the L_{den} metric. As part of the L_{den} metric, night-time noise is weighted by 10 dB representing the increased effects associated with night-time noise. As such, the population HA is influenced by night-time noise exposure in a prioritised manner. On this basis, the population HA and population HSD already weight and prioritise night-time noise with respect to measurable outcomes.

Although separate reduction targets for population HA and population HSD could be stipulated, the current approach of setting a single reduction target for population HA and population HSD already provides for prioritising the effects of aircraft noise at night.

Reductions in Population HA and Population HSD

The 2022 NAO is currently defined so that reductions in the population HA and population HSD are required incrementally with outcomes set for the 2030, 2035 and 2040. As outlined in Section 6.2, it is considered appropriate to align the outcomes set by the NAO to the relevant years defined under ENR. Furthermore, as discussed in Section 6.1, it is also appropriate to reset the reference year of the expected outcomes to 2023.

The NAP shows that between 2019 and 2023, the population HA and HSD decreased by over 30% as summarised in Figure 1.

Table 1: Comparison of the noise situation in 2023 against 2019 and associated changes in population HA and HSD

Metric	Situation and Year	
	2019	2023
Passengers (millions)	32.9	33.5
Annual 24-hour ATMs	238,002	240,638
Annual Night-time ATMs	29,230	33,507
Population Highly Annoyed	115,738	71,388
Population Highly Sleep Disturbed	47,045	32,563
% Reduction in Population HA against 2019		-31.8%
% Reduction in Population HSD against 2019		-38.4%

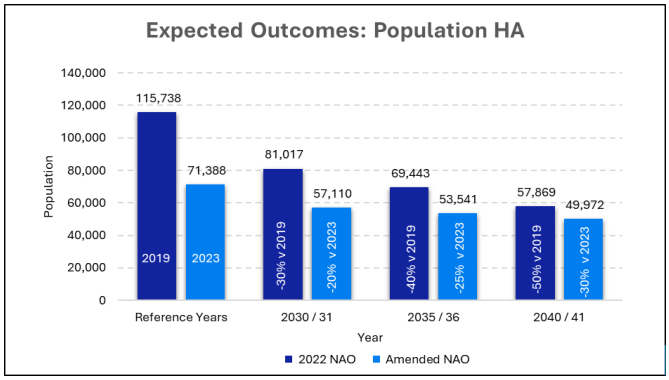
Section 7 of the NAP considers possible future situations reflecting forecast with and without NRRA and increases in the Airports passenger capacity. These forecasts indicate that by 2027, the population HA and population HSD could be reduced by 50% compared to 2019 and as such the Airport would be on track to comfortably meet the 30% reduction outcome set by the 2022 NAO for 2030. As indicated above, most of this occurred over the period 2019 to 2023 due to the opening of the North Runway, changes in associated flight paths and fleet modernisation.

Key to this element of the review is whether the current reduction targets continue to strike a balance between limiting and reducing aircraft noise, and the sustainable development of Dublin Airport in line with the policy objective. This means ensuring that expected outcomes set by the NAO hold Dublin Airport to the highest standards of airport noise management through both incentivisation of use of quieter aircraft and operating procedures whilst allowing the airport to grow in line with wider policies and plans.

When considering similar noise abatement objectives proposed and adopted in other European jurisdictions and recognising the 30% improvement that has already occurred between 2019 and 2023. It is considered appropriate to set a 20% reduction outcome in population HA and HSD to be achieved in 2031 compared to the noise situation in 2023. This is supplemented with a further 5% reduction outcome to be achieved every five years thereafter to 2041.

Figure 1 presents a comparison of the proposals against the 2022 NAO expected outcomes.

Figure 1: Comparison of 2022 NAO outcomes to proposed outcomes



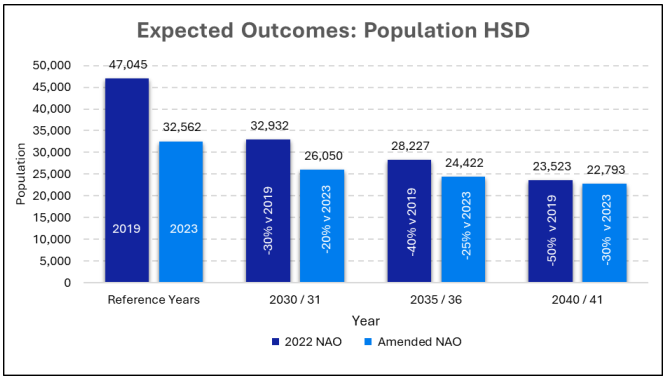


Figure 1 shows that the revised outcomes represent improved health outcomes, particularly over the period to 2041 with the 2023 referenced outcomes providing for a lower overall number of people HA and HSD than the outcomes currently set against 2019. When amending the expected outcomes for the numbers of people HA and HSD from the 2022 NAO, ANCA first had regard to recent changes in aircraft noise exposure, particularly during the period 2019-2023 with respect to fleet modernisation, alongside forecasts made available to ANCA through a number of statutory processes.

These forecasts were provided through the assessment of the Infrastructure Application (F23A/0781 through the process detailed by Section 34B of the Act of 2000) and also through a separate process of assessment pursuant to Section 9 of the Act of 2019 that commenced in December 2022. Recent and historic noise data was also considered. Across these forecasts, a combination of constrained and unconstrained airport and passenger scenarios were considered. The constrained forecasts considered the airports existing passenger cap (32mppa), the airport passenger cap as proposed through the Infrastructure Application (40mppa), and wider unconstrained forecast passenger numbers in the range of 50 to 60mppa.

Across the forecasts considered, the corresponding noise exposure data covered the period 2026 to 2046 across a range of metrics. Data for 2046 was not used in amending the NAO due to uncertainties in future aircraft noise technology performance.

6.4 Consideration 11

The 2022 NAO currently has an expected outcome that the number of people exposed to aircraft noise above 55 dB L_{night} and 65 dB L_{den} shall be reduced compared to 2019.

The Noise Action Plan for Dublin Airport 2024 – 2028 (NAP) highlights the increase in population exposed to aircraft noise generated by Dublin Airport operations, particularly within noise contours in the vicinity of the airport where the number of people exposed to noise levels above 55 dB L_{night} and above 65 dB L_{den} had increased in 2023 compared to 2019, and to all the previous Rounds of Strategic Noise Mapping since 2006.

A noise zoning system was introduced into the land planning system by Fingal County Council (FCC) in 2005. The current Aircraft Noise Zones were established in December 2019, consisting of Zone A, Zone B and Zone C which replaced the 2005 Outer and Inner Zones. In addition to these three noise zones, Zone D was established in the form of a list of townlands which could be potentially impacted by aircraft noise.

Zone A of the FDP sets policies where residential development is to be resisted. Families actively engaged in farming located within Zone A are permitted to build on suitable sites located within five kilometres outside Noise Zone A (Policy Objective SPQHO83). The analysis of changes in population and aircraft noise exposure presented in Appendix A indicates that this policy has been appropriately applied and has effectively prohibited the consent of new residential developments within Zone A since 2019. Appendix A highlights this by showing that there has been no increase in the number of residential dwellings in Zone A since 2021, following the development of pre-2019 permissions, whereas in all other zones the numbers of dwellings have increased by at least 10%. This indicates that the revised Noise Zones in the 2019 FDP have effectively prevented the construction of additional residential developments exposed above 65 dB L_{den} since 2021, which has helped to limit exceedance of the 65 dB L_{den} criteria in the existing 2022 NAO.

The Appendix A report also indicates that the increment in population exposure observed above 55 dB L_{night} and 65 dB L_{den} in 2023 was due to a combination of factors. Firstly, there was an increment or a different distribution of the

noise footprint around Dublin Airport, and secondly the growth in residential developments around the airport has mainly occurred within Zones B and C of the 2019 Airport Noise Zones. This development has included growth in the number of noise insulated dwellings in Zone B, some of which have contributed to the increment in the number of people exposed to levels above the 55 dB L_{night}.

The results of the analysis in Appendix A illustrate how the existing 2022 NAO criteria based on numbers of people exposed is affected by both airport operations (affecting the size and shape of the noise contour areas), and land use management and planning (affecting the number of consented residential dwellings). Additionally, while planning approval is granted for a specified given number of residential dwellings, there will naturally be some uncertainty as to the number of residents who will occupy the dwellings.

Appendix A reports that within 55 dB L_{night}, the number of dwellings has increased due in part to the provision of additional residential developments made available under the FDP, which are consented on the basis that development shall include appropriate noise insulation measures.

Appendix A also illustrates that land zoned for residential development under the FDP within Zone B is yet to be consented and fully developed, which may fall within the 55 dB L_{night} in the future. This has the potential to further increase the number of dwellings and people exposed to aircraft noise above 55 dB L_{night}. Appendix A demonstrates that where residential development is granted in Zone B, planning conditions make it a requirement for appropriate noise mitigation measures to be delivered so that internal noise levels, as they apply to the development, can be achieved and maintained.

For these reasons, it is considered appropriate to revise the measurable criteria to monitor and track the number of dwellings, schools and hospitals, exposed to aircraft noise above 65 dB Lden and 55 dB Lnight to more clearly align the NAO with both airport noise mitigation measures and land use management and development policy above these levels of exposure, in addition to monitoring the evolution of the noise situation at the airport.

Part C of Appendix A on Forward looking assessment of Population/Dwelling growth indicates that there are no forecasted additional new dwellings estimated to be consented above 65 dB L_{den}, based on the 112 dwellings within the 2023 noise contours (Table Appx-10). Part C of Appendix A also indicates an estimated forecast of a potential doubling in the number of dwellings exposed above 55 dB L_{night} from 1,404 in 2023 to an estimated forecast of 2,839, based on the 2023 noise contours (Table Appx-11). It may be appropriate that a combination of noise mitigation measures, land use policy and management measures, and possibly restrictions, will be used to mitigate and/or limit the number of dwellings, schools and hospitals exposed. In parallel, it is expected that the FDP will continue to manage development patterns that are compatible with the long-term noise environment, thus helping to avoid the introduction of new noise sensitive uses into areas incompatible with forecast aircraft noise.

It will be possible to track and monitor the number of dwellings via the reports submitted through ENR and annual reports prepared by ANCA under Section 21 of the Act of 2019. Changes in the number of dwellings, schools and hospitals exposed above 65 dB L_{den} and 55 dB L_{night} will be reviewed by ANCA when identifying and considering noise mitigation measures.

6.5 Consideration 12

Having established that people exposed to aircraft noise above 55 dB L_{den} and 50 dB L_{night} are more likely to experience adverse health outcomes and that at such levels noise management measures are more likely to be detectable, it has been considered whether expected outcomes should be set for these additional metrics.
In the context of ENR, the area, number of dwellings, and population exposed to aircraft noise above these metrics must be reported. In the NAP, trends in exposure at and above these metrics were reported and examined for each relevant year since 2006. The area of these contours provides an indication of the Airport's noise output i.e. the amount of noise produced by the Airport.

In some jurisdictions, restrictions have been set with reference to the size of specific airport noise contours. Such restrictions seek to limit the amount of noise an airport can produce at any given time or by a certain year or threshold of activity (i.e. passenger numbers or aircraft movements) without prescribing restrictions on the number or type of aircraft that operate at the airport or at a particular time of the day. However, such limits constitute a noise-related operating restriction which should only be determined following a process of aircraft noise regulation in line with the Balanced Approach. It is considered inappropriate to set such values for the 55 dB Lden and 50 dB Lnight contour areas within the 2026 NAO.

However, the policy objective seeks to limit and reduce adverse effects which can only be achieved if the noise output of Dublin Airport is to reduce over time. Given the increased risk of adverse health outcomes to those exposed to aircraft noise above 55 dB L_{den} and 50 dB L_{night} and the increasing exposure and size of such areas since aircraft noise at Dublin Airport was first measured under ENR, it is appropriate that noise exposure above these thresholds is monitored with the expectation that the Airport's noise output is to reduce over time in the context of sustainable development.

Changes in the area and the number of people within these contours will be reviewed by ANCA when identifying and considering noise mitigation measures.

6.6 Amendments following Review

Proposed Expected Outcomes
"In support of the sustainable development of Dublin Airport, the following outcomes are to be achieved in each relevant year under ENR in line with the methodology described in the NAO Guidance Note.

The number of people highly sleep disturbed and highly annoyed shall reduce so that:

- *The number of people highly sleep disturbed and highly annoyed in 2031 shall reduce by 20% compared to 2023;*
- *The number of people highly sleep disturbed and highly annoyed in 2036 shall reduce by 25% compared to 2023; and*
- *The number of people highly sleep disturbed and highly annoyed in 2041 shall reduce by 30% compared to 2023.*

The number of dwellings, schools and hospitals exposed to aircraft noise above 65 dB L_{den} and/or 55 dB L_{night} will be tracked, with the expectation that measures will be used to mitigate and/or limit the number of dwellings, schools and hospitals exposed in each relevant year under ENR.

The size of the 55 dB L_{den} and 50 dB L_{night} contours will be tracked with the expectation that these will reduce compared to 2023 in each relevant year under ENR. Noise mitigation measures may also be considered with reference to these contours."

The NAO stated that its monitoring would be *"informed by annual reports which will be reviewed by ANCA as part of its obligations under the Aircraft Noise (Dublin Airport) Regulation Act 2019."*.

Under Section 21 of the Act of 2019, ANCA is required to report on the effectiveness of noise mitigation measures at Dublin Airport in achieving the noise abatement objective. This review is carried out annually. Annual noise modelling data has been provided by daa to support ANCA in its functions under Section 21 of the Act and this should continue. To this end, ANCA will formally request that annual noise exposure data is provided by daa and that this data is used to indicate progress towards the expected outcomes of the NAO and to allow ANCA to report on the effectiveness of noise mitigation measures.

However, the expected outcomes set by ANCA relate to future years set against relevant years under ENR. It is therefore intended that performance against the 2026 NAO will be formally determined through the noise action planning process.

7.1 Amendments following Review

Proposed Monitoring
"Progress towards the expected outcomes of the NAO will be monitored through annual reports as prepared by ANCA under Section 21 of the Act of 2019, and through the process of strategic noise mapping and noise action planning under ENR. This will require airport noise to be modelled and reported having regard for the guidance set out in the NAO Guidance Note."

PART 3 - NOISE ABATEMENT OBJECTIVE FOR DUBLIN AIRPORT 2026

Policy Objective

Limit and reduce the long-term adverse effects of aircraft noise on health and quality of life, particularly at night, through measures that mitigate impacts and provide certainty to the communities and the airport operator as part of the sustainable development of Dublin Airport.

Explaining the Objective

The harmful effects of noise from Dublin Airport should be limited and reduced in line with principles of sustainable development. As Dublin Airport grows, the long-term adverse effects on human health and quality of life should be limited and progressively reduced. This should be achieved by providing measures which mitigate impacts, whilst providing assurance to communities as to how aircraft noise impacts are managed, and how they will be limited and mitigated in line with the Airport's development and growth. This is to be achieved by providing clear rules and expectations on measures that will limit, reduce and mitigate impacts. This means limiting changes in the noise situation only to those which are outweighed by the wider economic and consumer benefits of aviation, and prioritising measures which can reduce adverse effects. The Balanced Approach will be used to ensure that the measures adopted to achieve this objective are cost-effective, practicable and sustainable.

Measurable Criteria

The NAO will primarily be measured through the number of people highly sleep disturbed and highly annoyed measured in accordance with the approach recommended by the World Health Organization's Environmental Noise Guidelines 2018 as endorsed by the European Commission through Directive 2020/367 (END) and transposed as the Second Schedule of the ENR. This measure will take into account noise exposure from 45 dB L_{den} and 40 dB L_{night}. These metrics describe those chronically disturbed by aircraft noise and help articulate the effect of aircraft noise on health and quality of life.

The following will also be used to help identify where noise exposure results in the populations experiencing harmful effects. In these areas, noise management interventions are more likely to be detectable. These are:

- The number of residential dwellings, schools and hospitals exposed to aircraft noise above:
    - 65 dB L_{den} (representing an area where a large proportion of those living around Dublin Airport can be considered highly annoyed); and
    - 55 dB L_{night} (a level of night-time noise exposure considered increasingly dangerous for public health by the WHO); and
- The areas exposed to 55 dB L_{den} and 50 dB L_{night} representing the locations most affected by aircraft noise and where adverse health outcomes are more likely to present.

The measurement and calculation of these metrics shall be carried out in accordance with the **NAO Guidance Note**.

Expected Outcomes

In support of the sustainable development of Dublin Airport, the following outcomes are to be achieved in each relevant year under ENR in line with the methodology described in the NAO Guidance Note.

The number of people highly sleep disturbed and highly annoyed shall reduce so that:

- The number of people highly sleep disturbed and highly annoyed in 2031 shall reduce by 20% compared to 2023;
- The number of people highly sleep disturbed and highly annoyed in 2036 shall reduce by 25% compared to 2023;
- The number of people highly sleep disturbed and highly annoyed in 2041 shall reduce by 30% compared to 2023.

The number of dwellings, schools and hospitals exposed to aircraft noise above 65 dB L_{den} and/or 55 dB L_{night} will be tracked, with the expectation that measures will be used to mitigate and/or limit the number of dwellings, schools and hospitals exposed in each relevant year under ENR.

The size of the 55 dB L_{den} and 50 dB L_{night} contours will be tracked with the expectation that these will reduce compared to 2023 in each relevant year under ENR. Noise mitigation measures may also be considered with reference to these contours.

Monitoring

Progress towards the expected outcomes of the NAO will be monitored through annual reports as prepared by ANCA under Section 21 of the Act of 2019, and through the process of strategic noise mapping and noise action planning under ENR. This will require airport noise to be modelled and reported having regard for the guidance set out in the NAO Guidance Note.

PART 4 – 2026 NOISE ABATEMENT OBJECTIVE GUIDANCE NOTE

This Guidance Note has been prepared in support of the NAO for Dublin Airport. The guidance addresses relevant technical considerations in support of the NAO with respect to its application and interpretation.

The guidance covers the following:

- **Standard and Sophistication of Aircraft Noise Modelling** as required in support of assessing aircraft noise at Dublin Airport against the outcomes of the NAO; and

- **Information to be reported to ANCA in support of evaluations against the NAO** when**:**
    - Presenting the noise situation at Dublin Airport as it occurred under Section 21(2) of the Act of 2019 or for the purposes of preparing strategic noise maps under the ENR; and
    - Providing forecasts in support of functions under Section 9 of the Act of 2019.

Noise Model Selection

All noise modelling should be prepared using the Federal Aviation Authority (FAA) Aviation Environmental Design Tool (AEDT) version 3f or later. If an alternative software environment is to be used, this must prove compliance with the methodology described in Annex II to Commission Directive (EU) 2002/49/EC, as amended, as required under Regulation 2(1) of the ENR by means of certification of results against test cases.

All noise modelling used for the purposes of monitoring and/or determining the attainment of the NAO must be validated having regard for the required sophistication set out below.

Required Sophistication of Aircraft Noise Modelling

The NAO is evaluated using the outputs of noise modelling. The modelling can be carried out to various degrees of sophistication ranging for the use of standardised reference values through to the use of datasets that can better describe local factors. The consideration of local factors means ensuring that the noise modelling is representative of:

1) Where aircraft operate with respect to locations on the ground they overfly – this is addressed through the modelling of **mean track centrelines** and the **dispersion** around these;

   A ‘mean track centreline’ represents the average position of an aircraft based on all ground tracks observed to occur on a particular route or flight path. ‘Dispersion’ represents the degree to which aircraft are distributed either side of the mean track centreline. At a very basic level, noise models can be produced using standardised flight path descriptions that are available from the air navigation service provider and standardised dispersion patterns, such as those published in ECAC Doc 29. However, use of this data is unlikely to be representative of where aircraft fly with respect to people and locations on the ground.

2) How aircraft approach and depart the airport with respect to their altitude, speed and associated procedures – this is addressed through the modelling of **flight profiles**;

   ‘Flight Profiles’ represent the vertical position and performance of an aircraft above the runway. Flight profiles also consider the aircraft configuration used to achieve this i.e., engine power settings, speeds, climb rates, etc. Standardised flight profiles are available to aircraft noise modellers in the ICAO sponsored Aircraft

Noise and Performance (ANP) database[6]. The standardised flight profiles held within the ICAO ANP do not usually reflect operations at major airports. As such, the use of standardised information can lead to the noise model not being representative with respect to the departure and approach procedures in place.

3) The level of aircraft noise that is produced by the model reflects the level of noise measured at the airport's Noise Monitoring Terminals (NMTs) – this is addressed through aircraft **noise data** held within the noise model.

   'Noise data' is provided to aircraft noise modellers in the ICAO sponsored Aircraft Noise and Performance (ANP) database[7]. 'Noise data' is often referred to as 'Noise-Power-Distance' (NPD) information. This data provides a look-up for the level of noise that can be expected at a given power setting and distance from the aircraft. NPD data can differ depending on the noise metric that is to be computed. The ANP data is based on aircraft noise measured under standardised and controlled conditions based on flight profiles that do not necessarily represent actual airport operations.

Dublin Airport operates a Noise and Track Keeping (NTK) system that allows local factors to be considered within the noise modelling. The NTK system monitors and stores the ground position, altitude and speed of all aircraft operating into and out of Dublin Airport. Through its network of NMTs the system is also configured to record, correlate and store the noise levels associated with each aircraft overflight.

The following sections set out the relevant considerations that must apply and be evidenced as part of the noise model validation exercise.

Mean Track Centrelines and Dispersion
All modelled aircraft ground tracks (mean track centrelines and dispersion) must be representative of the current situation and/or forecast operations at Dublin Airport. Mean track centrelines and dispersion must be based on track keeping data obtained from the Airport's NTK. Any forecast modelling that incorporates proposed or planned airspace changes must be based on airspace design work carried out to a demonstratable level of maturity and confidence. The modelling of mean track centrelines and dispersion must be considered separately for each arrival and departure route.

Flight Profiles
All modelled aircraft arrival and departure flight profiles and modelled procedures must be representative of operations as observed through track keeping data obtained from the Airport's radar. In the case of any forecasts that incorporate proposed or planned airspace changes, confirmation is required that existing flight profiles remain appropriate for the purposes of forecasting. If not, flight profiles should be modified to reflect the proposed or planned changes.

Separate flight profiles should be modelled where these differ materially between each runway and corresponding arrival and departure routes, particularly where this may affect the number of people found to be within the 45 dB L_{den} and 40 dB L_{night} contours.

Noise Data
Noise data used in the modelling must be representative of measured levels at Dublin NMTs. Noise data must be adjusted for each modelled aircraft type that represent at least 95% of the modelled operations in the day (0700-1900), evening (1900-2300) and night-time (2300-0700) periods. Details of the NMTs utilised in validating the

[6] Further information can be found here: https://www.easa.europa.eu/en/domains/environment/policy-support-and-research/aircraft-noise-and-performance-anp-data
[7] Further information can be found here: https://www.easa.europa.eu/en/domains/environment/policy-support-and-research/aircraft-noise-and-performance-anp-data.

model's NPD datasets must be reported and declared to clarify whether noise data validation is based on single or multiple NMTs.

Evidence of Validation
All validation activities carried out for the purposes of preparing and modelling mean track centrelines, dispersion, flight profiles and noise data for Dublin Airport must be evidenced and reported. This shall include post-validation average measured and modelled L_{ASmax} and SEL values for each validated aircraft type for all NMT locations used for noise model validation purposes.

Requirements for the Purposes of Monitoring under Section 21(2) of the Act of 2019 and ENR

Noise modelling must conform to the required sophistication described in this guidance note and prepared annually for the purposes of monitoring under Section 21(2) of the Act of 2019. These requirements also apply to noise modelling carried out for the purposes of preparing strategic noise maps under the ENR.

Annual average noise exposure metrics shall be prepared based on aircraft operations occurring over the period 1 January to 31 December (inclusive). The following noise metrics shall be prepared:

- L_{den}
- L_{day}
- $L_{evening}$
- L_{night}

As aircraft take off and land into the wind, runway usage can vary from year to year due to the prevailing wind direction. The degree to which an airport's runways are used over a period is referred to as the runway 'modal split'. Modal split can vary from year to year. Under ENR, the actual situation that occurred in the relevant year must be presented for the purposes of preparing strategic noise maps. However, should prevailing winds be unusual, the noise impact presented for that year may be unrepresentative of long-term trends in noise exposure. In such situations, this may impact decision-making, particularly in the context of determining progress against the NAO and as part of preparing a noise action plan for the Airport.

For each metric, noise modelling shall be prepared for the **actual modal split** (i.e. the modal split that occurred in the year) and for **average modal split based on the previous 5-years** of runway operations. By preparing noise models that represent the situation that occurred along with the situation based on a 5-year average modal split, this allows for discretion should the modal split in any given year be unusual.

For each noise metric, exposure must be calculated and presented for the population based on the latest An Post GeoDirectory data and CSO Census data, including noise-sensitive buildings (namely dwellings, schools and hospitals). Exposure data should also be calculated and presented for the population and noise-sensitive buildings as occupied in 2023. The reporting of exposure in the latest and 2023 reference year will be used by ANCA to determine how changes in aircraft noise exposure are a consequence of changes in the airport's operations as well as the local population.

The reporting of population, dwellings and areas exposed to each noise metric, along with wider operational information, must be provided in an approved ANCA reporting template format. The ANCA reporting template makes provision for the reporting of the number of dwellings and noise sensitive buildings which have been

insulated. This information must be provided for ANCA to evaluate the potential effectiveness of the Airport's noise insulation schemes.

Requirements for the Purposes of Forecasting under Section 9 of the Act of 2019 and ENR

All forecasts must be carried out conforming to the required sophistication set out in this Guidance Note. Annual average noise exposure metrics shall be prepared based on aircraft operations occurring over the period 1 January to 31 December (inclusive). The following noise metrics shall be prepared:

- L_{den}
- L_{day}
- $L_{evening}$
- L_{night}

For each metric, noise modelling shall be prepared for an **average modal split based on the previous 10-years** of runway operations.

For each noise metric, exposure must be calculated and presented for the population based on the latest An Post GeoDirectory data and CSO Census data. Consideration of future population growth should also be provided by estimating the number of houses and dwellings that are consented and /or likely to be developed in zoned lands beyond those that have already been developed. For forecasting beyond 2031, consideration of expected population growth shall consider the Central Statistics Office (CSO) regional forecasts[8].

Exposure data should also be calculated and presented for the population and noise-sensitive buildings as existed in 2023. The reporting of exposure in the forecasts alongside the 2023 reference year will be used by ANCA to determine how changes in aircraft noise exposure are a consequence of changes in the airport's operations as well forecast changes to the local population.

The reporting of population, dwellings and areas exposed to each noise metric, along with wider operational information, must be provided in an approved ANCA reporting template format. The ANCA reporting template makes provision for the reporting of the number of dwellings and noise sensitive buildings which have been insulated. This information must be provided for ANCA to evaluate the potential effectiveness of the Airport's noise insulation schemes.

NAO Monitoring and Compliance

The NAO states that monitoring of the effectiveness of noise mitigation measures shall be carried out through annual reports as prepared under Section 21 of the Act of 2019. Annual noise contouring and associated exposure information must be provided considering the wider requirements of this Guidance Note. This will allow the tracking of NAO expected outcomes.

Review of Compliance in line with the ENR
Performance against the expected outcomes of the NAO will be determined in line with the 5-year regulatory cycles required under ENR. The outcomes set by the NAO require the population HA and HSD to be reduced compared to the noise situation in 2023 by the following percentages: 2031 (20%), 2036 (25%) and 2041 (30%). These years

[8] https://www.cso.ie/en/releasesandpublications/ep/p-rpp/regionalpopulationprojections2023-2042/

correspond to the 'relevant' years set by the ENR. Under ENR, Dublin Airport is required to prepare strategic noise maps which form the basis of preparing a noise action plan. This cycle is presented in

Figure 2 below.

Figure 2: Illustration of NAP Process

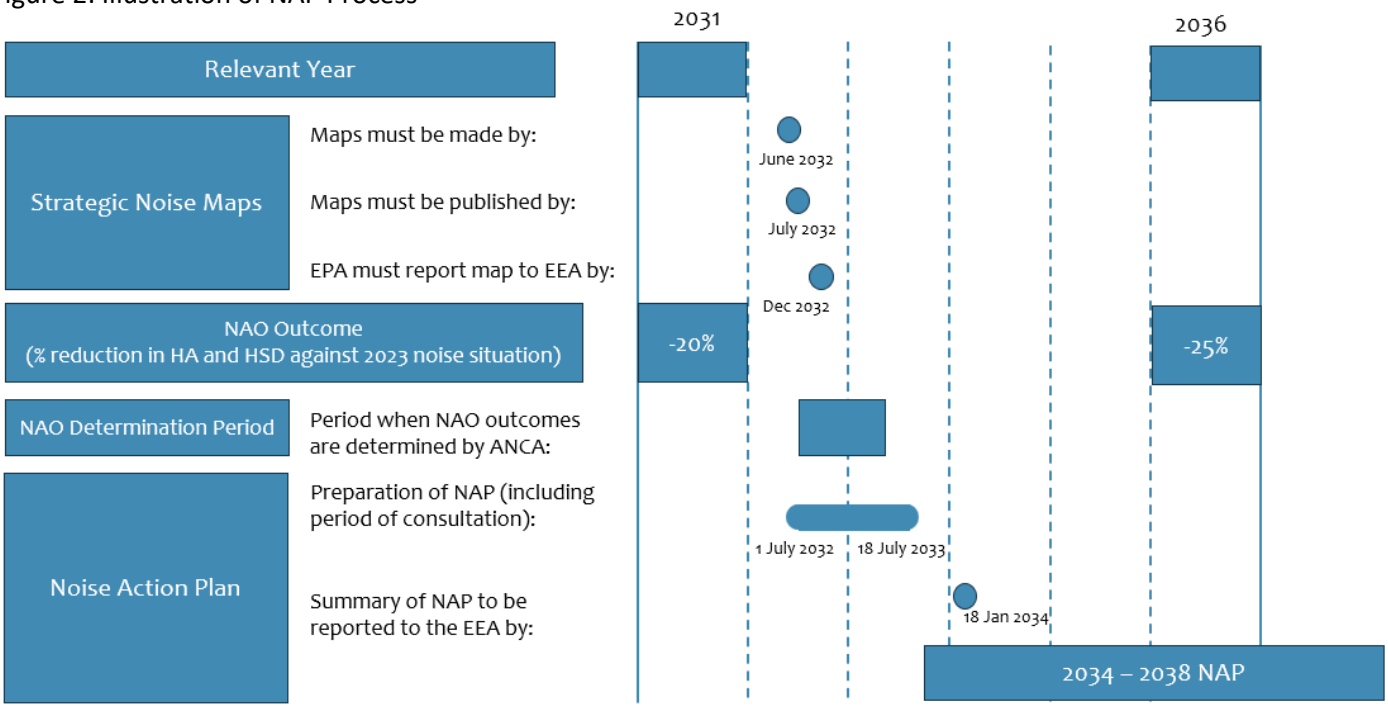


Figure 2 shows that the NAO will be determined following the making of the strategic noise maps in line with the requirements set out in this Guidance Note. If the noise mitigation measures and operating restrictions (if any) in place or due to come into place are not effective at achieving the outcomes of the NAO, this will be considered in the noise action plan and the process of aircraft noise regulation under Section 9 of the Act of 2019.

Compliance and Decision Making as part of Relevant Action or Proposed Development

Where a relevant action[9] or development is proposed[10], forecasts must be provided in line with this Guidance Note. Forecasts must be provided for each relevant year described by the NAO, and any other forecast years or situations that reflect the relevant action or proposed development. ANCA will utilise forecasts to determine whether a relevant action or proposed development meets the expected outcomes of the NAO and will regulate accordingly to meet the policy objective.

[9] Section 34C of the Act of 2000
[10] Section 34B of the Act of 2000

ENVIRONMENTAL ASSESSMENTS

Appropriate Assessment (AA)

ANCA undertook an AA Screening in respect of the Noise Abatement Objective (NAO) arising from an assessment of the noise situation resulting from planning application F23A/0781.

The NAO is a plan not directly connected with or necessary to the management of any European Site. Screening has concluded that the NAO is not predicted, either alone or in-combination with other plans or projects, to have a significant effect on any European Site.

Therefore, in alignment with the Methodological guidance on Article 6(3) and (4) of the Habitats Directive 92/43/EEC, it has been concluded that the NAO will generate no potential for Likely Significant Effects. Consequently, a Stage two Appropriate Assessment is not required.

Strategic Environmental Assessment (SEA)

The Noise Abatement Objective (NAO) may set the framework for future development consent of projects listed in Annex I and II to the EIA Directive, including changes or extensions to airfields and airports with a basic runway length of 2,100 metres or more.

ANCA is required to undertake Strategic Environmental Assessment (SEA) in respect of the NAO arising from an assessment of the noise situation resulting from planning application F23A/0781.

Accordingly, an SEA Draft Environmental Report has been prepared and published for consultation alongside the Noise Abatement Objective.

An tÚdarás Inniúil um Thorann Aerárthaí

Aircraft Noise Competent Authority

APPENDIX A

ANALYSIS OF CHANGES IN POPULATION AND AIRCRAFT NOISE EXPOSURE AROUND DUBLIN AIRPORT SINCE 2006



Appendix A

Analysis of changes in population and aircraft noise exposure around Dublin Airport since 2006

For Aircraft Noise Competent Authority (ANCA)

18 December 2025

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Acronyms

ANCA	Aircraft Noise Competent Authority
CSO	Central Statistics Office
CSV	comma-separated values
daa	dublin airport authority, Dublin Airport operator
ED	Electoral District
EIAR	Environmental Impact Assessment Report
END	Environmental Noise Directive
EPA	Environmental Protection Agency
FCC	Fingal County Council
FDP	Fingal Development Plan
GIS	Geographic Information System
ICAO	International Civil Aviation Organisation
NAO	Noise Abatement Objective
NAP	Noise Action Plan
OSi	Ordnance Survey Ireland
QGIS	Quantum GIS
RA	"Residential Area" - Fingal Development Plan 2023-2029 land use zoning objective for new residential developments
RS	"Residential" - Fingal Development Plan 2023-2029 land use zoning objective for existing residential developments
SAPS	Small Area Population Statistics
WHO	World Health Organisation

Noise metrics

Noise Metric	Description
L_{day}	Annual average daytime equivalent sound level. Representative of day period (07:00 to 19:00).
$L_{evening}$	Annual average evening equivalent sound level. Representative of evening period (19:00 to 23:00).
L_{night}	Annual average night-time equivalent sound level representative of night period (23:00 to 07:00). Used as an indicator linking noise exposure to sleep disturbance by Annex III of the END, as transposed into Irish Law through the European Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I. 663/2021).
L_{den}	Annual average day-evening-night rating level. The L_{den} metric is a rating level for the whole 24-hour period, however, depending on the period of the day the noise occurs, a different weighting is applied. If the noise occurs during the first 12 hours of the day (07:00 to 19:00), no weighting is applied. If it occurs during the evening (19:00 to 23:00) a weighting of +5 dB is added and if the noise occurs during the night-time period (23:00 to 07:00) a weighting of +10 dB is added. Each L_{eq} period is calculated/measured separately, and respective weighting is applied to the evening and night L_{eq} values before the L_{den} can be calculated. This metric is used as an indicator linking noise exposure to annoyance by Annex III of the END, as transposed into Irish Law through the European Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I. 663/2021).
$L_{Aeq,16hr}$	16-hour summer average daytime noise indicator for a period 07:00 to 23:00. This metric is used within the UK as a measure of aircraft noise exposure and has been used previously for assessment purposes at Dublin Airport. It underpins several planning conditions attached to the North Runway Planning Permission. The metric is the equivalent sound level of aircraft noise in dB for the 16-hour annual day. The UK metric is based on a 'summer average' which is based on the daily average movements that take place between 07:00 and 23:00 local time during a 92-day period of 16 June to 15 September inclusive.

Executive Summary

An analysis of the change over time in the number of people and dwellings exposed to aircraft noise around Dublin Airport has been carried out to better understand the causes of the increment in population exposed to aircraft noise.

The analysis is also meant to identify if development growth has resulted in the encroachment of incompatible noise sensitive developments.

The analysis has been carried out following a detailed methodology which has regard to relevant policies and legal context on land use planning and management at Dublin Airport.

The methodology has been developed taking in consideration the ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – Second Edition 2008, and consists of two tests:

- **Test 1:** Population/Dwellings changes within Airport Noise Zones;
- **Test 2:** Population/Dwellings and noise contour changes over time.

The Test 1 assessment aims to establish if and how the population and the number of dwellings has been changing over time within the Airport Noise Zoning through the Fingal Development Plan 2023 – 2029 (FDP) which has been effective since December 2019. This analysis has considered the following zones as defined by the FDP:

- **Zone A:** within which new developments are actively resisted, representing an incompatible area for noise sensitive development as per ICAO guidelines.
- **Zone B:** within which new developments must present internal and external noise assessment along with well-designed noise insulation measures. As consented developments are subject to noise insulation, as per the ICAO guidelines this may be seen to represent a compatible area for insulated noise sensitive development; and
- **Zone C:** within which noise may cause annoyance and/or disturbance, therefore a noise assessment must be presented and, where appropriate, noise insulation measures. This may be seen to represent a compatible area for uninsulated or insulated noise sensitive developments, as appropriate, as per the ICAO guidelines.

The same exercise has been carried out also against the superseded 2005 zoning system, which was in place until December 2019:

- **The Inner Zone:** within which new provision for residential development and other noise sensitive uses were to be resisted, this may be seen to represent an incompatible area for noise sensitive development as per the definition within the ICAO guideline;
- **The Outer Zone:** within which consented developments were subject to noise insulation, which may be seen to represent a compatible area for insulated noise sensitive development as per the ICAO guidelines.

The aim of Test 1 is to assess how population and number of dwellings have changed over the years within the Airport Noise Zones, as well as determine if encroachment occurred within Zone A, since this may be seen to represent an incompatible area for noise sensitive development as per the definition of the ICAO guidelines.

Test 2 analysis aims at establishing how population and the number of dwellings has grown over time in the areas exposed to aircraft noise, when compared against the L_{den}, L_{night} and $L_{Aeq,16hrs}$ contours.

Consistent with the methodology outlined in the ICAO Doc. 9829 Appendix I, the methodology for Test 2 includes:

- A comparison between the population/dwellings as a fixed parameter, against contours of different assessment years;
- A comparison of the population/ dwellings changes over the years against a fixed noise contour.

The results of Test 1 indicate that the main growth in residential developments has occurred within Zones B and C of the 2019 Airport Noise Zones, whilst Zone A effectively prevented the construction of new developments and land-use encroachment of incompatible noise sensitive development.

The results of Test 2 suggest the increment in population exposure observed in 2023 was due an increment or a different distribution of the noise footprint around Dublin Airport.

However, the residential growth observed since 2019 within Zone B and Zone C is an additional factor that has contributed to the increment of the total number of people exposed to noise observed around Dublin Airport in 2023.

In particular, while the introduction of the 2019 Airport Noize Zone has effectively prevented the construction of new residential developments with Zone A, growth in the number of developments is observed in Zone B within the areas designated for residential use by the FCC Development Plan, which has contributed to the increment in the number of people exposed to levels above the 55 dB L_{night}.

Whilst consent can be given to developments in the areas designated for residential use by the FCC development plan on condition that appropriate sound insulation is provided, any further growth in these areas may conflict with the achievement of the current Noise Abatement Objective, particularly the measure linked to 55 dB L_{night}.

Introduction

Dublin Airport is the busiest airport in Ireland in terms of both total passenger numbers and air traffic movements. It is situated 7 km north of Dublin City and has three runways; the 'South Runway', the 'North Runway' constructed between 2019 and 2022 and officially opened on the 24th of August 2022, both of which run in an east-west direction, and the 'Crosswind Runway', which runs in a north-west to south-east direction.

In 2019, Fingal County Council (FCC) was appointed as Competent Authority for the purposes of Aircraft Noise Regulation at Dublin Airport[1]. In compliance with the legislation, the Aircraft Noise Competent Authority (ANCA) was established as a separate and independent Directorate within FCC receiving full operational functional authority status. The Competent Authority is responsible for ensuring that the impact of aircraft noise at Dublin Airport and the surrounding neighbourhoods, is analysed, communicated, managed and reduced over time[2].

In 2022, ANCA set out the Noise Abatement Objective (NAO) for Dublin Airport aiming to "*Limit and reduce the long-term adverse effects of aircraft noise on health and quality of life, particularly at night, as part of the sustainable development of Dublin Airport*[3]". The achievement of the NAO is measured through the number of people highly sleep disturbed and highly annoyed[4], and in terms of number of people exposed to aircraft noise so that "*The number of people exposed to aircraft noise above 55 dB L_{night} and 65 dB L_{den} shall be reduced compared to 2019*[3]".

The Noise Action Plan for Dublin Airport 2024 – 2028 (NAP) highlights the increase in population exposed to aircraft noise generated by Dublin Airport operations, particularly within noise contours in the vicinity of the airport where the number of people exposed to noise levels above 55 dB L_{night} and above 65 dB L_{den} had increased in 2023 compared to 2019, and to all the previous Rounds of Strategic Noise Mapping since 2006[5].

To better understand the causes of the increased population exposed to aircraft noise, ANCA has commissioned an analysis on how the population, and the number of dwellings, exposed to noise in the vicinity of Dublin Airport has changed over time.

Noise Consultants Limited | Part of Logika Group (NCL) has undertaken such analysis having regard for the relevant land use planning and management policies and Dublin Airport noise exposure contours produced for the Strategic Noise Mapping Rounds and supplementary years.

The outcomes of the analysis present the historical trends in the change of population and dwellings within the Airport Noise Zones and noise contours of Dublin Airport. The analysis is also meant to identify if development growth has resulted in the encroachment of incompatible noise sensitive developments.

This document is structured in three parts:

- **Part A**, which describes the methodology for assessing population/dwelling growth over time and encroachment at Dublin Airport. outlining:

[1] Aircraft Noise (Dublin Airport) Regulation Act 2019, Section 3
[2] Aircraft Noise Competent Authority, Annual Report 2024
[3] Noise Abatement Objective for Dublin Airport 20th June 2022 Noise Abatement Objective | Fingal County Council
[4] In accordance with the approach recommended by the World Health Organisation's Environmental Noise Guidelines 2018 as endorsed by the European Commission through D. 2020/367
[5] Noise Action Plan for Dublin Airport 2024-2028 Noise Action Plan for Dublin Airport 2024 -2028 | Fingal County Council

- The relevant policies and legal context on land use planning and management at Dublin Airport;
- The Noise Abatement Objective for Dublin Airport, with reference to the exposure levels used to monitor the achievement of the objectives;
- The proposed methodology for assessing the change in population and number of dwellings over time.
- **Part B**, which presents the results and the main findings of the analysis on population/dwelling growth over time and encroachment at Dublin Airport.
- **Part C**, which presents a forecast of how Population/Dwelling Growth may grow against the existing NAO, considering also forecasts of noise levels produced by the airport operations.

Part A - Methodology for Assessing Population/Dwelling Growth Over Time and Encroachment at Dublin Airport

A1 Policies and legal context on Land Use Planning and Management at Dublin Airport

Land-use planning and management around airports is one of the four principal elements of the ICAO Balanced Approach. Local or regional authorities are responsible for the land-use planning and management functions and for the implementation of urbanisation control measures around the airport.

Since 2005, a noise zoning system has been established by FCC to manage noise-sensitive development in the vicinity of Dublin Airport, which was last revised in December 2019.

A1.1 Fingal Development Plan 2005-2011, 2011-2017 and 2017-2023

A noise zoning system was introduced into the land planning system by Fingal County Council (FCC) in 2005 to facilitate efficient land use planning for development within the airport noise zones. The system was implemented to minimise the adverse impact of aviation noise without placing unreasonable restrictions on development.

Policy DAP11 of the Fingal Development Plan 2005-2011 defined two zones[6]:

- an **Outer Zone** within which the Council was to continue to restrict inappropriate development, and to require noise insulation where appropriate;
- an **Inner Zone** within which new provision for residential development and other noise sensitive uses were to be resisted.

Both the Outer and the Inner zones are shown in Figure A1-1.

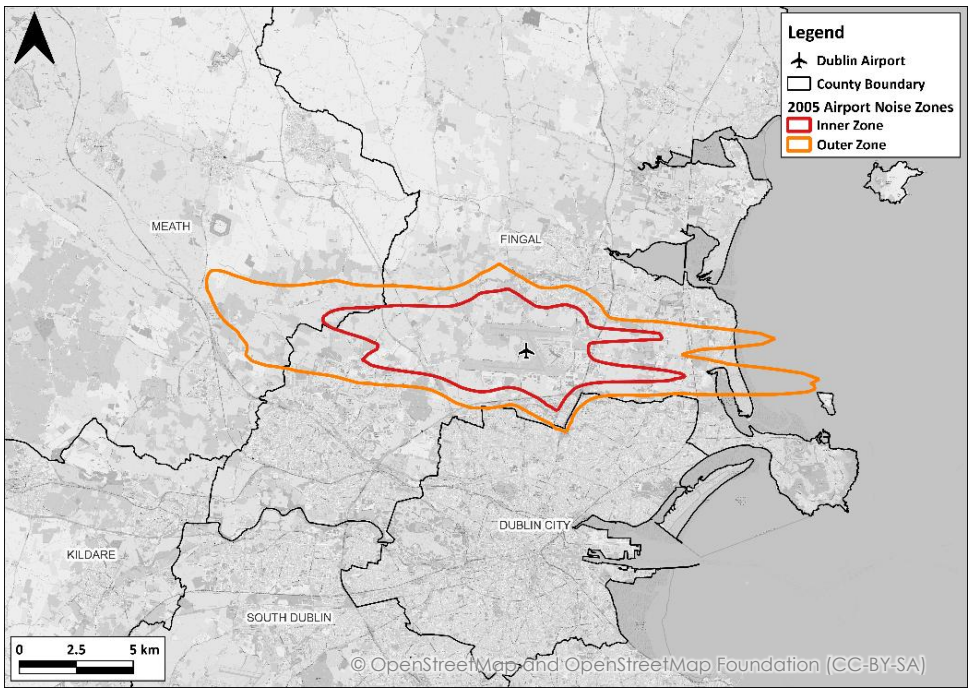


Figure A1-1: Map of 2005 Noise Zones at Dublin Airport with overlayed County areas

[6] Fingal Development Plan 2005 - 2011

In addition to the established zoning system, which from 2017 started being referred to as 'Airport Noise Zones', the Fingal Development Plan (FDP) 2011-2017 and 2017-2023 defined respectively Objectives[7], and Objectives DA08 and RF4[8], which applied to the provisions of the Rural Settlement Strategy, with regard to 'New Housing for Farming Families' within the Airport Inner Noize Zone, subject to the following restrictions:

- Under no circumstances shall any dwelling be permitted within the predicted 69dB $L_{Aeq,16hr}$ noise contour;
- Comprehensive noise insulation shall be required for any house permitted under this objective; and
- Any planning application shall be accompanied by a noise assessment report produced by a specialist in noise assessment which shall specify all proposed noise mitigation measures together with a declaration of acceptance of the applicant with regard to the result of the noise acceptance report.

A1.2 Fingal Development Plan 2017-2023 Variation No.1 and Fingal Development Plan 2023-2029

Since the first implementation of the airport noise zoning system in 2005, further evidence emerged linking the effects of aircraft noise exposure to human health and quality of life, which combined with the availability of better flight path and aircraft noise performance information and the planned constructions of the new northern runway, resulted in the revision of the Dublin noise zoning system in 2019 through Variation No.1 of the Fingal Development Plan 2017-2023[9], effective from 9th December 2019.

The new Aircraft Noise Zones were established with reference to wider policy as described in the Government of Ireland's National Planning Framework 2040[10]. National Policy Objective 65 of the Framework set out the following:

"Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans".

The Plan cites the Aircraft Noise Regulation (EU) 598/2014, referring to the key objective set by the Dublin Airport NAP 2019[11]. The Plan states that having regard for this policy:

"There is a need to minimise the adverse impact of noise without placing unreasonable restrictions on development and to avoid future conflicts between the community and the operation of the airport."

The 2019 Aircraft Noise Zones consist of Zone A, Zone B and Zone C as shown in Figure A1-2, which replace the Outer and Inner Zones introduced by FDP 2005 - 2011. In addition to these three noise

[7] Fingal Development Plan 2011 - 2017 https://www.fingal.ie/development-plan-2011-2017
[8] Fingal Development Plan 2017 – 2023 https://www.fingal.ie/fingal-development-plan-2017-2023
[9] Variation No. 1 of the Fingal Development Plan 2017-2023 effective from 09th December 2019 adopted-fdp-variation-no-1.pdf
[10] Project 2040 National Planning Framework gov.ie - National Planning Framework - Ireland 2040 Our Plan (NPF) (2018)
[11] Noise Action Plan for Dublin Airport 2019-2023 https://www.dublinairport.com/corporate/environmental-social-governance/noise/noise-management/airport-noise-plans-and-reports

zones, Zone D was established in the form of a list of townlands which could be potentially impacted by aircraft noise.

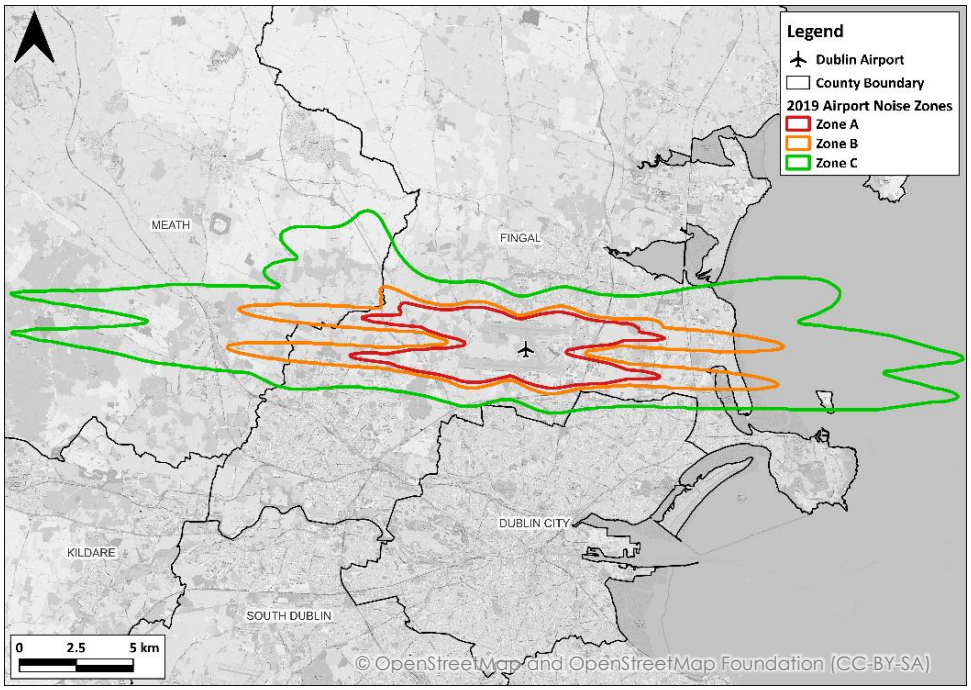


Figure A1-2: Map of 2019 Airport Noise Zones currently in use at Dublin Airport with overlayed County areas

The Aircraft Noise Zones have been developed with the overarching objective to balance the potential impact of aircraft noise from Dublin Airport on both external and internal noise amenity. This allows larger development which may be brought forward in the vicinity of the Airport's flight paths to be identified and considered as part of the planning process.

The focus of the noise zones is to ensure proposed residential developments are compatible with pertinent standards and guidance in relation to planning and noise.

The objectives of each of the 2019 Airport Noise Zones are described in Table A1-1, along with the indicated potential noise exposure level due to the Airport using either the new northern or existing southern runway for arrival and departures.

Table A1-1: Aircraft noise zones and the associated objective of each zone along with an indication of the potential noise exposure from operations at Dublin Airport

Zone	Indication Of Potential Noise Exposure During Aircraft Operations	Objective
D	≥ 50 and < 54 dB $L_{Aeq,16hr}$ and ≥ 40 and < 48 dB L_{night}	To identify noise sensitive developments which could potentially be affected by aircraft noise and to identify any larger residential developments in the vicinity of the flight paths serving the Airport in order to promote appropriate land use and to identify encroachment. All noise sensitive development within this zone is

Zone	Indication Of Potential Noise Exposure During Aircraft Operations	Objective
		likely to be acceptable from a noise perspective. An associated application would not normally be refused on noise grounds, however where the development is residential-led and comprises non-residential noise sensitive uses, or comprises 50 residential units or more, it may be necessary for the applicant to demonstrate that a good acoustic design has been followed. Applicants are advised to seek expert advice.
C	≥ 54 and < 63 dB $L_{Aeq,16hr}$ and ≥ 48 and < 55 L_{night}	To manage noise sensitive development in areas where aircraft noise may give rise to annoyance and sleep disturbance, and to ensure, where appropriate, noise insulation is incorporated within the development. Noise sensitive development in this zone is less suitable from a noise perspective than in Zone D. A noise assessment must be undertaken in order to demonstrate good acoustic design has been followed. The noise assessment must demonstrate that relevant internal noise guidelines will be met. This may require noise insulation measures. An external amenity area noise assessment must be undertaken where external amenity space is intrinsic to the development's design. This assessment should make specific consideration of the acoustic environment within those spaces as required so that they can be enjoyed as intended. Ideally, noise levels in external amenity spaces should be designed to achieve the lowest practicable noise levels. Applicants are strongly advised to seek expert advice.
B	≥ 54 and < 63 dB $L_{Aeq,16hr}$ and ≥ 55 dB L_{night}	To manage noise sensitive development in areas where aircraft noise may give rise to annoyance and sleep disturbance, and to ensure noise insulation is incorporated within the development. Noise sensitive development in this zone is less suitable from a noise perspective than in Zone C. A noise assessment must be undertaken in order to demonstrate good acoustic design has been followed. Appropriate well-designed noise insulation measures must be incorporated into the development in order to meet relevant internal noise guidelines. An external amenity area noise assessment must be undertaken where external amenity space is intrinsic to the developments design. This assessment should make specific consideration of the acoustic environment within those spaces as required so that they can be enjoyed as intended. Ideally, noise levels in external amenity spaces should be designed to achieve the lowest practicable noise levels.

Zone	Indication Of Potential Noise Exposure During Aircraft Operations	Objective
		Applicants must seek expert advice.
A	≥ 63 dB $L_{Aeq, 16hr}$ and / or ≥ 55 dB L_{night}	To resist new provision for residential development and other noise sensitive uses. All noise sensitive developments within this zone may potentially be exposed to high levels of aircraft noise, which may be harmful to health or otherwise unacceptable. The provision of new noise sensitive developments will be resisted.

Furthermore, Objective RF40 of Variation No.1 of the FDP stated that under no circumstances should any dwelling be permitted within the predicted 69 dB $L_{Aeq,16hr}$ noise contour, and that any planning application needs to present a noise assessment report along with noise mitigation measures produced by a specialist in noise assessment[12].

The Dublin Airport Noise Zones as defined in 2019 in Variation No.1 of the Fingal Development Plan 2017-2023, are also adopted by the latest Fingal Development Plan 2023-2029[13] and therefore, are currently in force.

Along with the objectives presented in Table A1-1, FDP 2023-2029 Objective DAO11 requires to strictly control inappropriate development and require noise insulation where appropriate within Noise Zone B and Noise Zone C and where necessary in Assessment Zone D, and actively resist new provision for residential development and other noise sensitive uses within Noise Zone A, while recognising the housing needs of established families farming in the zone[13].

Notwithstanding Objective DAO11, Objective DAO12 requires to apply the provisions with regard to New Housing for Farming Families within the Inner Noise Zone subject to the following restrictions and provisions[13]:

- Under no circumstances shall any dwelling be permitted within the predicted 69 dB $L_{Aeq,16hr}$ noise contour;
- Comprehensive noise insulation shall be required for any house permitted under this objective;
- Any planning application shall be accompanied by a noise assessment report produced by a specialist in noise assessment which shall specify all proposed noise mitigation measures together with a declaration of acceptance of the applicant with regard to the result of the noise acceptance report; and
- New developments for those who are not involved in farming, within Zone A, will be actively resisted.

[12] Fingal Development Plan 2017 – 2023 https://www.fingal.ie/fingal-development-plan-2017-2023
[13] Fingal Development Plan 2023-2029, April 2023 Fingal Development Plan 2023-2029 | Fingal County Council

Besides the specific objectives of each Airport Noise Zone, the Fingal Development Plan 2023-2029 provides also land use zoning objectives to describe the permitted uses in different locations. The land use zoning objectives are summarised in Table A1-2.

Table A1-2: Fingal Development Plan 2023-2029 Land Use Zoning Objectives

Land Use Zoning Objective	Description
CI	Community Infrastructure" for civic, religious, community, education, health care and social infrastructure
GB	Greenbelt
GE	General Employment" to provide general enterprise and employment opportunities
HA	High Amenity" areas
LC	Local Centre" facilities
RA	Residential Area" for new residential developments
RC	Rural Cluster
RS	Residential" for existing residential developments
OS	Open Space" for open space and recreational amenities
RV	Rural Village
TC	Town and District Centre

In some instances, the FCC land use zoning might overlap with the Airport zoning[14]. An example is given in the following image extracted from Sheet9 Malahide-Portmarnock 2023-2029[15] which shows a residential area within the Airport Zone B (denoted by the orange boundary in Figure A1-3). This indicates that the residential developments falling within Zone B have been approved subject to a condition requiring the incorporation of the necessary noise insulation.

[14] Development Plan 2023-2029 | Fingal County Council
[15] Sheet9 Malahide-Portmarnock 2023 - 2029_0.pdf

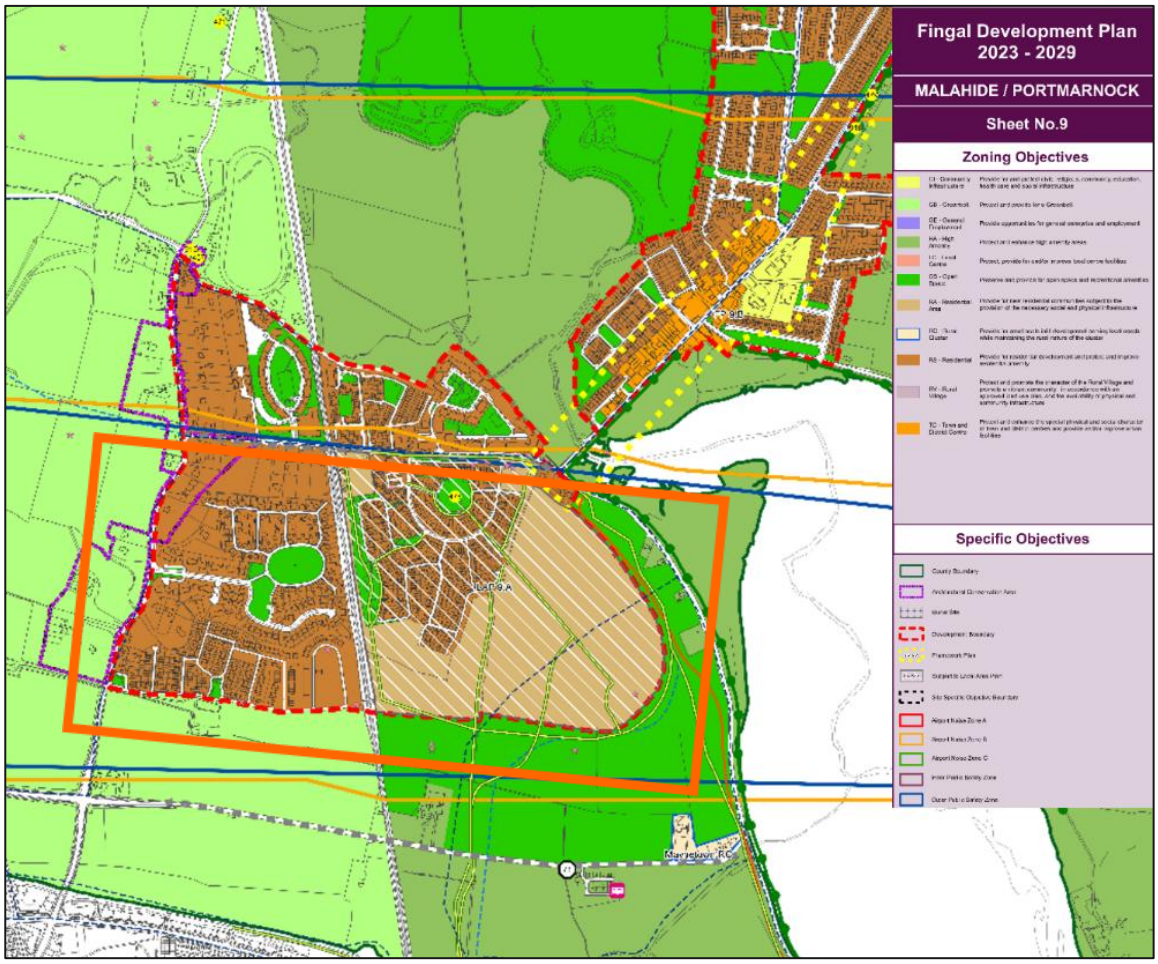


Figure A1-3: Extracted Image from Sheet9 Malahide-Portmarnock 2023-2029[15] – orange rectangle in Zone B

A2 Noise Abatement Objective for Dublin Airport

The Noise Abatement Objective for Dublin Airport[16] aims to *"Limit and reduce the long-term adverse effects of aircraft noise on health and quality of life, particularly at night, as part of the sustainable development of Dublin Airport[17]"*.

The NAO includes measurable objectives through percentage reductions in the number of people highly sleep disturbed and highly annoyed[18] considering noise exposure above 45 dB L_{den} and 40 dB L_{night}, which are used to describe the impacts of noise on health and life quality.

The targeted outcomes of the NAO are the reduction of the number of people highly sleep disturbed and highly annoyed by 30% in 2030, by 40% in 2035 and by 50% in 2040 compared to 2019.

[16] https://consult.fingal.ie/ga/consultation/aircraft-noise-consultation/chapter/noise-abatement-objective-nao-dublin-airport
[17] Noise Abatement Objective for Dublin Airport 20th June 2022 Noise Abatement Objective | Fingal County Council
[18] In accordance with the approach recommended by the World Health Organisation's Environmental Noise Guidelines 2018 as endorsed by the European Commission through Directive 2020/367

The NAO also sets measurable objectives in terms of number of people exposed to aircraft noise above the following thresholds:

- 55 dB $L_{night,}$ (the night noise exposure level that represents a clear risk to health as per the WHO); and
- 65 dB L_{den} (as a significant number of people residing near Dublin airport may be regarded as highly annoyed).

The targeted outcome of the NAO is to decrease the number of people exposed in these areas compared to 2019.

Nonetheless, the NAO does not provide any direct restriction to land use planning within these thresholds, neither explicitly establish nor define incompatible levels for development consent.

A3 Methodology for Assessing Trends in Development Growth Over Time and Encroachment at Dublin Airport

A methodology has been developed to undertake an analysis to understand how the population and the number of dwellings has changed over time in the areas surrounding Dublin Airport.

In developing the methodology, consideration has been given to the ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – Second Edition 2008.

A3.1 ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – Second Edition 2008

The International Civil Aviation Organization (ICAO) is a specialised division of the United Nations that works with Member States and industry groups to reach consensus on international civil aviation standards and recommended practices and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector.

Resolution A33/7 of ICAO[19] introduces the concept of a Balanced Approach to address aircraft noise. The Balanced Approach is considered as the foundation of noise regulation for aviation as a global industry setting international rules and standards. It is implemented in legislation in the EU under The Aircraft Noise Regulation (EU) 598/2014[20].

The Balanced Approach recommends identifying the noise problem at an airport and then analysing the various measures available to reduce noise through the exploration of four principal elements, namely:

1) Reduction at source (quieter aircraft);

2) Land-use planning and management;

[19] ICAO Resolution A33-7 Doc 9790, A33-7
[20] REGULATION (EU) No 598/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC

3) Noise abatement operational procedures (optimising how aircraft are flown and the routes they follow to limit the noise impacts);

4) Operating restrictions.

Land-use planning and management around airports is one of the principal elements of the Balanced Approach. Local or regional authorities are responsible for the land-use planning and management functions and for the implementation of urbanisation control measures around the airport.

A measure such as noise zoning enables the relevant authority to designate the uses that are permitted for each parcel of land, depending on the noise exposure. It normally consists of a zoning ordinance that specifies land development and use constraints. Generally, no noise-sensitive land use should be permitted in an area subjected to levels of noise higher than considered acceptable for that use.

The guideline defines as Compatible land use:

"*The use of land (for example, commercial, industrial, agricultural) that is normally compatible with aircraft and airport operations, or sound-insulated land uses (for example, sound-insulated homes, schools, nursing homes, hospitals, libraries) that would otherwise be considered incompatible with aircraft and airport operations*[21]",

and as Incompatible land use:

"*The use of land that is normally incompatible with aircraft and airport operations for homes, schools, nursing homes, hospitals and libraries*[22]".

Consequently, a further measure of land use planning and management consists in preventing land-use encroachment around the airport i.e. "*preventing the growth of residential development in areas that are incompatible or potentially incompatible with aircraft noise*[23]".

An encroachment analysis needs to be carried out "*over a time frame, usually ten to twenty years, of the percentage of change in population/households within the airport-regulated area where land-use planning is applicable as defined by the authority*[24]".

The ICAO Doc 9829 Appendix I illustrates different methods of assessing population and dwelling growth over time, and how this growth tracks against noise zones and against a contour that changes over time, identifying potential encroachment, given the appropriate historical data:

5) When noise protection zones are formally defined, population and dwellings overall changes over time can be quantified for each of the noise zones.

6) By quantifying changes in population and dwellings against contour bands developed for different reference years. There are three different ways of looking at population and housing growth over time and how this growth tracks against a contour that changes over time:

[21] ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – page (v)
[22] ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – page (vi)
[23] ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – para. 2.2, page I-A1-2
[24] ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – para. 2.2, page I-5-6

a) a comparison between the 'Base Case' population/dwellings, as a fixed parameter, against future contours to study the "Noise Change" i.e. how the noise has changed over the time;

b) a comparison between the 'Base case' consisting of the baseline noise contour and baseline population/dwellings against the 'After' population/dwellings and 'After' noise contours combined, therefore it would represent the 'Noise and population change' scenario in which the combined effects of noise and population/dwellings changing are observed;

c) lastly the 'After' population/dwellings could be compared to both the 'Base case' and the 'Noise change' scenarios to get respectively the 'population change (before)' and 'population change (after)' the noise contour.

<table>
<tr><td colspan="2" rowspan="2">Scenarios</td><td colspan="2">Census data</td></tr>
<tr><td>Before</td><td>After</td></tr>
<tr><td rowspan="3">Contour set</td><td>Before</td><td>Base case</td><td>Population change (before)</td></tr>
<tr><td>After</td><td>Noise change</td><td>Population change (after)</td></tr>
<tr><td colspan="2"></td><td>Noise and population change</td></tr>
</table>

Figure A3-1: Methods of looking at population and dwellings growth over time[25]

A3.2 Population/dwelling change methodology

Taking into considerations the methodologies outlined in the ICAO Doc 9829 Appendix I, the methodology to quantifying the growth of residential development over time at Dublin Airport consists of two tests:

- **Test 1:** Population/Dwellings changes within Airport Noise Zones;
- **Test 2:** Population/Dwellings and noise contour changes over time.

A3.2.1 Test 1 – Population/Dwellings changes within Airport Noise Zones

The assessment aimed to establish if and how the population and the number of dwellings has been changing over time within the current 2019 Airport Noise Zoning. The same exercise was also carried out against the superseded 2005-2019 zoning system at Dublin Airport.

As advised in the ICAO guideline, Test 1 was carried out over a 10 - 20 year period. The analysis was undertaken for:

- 2005 when the Inner & Outer Noise Zones were established;
- 2019 when the Airport Noise Zones were established;
- 2006, 2011, 2016, 2021 for each of the Strategic Noise Mapping assessment years; and

[25] ICAO Doc 9829 AN/451- Guidance on the Balanced Approach to Aircraft Noise Management – Appendix 1 – Table I-A1-1

- any other year in which supplementary noise assessments have been provided.

This effectively provides coverage from 2005 to 2024.

Test 1 has been carried out against both the 2005-2019 noise zoning system and the current 2019 Airport Noise Zones, with the zones defined as follow:

- **2005-2019 noise zoning system:**
    - **The Inner Zone:** within which new provision for residential development and other noise sensitive uses were to be resisted, this may be seen to represent an incompatible area for noise sensitive development as per the definition within the ICAO guideline;
    - **The Outer Zone:** within which consented developments were subject to noise insulation, which may be seen to represent a compatible area for insulated noise sensitive development as per the ICAO guidelines.
- **2019 Airport Noise Zones:**
    - **Zone A:** within which new developments are actively resisted, representing an incompatible area for noise sensitive development as per ICAO guidelines.
    - **Zone B:** within which new developments must present internal and external noise assessment along with well-designed noise insulation measures. As consented developments are subject to noise insulation, as per the ICAO guidelines this may be seen to represent a compatible area for insulated noise sensitive development;
    - **Zone C:** within which noise may cause annoyance and/or disturbance, therefore a noise assessment must be presented and, where appropriate, noise insulation measures. This may be seen to represent a compatible area for uninsulated or insulated noise sensitive developments, as appropriate, as per the ICAO guidelines.

The results of the analysis of the growth of residential development over time for Test 1 have been presented separately for the 2005-2019 noise zoning system and 2019 Airport Noise Zones.

Through Test 1 it has been possible to assess how population and number of dwellings have changed over the years against the Airport Noise Zones and their objectives as well as determine if encroachment occurred within the Inner Zone and Zone A since these areas as per the definition of the ICAO guidelines may be seen to represent an incompatible area for noise sensitive development.

A3.2.2 Test 2 – Population/Dwellings and contour changes over time

Test 2 analysis aimed to establish how population and the number of dwellings has grown over time when compared against the noise contours of a specific year. It also established how population/dwellings exposure within the noise contours has changed over time.

Consistent with the methodology outlined in the ICAO Doc. 9829 Appendix I, the assessment undertook:

- A comparison between the population/dwellings as a fixed parameter, against contours of different assessment years;
- A comparison of the population/ dwellings changes over the years against a fixed noise contour.

As advised in the guideline, Test 2 was carried out over a 10 – 20 year period. Noise contours produced for each Round of the Strategic Noise Mapping were used, supplemented by any other available noise assessment years, providing effectively a coverage from 2006 to 2024.

The Test 2 analysis was carried out against the following noise contours:

- 65 dB L_{den} and 55 dB L_{night}: the noise levels associated with the Noise Abatement Objective currently set for Dublin Airport for which population exposure *shall be reduced compared to 2019*;
- 45 dB L_{den} and 40 dB L_{night}: the noise levels from which are associated health effects in accordance with the World Health Organization 2018 – Environmental Noise Guidelines for the European Region, and which are used by Dublin Airport NAO to describe the impacts of noise on health and life quality and set measurable objectives through percentage reductions in the number of people highly sleep disturbed and highly annoyed.
- 69 dB $L_{Aeq,16hr}$: the noise level within which dwellings should not be permitted in accordance with Fingal Development Plan.

A3.2.3 Objectives of the proposed methodology

The outputs of Test 1 and Test 2 aim to present the historical trends in the change of population and dwellings over time within areas affected by aircraft noise from Dublin Airport.

The results of Test 1 describe how population and the number of dwellings has changed over time against the Airport Noise Zones and their objectives. In particular, the population/dwellings changes within the Inner Zone and Zone A will indicate if development growth has occurred within the incompatible areas defined by the planning authority, resulting therefore in land-use encroachment of incompatible noise sensitive development around the airport.

The results of Test 2 provide an indication whether development growth has occurred over time within the 55 dB L_{night} and the 65 dB L_{den} contours which are used as part of measuring the achievement of Dublin Airports Noise Abatement Objective.

Development growth within the 69 dB $L_{Aeq,16hrs}$ contour, within which no dwellings shall be consented, would indicate that encroachment has occurred.

A3.3 Data required for the analysis

In order to carry out the population/dwellings change analysis as outlined in the previous section, the following data was required:

- Dublin Airport Noise Zones polygons (or lines) shapefile:
    - 2005-2019 noise zoning system;
    - 2019 Airport Noise Zones.
- Noise Contours of annual average situation using metrics required by ANCA under the NAO i.e. L_{den}, L_{night} ,and $L_{eq,16hr}$ as required under the FDP:
    - Strategic noise maps for END Round 1 2006;
    - Strategic noise maps for END Round 2 2011;
    - Strategic Noise Maps for END Round 3 2016;

- Strategic Noise Maps for END Round 4 2021;
- Any supplementary years i.e. 2019, 2022 and 2023.

- Census Data:
  - Population and dwellings data was required at least for each of the noise contour years included in the assessment (see second bullet point);
  - The Central Statistics Office (CSO) is the Ireland's national statistics institute which publishes the Census of the Irish population typically every 5 years. Census data was available for the years 2006, 2011, 2016 and 2022 published at a range of geographical levels that go from State down to Small Area Population Statistics (SAPS) depending on the year;
  - With regard to the area extent, this included Fingal, Meath, Dublin and parts of South Dublin and Kildare, as they all intersect with the noise zones of Dublin Airport.

- GeoDirectory Data Q4 alongside the Census data:
  - GeoDirectory was required for each of the noise contour years included in the assessment (see second bullet point). The data required to cover all the extents of the SAPS areas of interest in order to assign the Census data to all the GeoDirectory points within the same SAPS area.

A4 Data gathering

A4.1 Review of the collected data

Data provided by ANCA to carry out the population/dwellings change analysis, based on the required data listed in Section A3.3 includes:

- Noise contours (all years and noise metrics);
- Airport Noise Zones as published in the FDP;
- Census datasets from CSO;
- GeoDirectory data.

A4.1.1 Noise Contours

The following airport noise contours were supplied by ANCA, as prepared in line with the European Communities (Environmental Noise) Regulations 2018, as amended, and EU Directive 2002/49/EC, as amended, and received from daa:

- 2006 L_{den} and L_{night}
- 2011 L_{den} and L_{night}
- 2016 L_{den} and L_{night}
- 2021 L_{den} and L_{night}
- 2022 L_{den} and L_{night}
- 2023 L_{den}, L_{night} and $L_{Aeq,16h}$

This data has been utilised to assess the number of people and dwellings within relevant noise contours. The L_{den} and L_{night} noise contours have been made available from 45dB and 40 dB in 5 dB increments, with the 2023 $L_{Aeq,16hr}$ contours provided from 51 dB in 3 dB increments.

A4.1.2 Airport Noise Zones

Fingal County Council (FCC) is the authority responsible for land-use planning and management in the areas around Dublin Airport. In 2005 FCC established a noise zoning system to minimise the adverse impact of aviation noise without placing unreasonable restrictions on development. These Noise Zones consisted of the Inner Noise Zone and the Outer Noise Zone.

In December 2019 the noise zoning was revised to reflect expected changes and updated forecasts prior to the commencement of operations from the Airport's North Runway. The updated zones also had regard for up-to-date evidence linking the impacts of aviation noise on human health/quality of life, and wider principles of noise assessment and design as described in ProPG: Planning & Noise – New Residential Development, May 2017[26] and British Standard BS8233:2014 'Guidance on sound insulation and noise reduction for buildings[27].

The 2005 noise zones were replaced by Airport Noise Zones A, B and C which remain in place and are used to support noise management objectives under the Fingal Development Plan.

Spatial data of the 2005 and 2019 Airport Noise zones were provided by ANCA and are shown in Figure A1-1 and Figure A1-2.

A4.1.3 Census Datasets

To calculate trends in Population Growth at Dublin Airport, Census datasets have been utilised which are made available online by the Central Statistics Office (CSO), Ireland's national statistical institute, for the following years and level of granularity:

- Census 2006 produced at Electoral District level (ED);
- Census 2011 produced at Small Area Population Statistics level (SAPS);
- Census 2016 produced at Small Area Population Statistics level (SAPS);
- Census 2022 produced at Small Area Population Statistics level (SAPS).

[26] ProPG: Planning & Noise, Professional Practice Guidance on Planning & Noise, New Residential Development, May 2017 https://www.ioa.org.uk/publications/propg
[27] BS 8233:2014 Guidance on sound insulation and noise reduction for buildings, 28 Feb 2014 https://knowledge.bsigroup.com/products/guidance-on-sound-insulation-and-noise-reduction-for-buildings

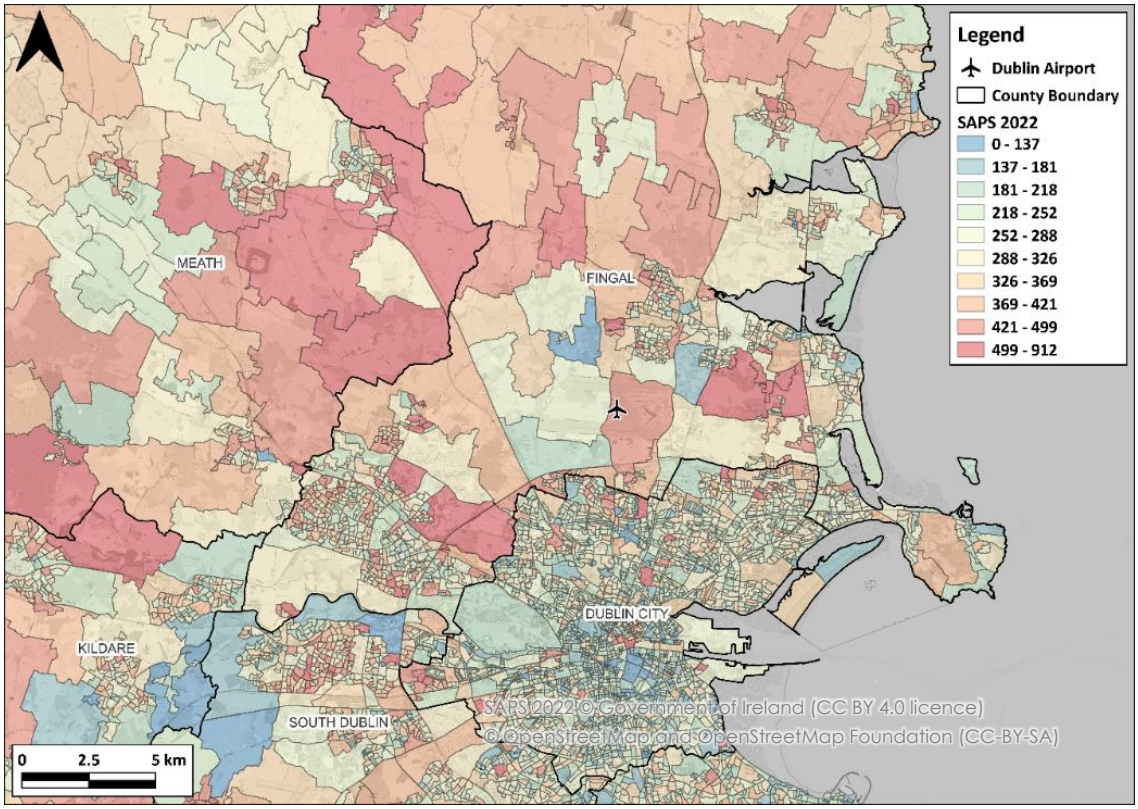


Figure A4-1: Small Area Population Statistics 2022 with overlayed Study Area B

The Census datasets provided total population figures for each area, which were used to estimate the number of people per dwelling in accordance with the methodology outlined in Section 0. As Census in Ireland is conducted every 5 years, population data were unavailable for the intermediate assessment years. Consequently, the available datasets were used as a baseline to derive population estimates for the remaining years.

A4.1.4 GeoDirectory Datasets

Study Area Extent

Study area extent was defined to meet the required coverage for the analysis which was derived taking into considerations:

- All Census years boundaries, i.e. the 2006 ED boundaries and 2011-2016-2022 SAPS boundaries;
- The 2005-2019 noise zoning system boundaries;
- The 2019 Airport Noise Zones boundaries;
- The 50 dB L_{night} and the 55 dB L_{den} noise contours between 2006 and 2023; and
- The 40 dB L_{night} and 45 dB L_{den} contours for the most recent assessment years (2021, 2022 and 2023) [28].

[28] the 40 dB L_{night} and 45 dB L_{den} contours from 2006 and 2019 have not been excluded from the analysis due to their geographical extents which would have significantly increase the study area and consequently the supply of the GeoDirectory data, also across all the required assessment years.

- ANCA has provided GeoDirectory data accordingly to the above requirements. The study area extent is shown in Figure A4-2.

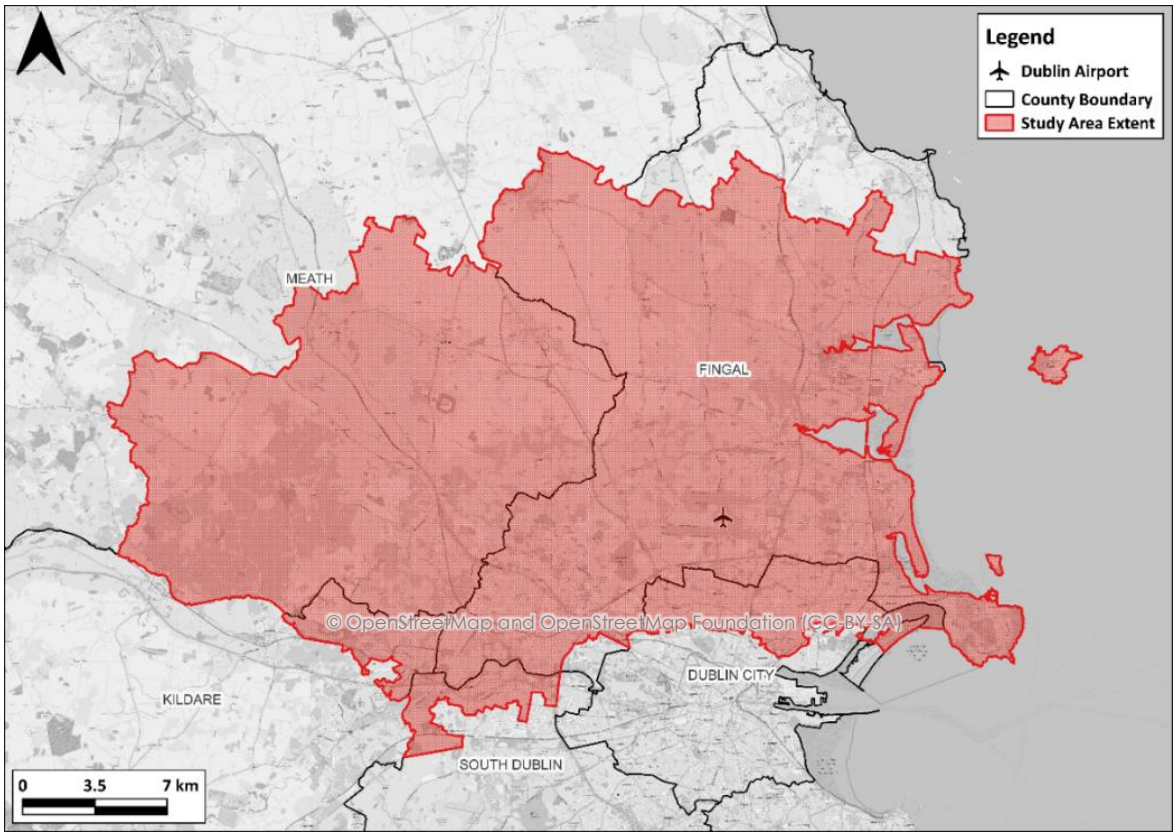


Figure A4-2: Study Area Extent

GeoDirectory Data

To calculate trends and changes in dwellings around Dublin Airport, GeoDirectory data produced by OSi and An Post, which is published quarterly, was used to provide the location of all buildings in Ireland through a single point object, as shown in Figure A4-3. The GeoDirectory points also provided information about building uses, including occupancy status. The following GeoDirectory datasets were received by ANCA which covered the extents of the defined study area:

- 2005 Q2
- 2006 Q2
- 2011 Q2
- 2016 Q2
- 2019 Q2
- 2021 Q4
- 2022 Q4
- 2023 Q4
- 2024 Q4



Figure A4-3: Sample GeoDirectory dataset

A4.1.5 Years considered for the analysis following review of data

Based on the received data, namely the noise contours, airport noise zones, and GeoDirectory data, Table A4-1summarises the tests carried out for study, indicating the corresponding year analysed for each test.

Table A4-1: Overview of tests that was possible to carry out based on the data collected

Years Assessed by Test										
Test	**Zoning/Metric**	**Zone / Level**	**2005**	**2006**	**2011**	**2016**	**2019**	**2021**	**2022**	**2023**	**2024**
Test 1	**2015 Noise Zoning**	**Inner Zone**	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2019 Noise Zoning	**Zone A Zone B Zone C**	✓	✓	✓	✓	✓	✓	✓	✓	✓
Test 2	**L_{den}**	**65 dB**	a	✓	✓	✓	✓	✓	✓	✓	c
	L_{den}	**45 dB**	a	b	b	b	b	✓	✓	✓	c
	L_{night}	**55 dB**	a	✓	✓	✓	✓	✓	✓	✓	c
	L_{night}	**40 dB**	a	b	b	b	b	✓	✓	✓	c
	$L_{Aeq,16hr}$	**69 dB**	a	a	a	a	a	a	a	✓	a

a) Contours not available / provided at the time of the assessment

A5 Assigning population to residential dwellings

For the purposes of this assessment, it was necessary to estimate the population at each GeoDirectory point representing residential building use.

The process used to assign population to residential dwellings for all the assessment years has been undertaken with regard to the EPA draft guidance document ('EPA Guidance Note for Strategic Noise Mapping [29], hereafter referred to as the 'EPA Guidance Note') and is summarised in the following 3 steps.

Step 1: Census data preparation

The 2006 Census population data was available on the CSO website in form of a CSV table. This has been spatially joined to the 2006 boundaries to attribute each Electoral Division (ED) polygon to its population value. Census 2011, 2016 and 2022 data were available as csv tables per Small Area Population Statistics (SAPS) which were joined to the relevant SAPS polygon boundaries. Lastly, the polygons have been clipped to the study areas and any geometry issue resolved to facilitate analysis in GIS.

Step 2: Assigning population to residential dwellings

For this assessment related to aircraft noise, the use of building polygons within the EPA Guidance note is considered unnecessary, and GeoDirectory point data, which represent all the postal delivery points in Ireland, has been deemed a sufficient dataset to support the analysis. Therefore, modifications to the EPA Guidance Note' method were required to assign population to the GeoDirectory delivery points. This has included:

7) Filtering out all unnecessary GeoDirectory points, such as commercial buildings and invalid buildings

8) Spatially joining the ED/SAPS areas to the GeoDirectory points to calculate:

   - The number dwellings in each area
   - The number of residential delivery points
   - The number of occupied delivery points

9) Using the data calculated at point 2) to assign the number of people in private households, given by the Census, per occupied address point to each area;

10) Spatially joining the data calculated at area level to the GeoDirectory points to apply the population to each address point separately;

11) Calculating the dwellings occupancy per building for each Census year, i.e. 2006, 2011, 2016 and 2022.

Step 3: Estimate population for the remaining years

[29] EPA "Guidance Note for Strategic Noise Mapping (02/2025 May Draft) Part 2: Calculation Methodology & Noise Modelling", https://www.epa.ie/publications/monitoring--assessment/noise/Part-2-Calculation-Methodology-(May-2025).pdf

The population statistics for the years where CSO Census data were not available have been estimated using the calculated dwelling occupancy from the Census year closest to the one assessed and the GeoDirectory points data supplied of that year, as well as the same granularity areas of the Census. Therefore, if the GeoDirectory points have increased between one year and the following year in some areas, also the population of those areas resulted in an increment. Consequently, the population in each area would increase only if the number of dwellings has increased and vice versa.

Table A5-1: Population Dataset used to estimate years not covered by Census data

	Dataset used by year assessed								
Dataset	**2005**	**2006**	**2011**	**2016**	**2019**	**2021**	**2022**	**2023**	**2024**
Census and relative area boundaries	2006		2011	2016		2022			
GeoDirectory	2005	2006	2011	2016	2019	2021	2022	2023	2024

A5.1 Differences with number of people and dwellings reported in Dublin Airport Noise Action Plan 2024 - 2028

The datasets utilised in the Dublin Airport Environmental Impact Assessment Report (EIAR)[30] for the 2019 NRRA noise assessment, and in the strategic noise mapping for 2023, which are both reported in the 2024 – 2028 Noise Action Plan, are based respectively on 2019 Q2 and 2023 Q3 GeoDirectory data, consistent with the methodology proposed within this document.

However, there are differences in how population per dwelling rates are estimated.

For the EIAR and the strategic noise mapping, the airport authority's consultants have estimated the population data using the average dwelling occupancy by small area. This was based on Census data from the Central Statistics Office, by dividing the number of people by the number of dwellings for each small area. It was then 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 relevant area. The 2022 Census data has been utilised for the 2023 Q3 dataset, and the 2016 Census data has been utilised for the 2019 Q2 dataset. Dwellings marked as vacant in the GeoDirectory data have been included in the dwelling totals, but [31].

As this consists in a different methodology to the one proposed within this document, differences between the number of people and dwellings exposed to noise reported in the 2024 – 2028 NAP and the one assessed as part of this study are expected.

[30] Dublin Airport North Runway Relevant Action Application, https://www.dublinairport.com/docs/default-source/chauffeur/environmental-impact-assessment-report.pdf?sfvrsn=e92966c9_2&_gl=1*124eirw*_up*MQ..*_ga*MTQ0MDQ4OTc4Ny4xNzYxNTY1NTY2*_ga_Q3LM60W37J*czE3NjE1NjU1NjUkbzEkZzAkdDE3NjE1NjU1NjUkajYwJGwwJGg5NTcwMTU2ODA.
[31] Infrastructure Application (F23A/0781) EIAR Appendix 9.2 Air Noise Modelling Methodology, December 2023

Part B – Results and main findings of the analysis on population/dwelling growth over time and encroachment at Dublin Airport

B1 Results of the Analysis

This section summarises the results of the two tests carried out to assess the historical trends in the change over time of population and dwellings around Dublin Airport.

- **Test 1:** Population/Dwelling change within Airport Noise Zones; and
- **Test 2:** Population/Dwelling change within airport noise contours.

The full results of Test 1 and Test 2 analyses are reported in Appendix 1.

B1.1 Test 1: Population/Dwelling change within Airport Noise Zones

The results of the Test 1 analysis provide an indication on how population and number of dwellings have been changing over time within:

- Inner Zone and the Outer Zone of the 2005-2019 noise zoning system;
- Zone A, Zone B and Zone C of the 2019 Airport Noise Zones currently in use.

Through Test 1 it will also be possible to assess the effectiveness of the Airport Noise Zones as well as determine if encroachment occurred in the areas defined incompatible for noise sensitive development.

The results of the tests are reported as bar charts, presenting for each year the number of dwellings within the airport noise zones. The charts also report the correspondent number of people within each zone to illustrate how population has changed over time.

Full results of Test 1 assessments are reported in Table Appx-1 and Table Appx-2 in Appendix 1.

B1.1.1 Inner Zone and the Outer Zone of the 2005-2019 noise zoning system

Figure B1-1 and Figure B1-2 illustrate how population and number of dwellings have changed within the Inner and Outer Zone boundaries of the 2005-2019 noise zoning system (Figure A1-1).

The analysis has been carried out from 2005 up to 2024. However, 2005-2019 noise zoning system effectiveness has been evaluated up to 2019, i.e. when the 2019 Airport Noise Zones were adopted.

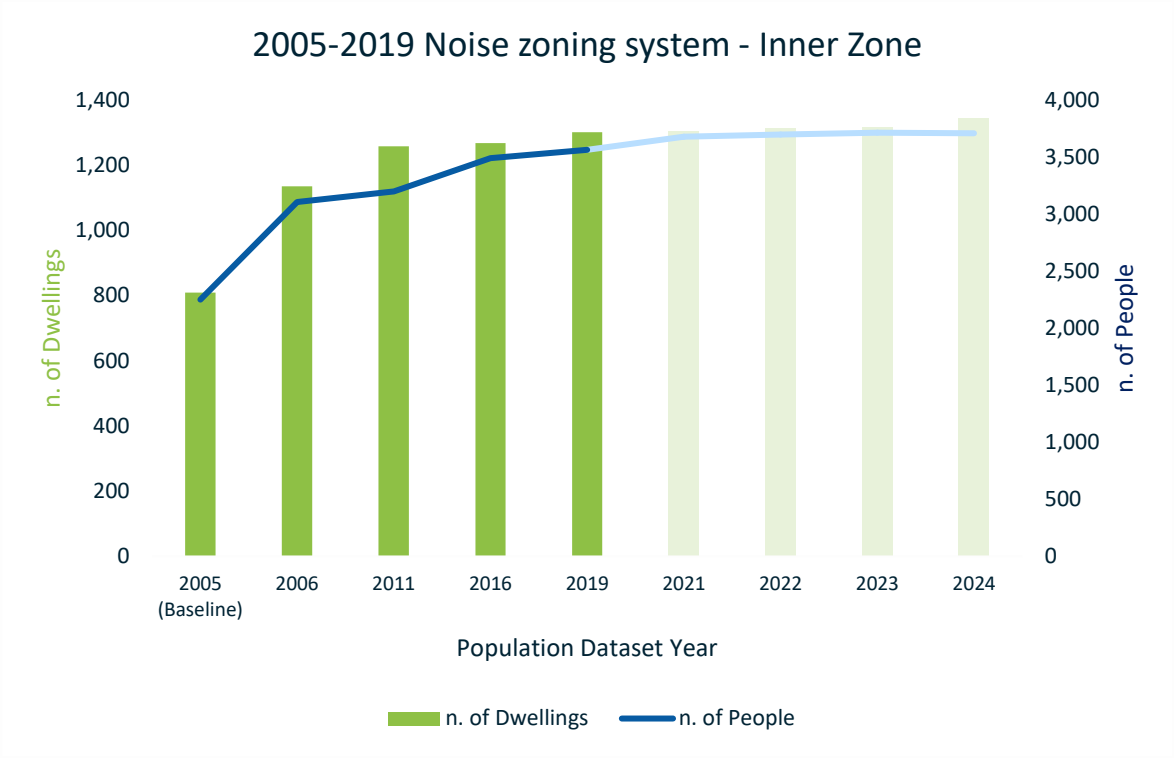


Figure B1-1: Number of dwellings and population within the 2005 Airport Noise Zone – Inner Zone considering population data from different years

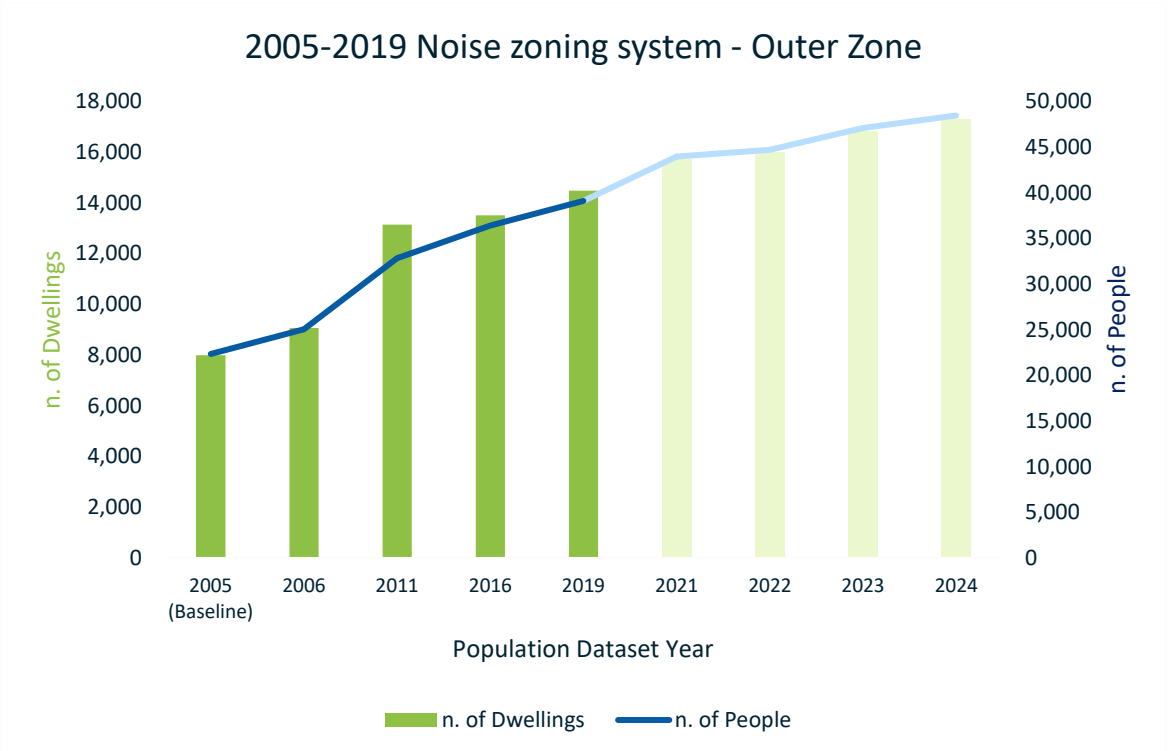


Figure B1-2: Number of dwellings and population within the 2005 Airport Noise Zone – Outer Zone considering population data from different years

The results of Test 1 analysis against the 2005 - 2019 noise zoning system show that in the Inner Zone the main growth in population and number of dwellings can be observed between 2005 and 2006, and, to a reduced extent, between 2006 and 2011.

Table B1-1 presents the number of new dwellings since 2005 for each reference period within the Inner Zone which, as per the definition of the ICAO guidelines, may be seen to represent an incompatible area for noise sensitive development.

Table B1-1: Number of new dwellings within the 2005 Airport Noise Zone – Inner Zone per each period since 2005

Number of new dwellings in the Inner Zone per each period since 2005							
2005 - 2006	**2006 - 2011**	**2011 - 2016**	**2016 - 2019**	**2019 - 2021[a]**	**2021 - 2022[a]**	**2002 - 2023[a]**	**2023 - 2024[a]**
326	123	9	34	4	9	4	26

a) 2005-2019 noise zoning system in place until 2019 when the 2019 Airport Noise Zone currently in use has been defined and adopted.

Table B1-2 reports the total number of new dwellings that would have been built from 2005, 2006 and 2011 in the Inner Zone up to 2019, and which would effectively indicate the occurrence of encroachment within an incompatible area for noise sensitive development as per the definition given within the ICAO guidelines.

Table B1-2: Number of encroachments against 2005 - 2019 noise zoning systems

Number of Encroachments in the 2005 – 2019 period	
From 2005	492
From 2006	166
From 2011	43

In the Outer Zone the main growth in population and number of dwellings can be observed between 2006 and 2011. Full results of Test 1 analysis against the 2005-2019 noise zoning system are reported in Table Appx-1 of Appendix 1.

B1.1.2 Zone A, Zone B and Zone C of the 2019 Airport Noise Zones

Figure B1-3, Figure B1-4 and Figure B1-5 illustrate how population and number of dwellings have changed over time within Zone A, Zone B and Zone C of the currently in use 2019 Airport Noise zoning.

The analysis has been carried out from 2005 up to 2024. However, 2019 Airport Noise Zone effectiveness has been evaluated from 2019, i.e. when the 2019 Airport Noise Zone has been adopted, superseding the 2005 - 2019 noise zoning system.

The results of Test 1 analysis against the 2019 Airport Noise Zones show a growth in population and number of dwellings within Zone A between 2019 and 2021 (Figure B13). The analysis of the GeoDirectory data identify 11 new developments within an incompatible area for noise sensitive development.

The results of Test 1 analysis against the 2019 Airport Noise Zones show a growth in population and number of dwellings within Zone A between 2019 and 2021 (Figure B1-3). The analysis of the GeoDirectory data identify 11 new development within an incompatible area for noise sensitive development.

Table B1-3 presents the number of dwellings that have been constructed since 2019 up to 2024 within the Zone A which, as per the definition of the ICAO guidelines, may be seen to represent an incompatible area for noise sensitive development.

Full results of Test 1 analysis against the 2019 Airport Noise zoning are reported in Table Appx-2 of Appendix 1.



Figure B1-3: Number of dwellings and population within the 2019 Airport Noise Zone – Zone A considering census data from different years

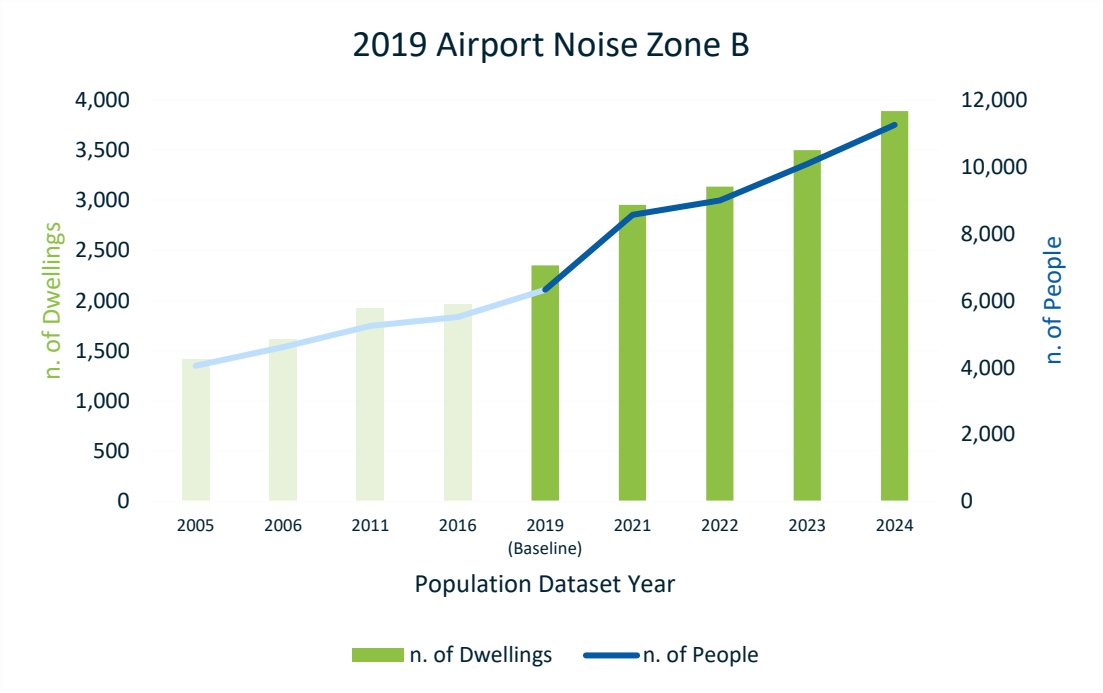


Figure B1-4: Number of dwellings and population within the 2019 Airport Noise Zone – Zone B considering census data from different years

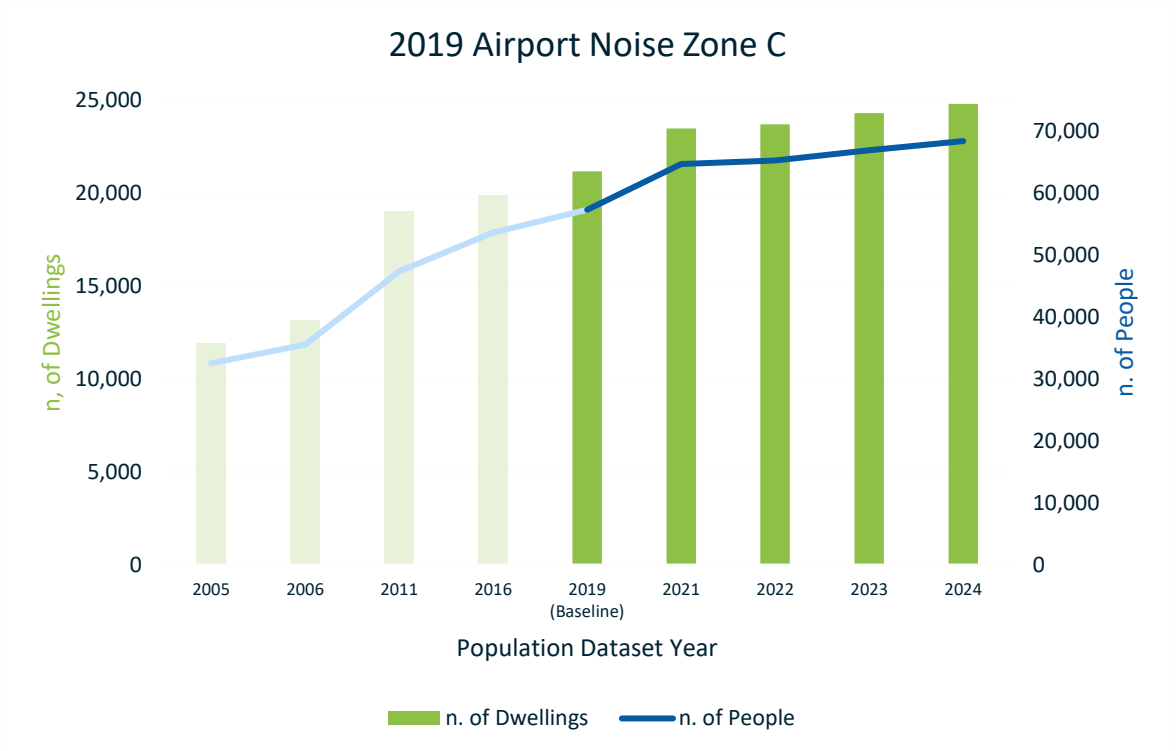


Figure B1-5: Number of dwellings and population within the 2019 Airport Noise Zone – Zone B considering census data from different years

The results of Test 1 analysis against the 2019 Airport Noise Zones show a growth in population and number of dwellings within Zone A between 2019 and 2021 (Figure B1-3). The analysis of the GeoDirectory data identify 11[32] new development within an incompatible area for noise sensitive development.

Table B1-3: Number of new dwellings per each reference period within the 2019 Airport Noise Zone - Zone A since 2019

Number of new dwellings in Zone A per each period since 2019			
2019 - 2021	**2021 - 2022**	**2022 - 2023**	**2023 - 2024**
11[32]	0	0[33]	0[34]

The higher growth in population and number of dwellings can be observed within Zone B, which according to the ICAO guidelines, may be seen to represent a compatible area for noise sensitive development provided that consented developments are subject to appropriate noise insulation. Growth in population and number of dwellings can also be observed within Zone C within which noise may cause annoyance and/or disturbance and may be seen to represent a compatible area for uninsulated or insulated noise sensitive developments, as appropriate, as per the ICAO guidelines.

B1.2 Test 2: Population/Dwelling change within airport noise contours

The results of the Test 2 analysis provide an indication on how residential development growth has occurred over time in areas exposed to aircraft noise.

Results may be used to indicate the main causes of the increment in population exposed to aircraft noise that was observed in 2023, and whether they may be attributed to an increment in the noise emissions from airport operations and / or a growth in the number of residential developments around Dublin Airport.

The results of this test are reported as bar charts, presenting for each noise assessment year the total number of people within the airport noise contours. For each assessment year, the bars of the chart indicate the population exposed to noise based on the data from different census years, providing a comparison of the population changes over the years against the same noise contour. The charts also report the extension of the noise contours area for each assessment year to illustrate how the noise footprint has changed over time.

As outlined in section A3.2.2, results of Test 2 analysis are provided against the following noise contours:

- The NAO thresholds: 65 dB L_{den} and 55 dB L_{night};
- The WHO thresholds: 45 dB L_{den} and 40 dB L_{night}; and
- 69 dB $L_{Aeq,16hr}$.

Full results of Test 2 assessments are reported from Table Appx-3 to Table Appx-8 in Appendix 1.

[33] The analysis carried out on the Geodirectory data shows a reduction of 3 dwellings in 2023 compared to 2022 within the Zone A
[34] The analysis carried out on the Geodirectory data shows a reduction of 1 dwelling in 2024 compared to 2023 within the Zone A

B1.2.1 NAO thresholds: 65 dB L_{den} and 55 dB L_{night}

Figure B1-6 and Figure B1-7 provide an illustration on how the population exposure has changed over time within the 65 dB L_{den} and the 55 dB L_{night} contours which are used to measure the achievement of Dublin Airport's Noise Abatement Objective[35] against the 2019 baseline.

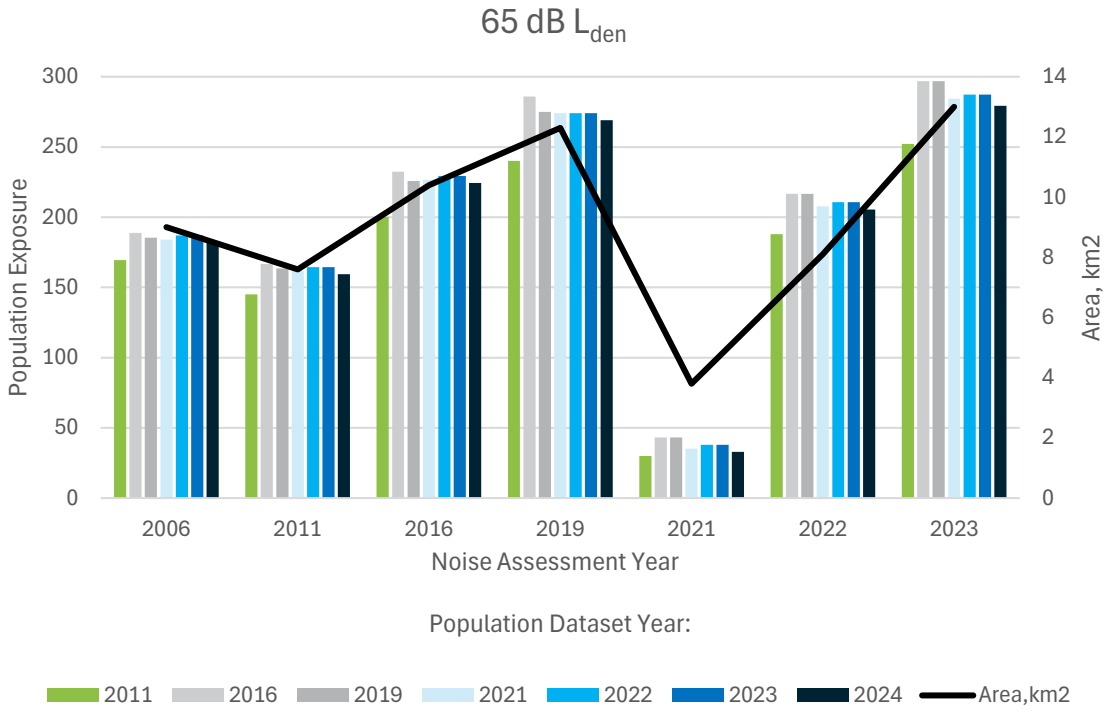


Figure B1-6: Population within 65 dB L_{den} contours from different assessment years using data from different population dataset years

[35] Noise Abatement Objective for Dublin Airport 20th June 2022 Noise Abatement Objective | Fingal County Council

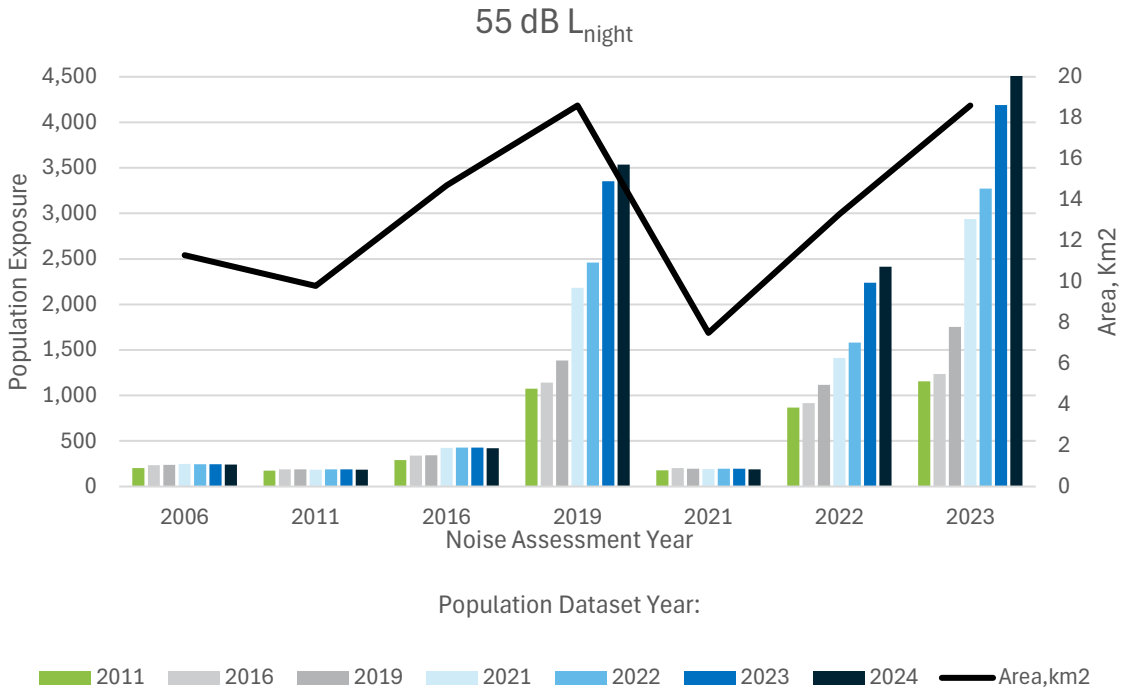


Figure B1-7: Population within 55 dB L_{night} contours from different assessment years using data from different population dataset years

The results against the 65 dB L_{den} contours show marginal differences in population exposure within the same contour using different census years.

The results against the 55 dB L_{night} contours show that population exposure increased between 2019 and 2023 when the comparison is carried out using population dataset from the same census years even if there is no difference in the contour area extension. This is due to the different distribution of the noise footprint caused by the opening of the new North Runway in 2022. However, an increment in the number of people within contours of the same assessment years is also observed.

B1.2.2 WHO thresholds: 45 dB L_{den} and 40 dB L_{night}

Figure B1-8 and Figure B1-9 show how population exposure has grown between 2021 and 2023 within the 45 dB L_{den} and the 40 dB L_{night} contours. These are the WHO thresholds for the assessment respectively of high annoyance and high sleep disturbance which are used to support the measurement of the achievement of Dublin Airports Noise Abatement Objective against the 2019 baseline.

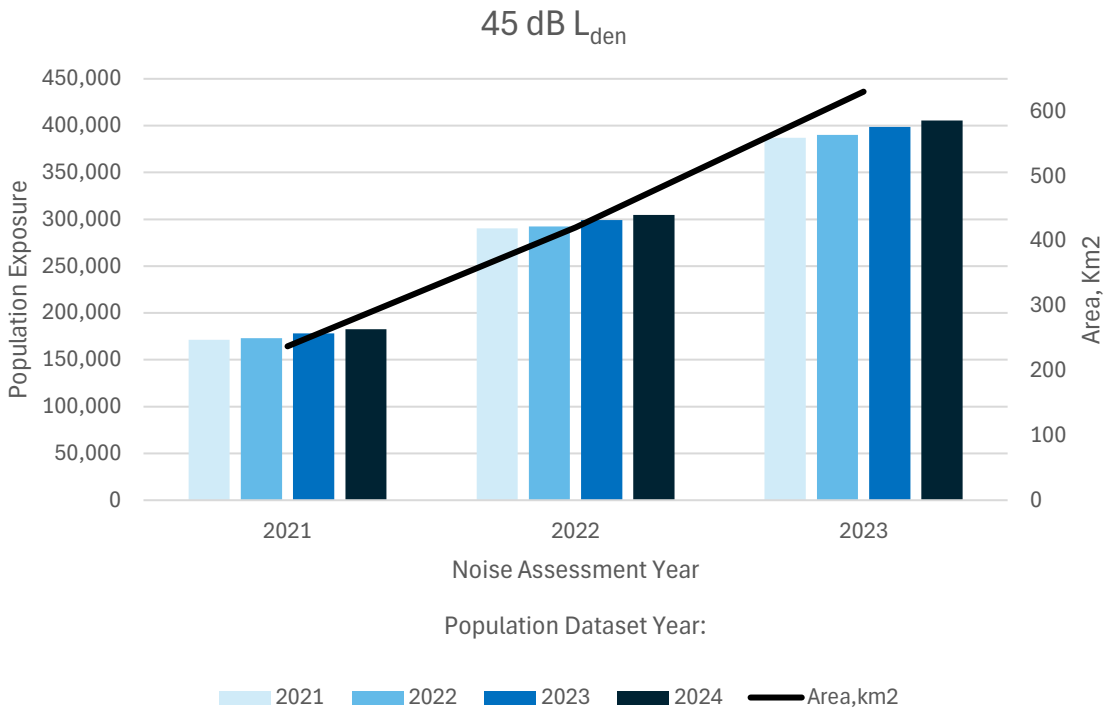


Figure B1-8: Population within 45 dB L_{den} contours from different assessment years using data from different population dataset years

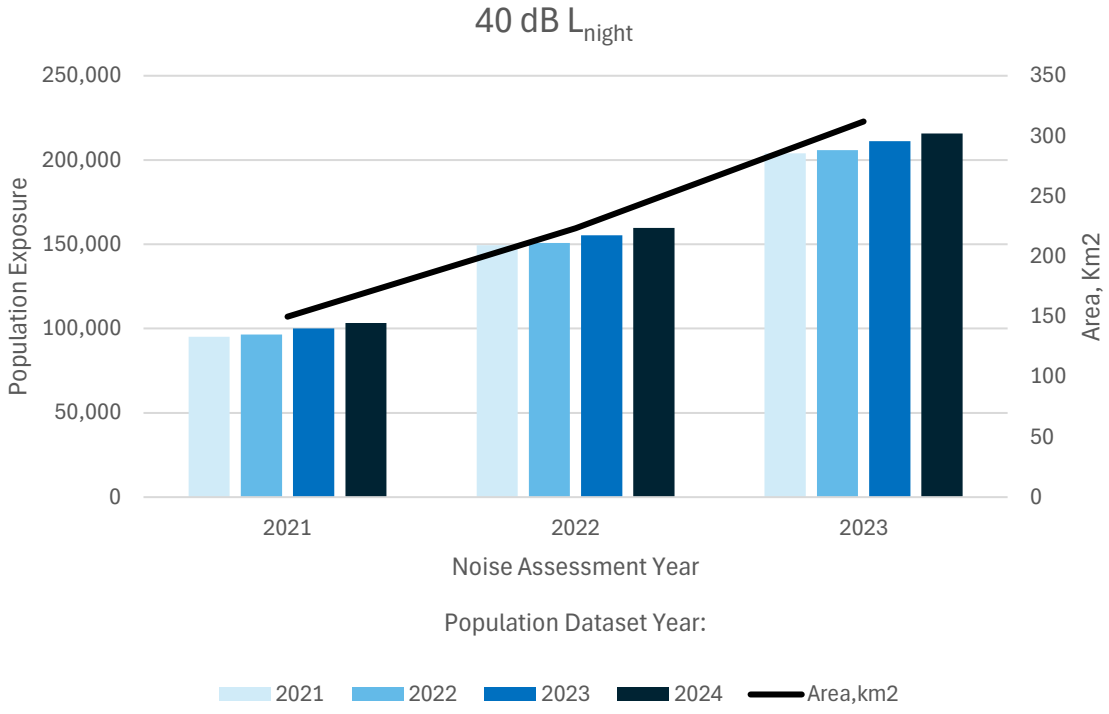


Figure B1-9: Population within 40 dB L_{night} contours from different assessment years using data from different population dataset years

The results against the 45 dB L_{den} and 40 dB L_{night} contours show no significant difference in population exposure using different census years.

B1.2.3 69 dB $LA_{eq,16hr}$

Development growth within the 69 dB $L_{Aeq,16hrs}$ contour, within which no dwellings shall be consented, would indicate that encroachment has occurred.

Table B1-4 reports how the number of people and dwellings within the 2023 69 dB $L_{Aeq,16hr}$ contour has changed when using population dataset from different census years.

Table B1-4: Number of people and dwellings within the 2023 69 dB $L_{Aeq,16hr}$ population dataset from different assessment years

Results	2005	2006	2011	2016	2019	2021	2022	2023	2024
n. of Dwellings	7	5	5	5	5	5	5	5	4
n. of People	14	12	12	12	12	12	12	12	7

The results of this test show no population or development growth within the 2023 69 dB $L_{Aeq,16hr}$, with the number of population and dwelling being reduced over time.

B2 Analysis of the results and main findings

The outputs of Test 1 and Test 2 have presented the historical trend of how population and dwellings have changed over time around Dublin Airport.

B2.1 Results and main findings of Test 1

B2.1.1 Inner and Outer Zones

The results of the Test 1 analysis against the 2005 - 2019 noise zoning system have shown that in both the Inner and Outer zones the main growth in population and number of dwellings can be observed between 2005 and 2006, and, to a reduced extent, between 2006 and 2011, as presented in Table B1-2. Such increment may be attributed to a temporal lag between planning consent given before the introduction of the noise zoning in 2005, and the actual construction of new residential developments between 2006 and 2011.

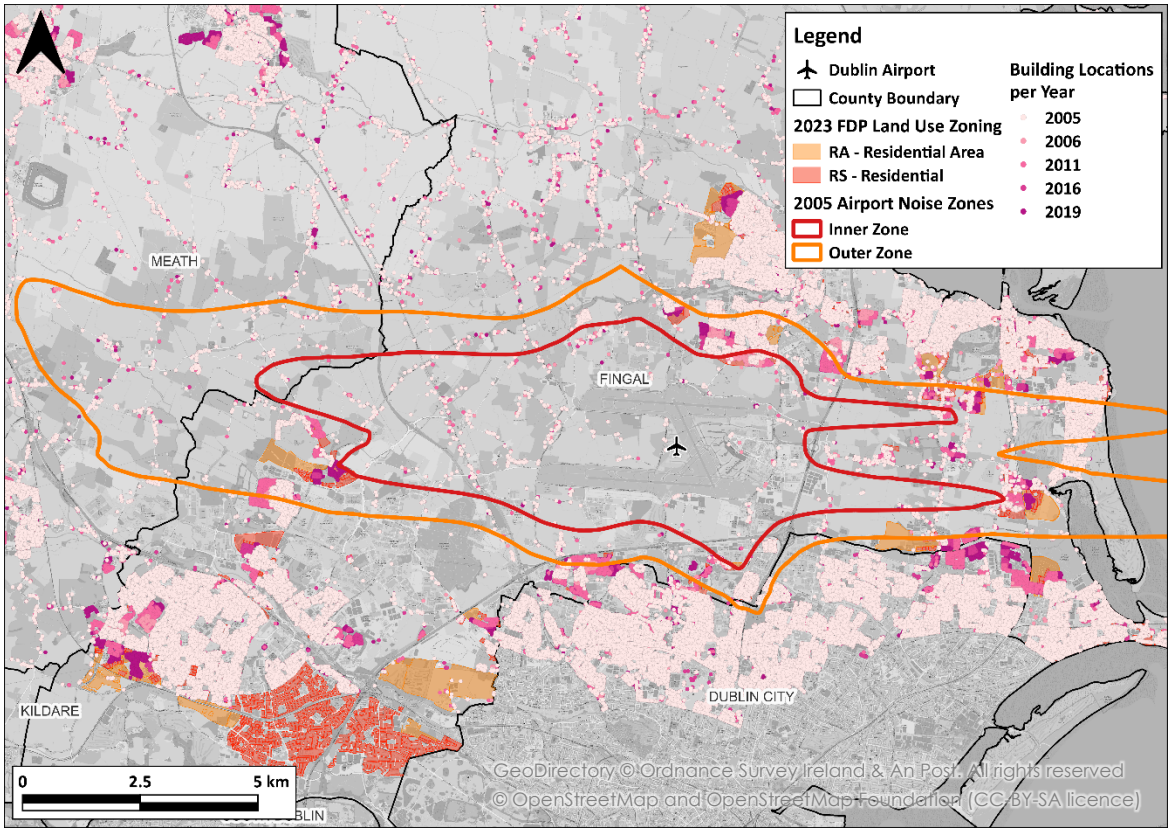


Figure B2-1: Comparison between residential developments in 2005 and additional residential developments built up to 2019 within 2005 Airport Noise Zones

B2.1.2 Zone A, B and C

The results of Test 1 presented in Section B1.1 indicate that the main growth in residential developments has occurred within Zones B and C of the 2019 Airport Noise Zones.

As presented in Figure B1-4, the higher growth in population and number of dwellings can be observed within Zone B, which according to the ICAO guidelines, may be seen to represent a compatible area for noise sensitive development provided that consented developments are subject to specialist assessment and appropriate well-designed noise insulation noise insulation measures are incorporated into the development in order to meet or exceed relevant internal noise standard.

Table B2-1 shows examples of planning conditions relative to new residential developments in areas where noise insulation is required, as in Zone B.

Table B2-1: Example of planning conditions for new residential developments in areas where noise insulation is required

Example of planning conditions for new residential developments in areas where noise insulation is required
The development shall be provided with noise insulation to an appropriate standard, having regard to the location of the site within Noise Zone XX associated with Dublin Airport. REASON: In the interest of public health and to comply with Objective DAO11 of the Fingal County Development Plan 2023-2029.

Example of planning conditions for new residential developments in areas where noise insulation is required
Prior to commencement of development, the following shall be submitted for the written agreement of the Planning Authority: b) The predicated noise environment of the site with consideration for future airport growth. c) Details, including noise mitigation measures as appropriate, to demonstrate that internal noise levels appropriate for the proposed development can be achieved and maintained. REASON: In the interest of proper planning and sustainable development of the area and to comply with Objective DAO11 of the Fingal County Development Plan 2023-2029.
Prior to the commencement of development, the developer shall submit for the written agreement of the Planning Authority, full details of the proposed noise mitigation measures and expected internal noise levels within each building. REASON: In the interests of public health and compliance with Objective DAO11 of Fingal Development Plan 2023-2029.

Growth in population and number of dwellings can also be observed within Zone C within which noise may cause annoyance and/or disturbance and may be seen to represent a compatible area for uninsulated or insulated noise sensitive developments, as appropriate, as per the ICAO guidelines.

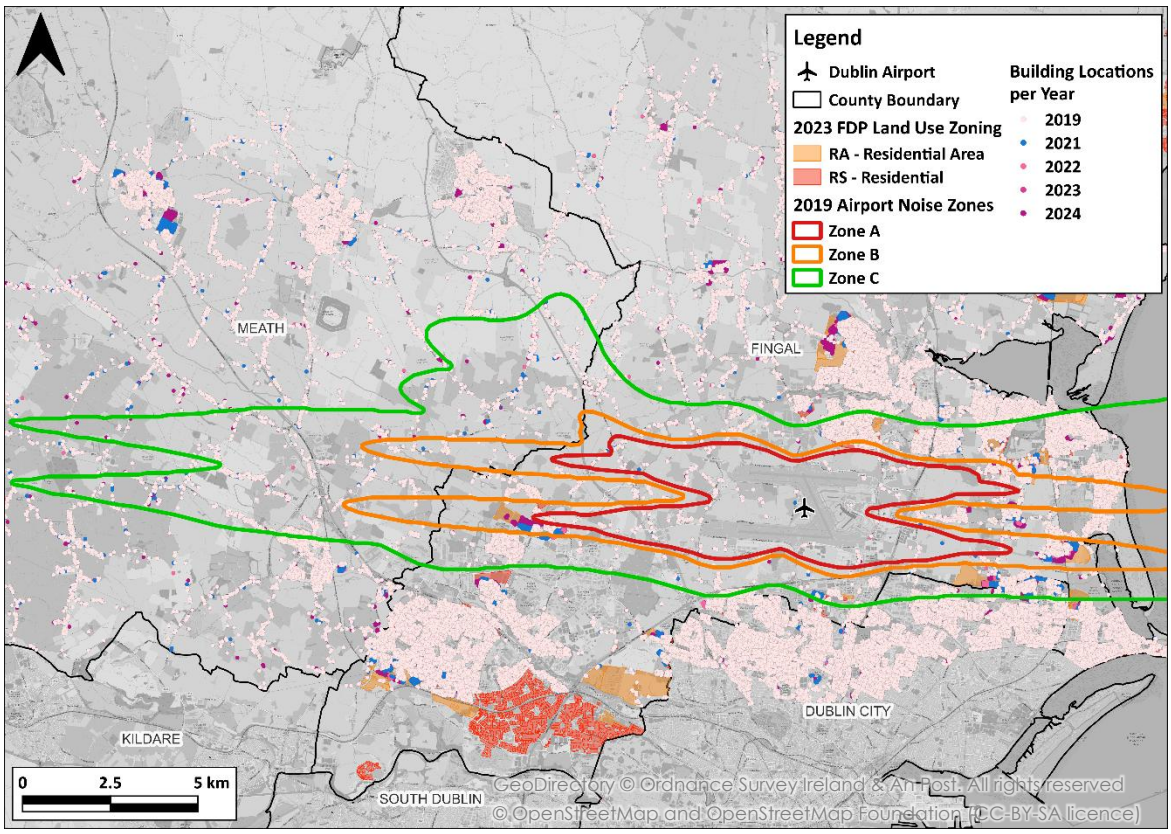


Figure B2-2: Comparison between residential developments in 2019 and additional residential developments built up to 2024 within 2019 Airport Noise Zones

The results of Test 1 analysis against the 2019 Airport Noise Zones illustrated in Figure B1-3 and The results of Test 1 analysis against the 2019 Airport Noise Zones show a growth in population and number of dwellings within Zone A between 2019 and 2021 (Figure B13). The analysis of the GeoDirectory data identify 11 new developments within an incompatible area for noise sensitive development.

The results of Test 1 analysis against the 2019 Airport Noise Zones show a growth in population and number of dwellings within Zone A between 2019 and 2021 (Figure B1-3). The analysis of the GeoDirectory data identify 11 new development within an incompatible area for noise sensitive development.

Table B1-3 show a growth in population and number of dwellings between 2019 and 2021 within Zone A, an incompatible area for noise sensitive development as per ICAO definition.

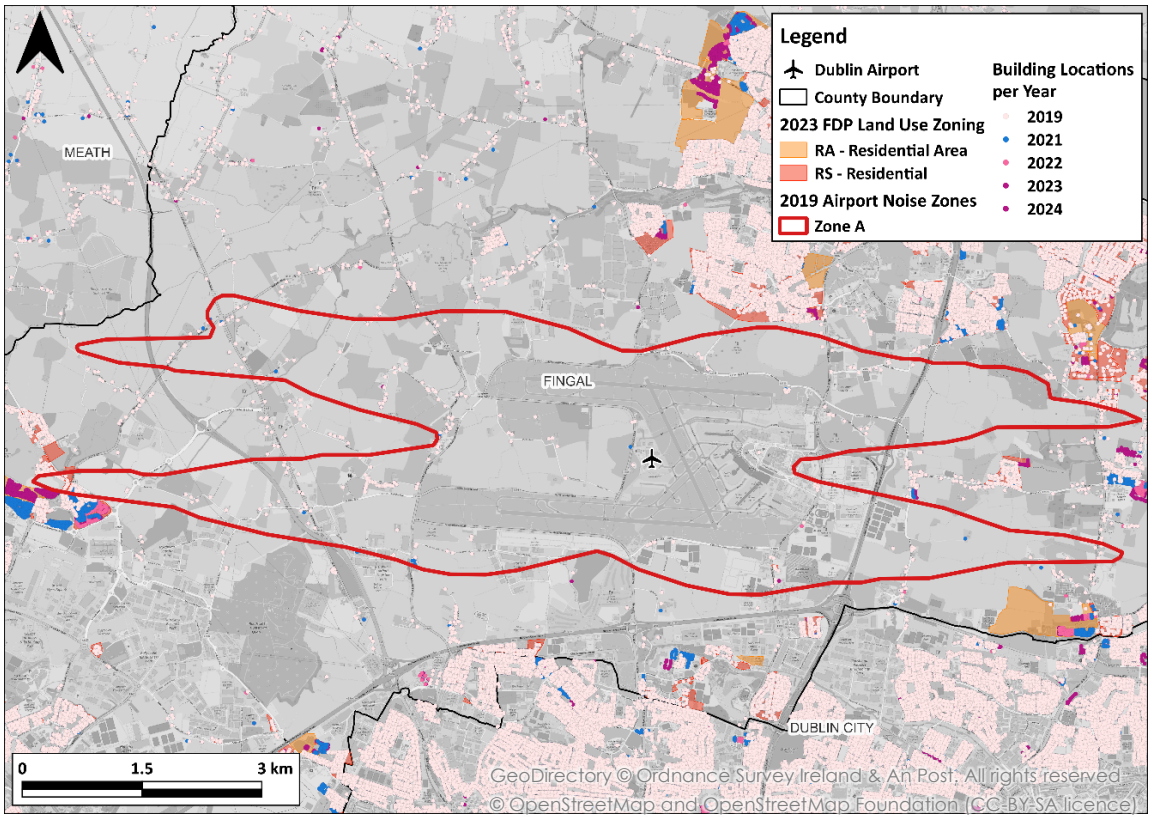


Figure B2-3: Comparison between residential developments in 2019 and the additional residential developments built up to 2024 within Zone A

A review on those 11 residential developments within Zone A that have been identified as 'new' from 2019, has been carried out also with the aid of satellite images from Google Earth and information from the FCC planning portal[36]. The following considerations have been drawn:

- All the 11 developments are found to be outside the Residential Area (RA) and Residential (RS) land assigned for residential developments in the 2023 FDP Land Use Zoning.
- From a review of the FCC planning portal, planning applications and consents for some the identified developments are dated before 2019 i.e since the adoption of the 2019 Airport Noise Zone.

[36] https://www.fingal.ie/view-or-search-planning-applications

- Despite being outside the RA and RS land use zoning, the new development might represent new housings for farming families which under the Objective DAO11 and DAO 12 of the Fingal Development Plan can be consented within Zone A as long they are outside the 69 dB $L_{Aeq,16hr}$ contours.

- A comparison between the 2019 GeoDirectory data and the datasets for the other years considered in the analysis shows that some of the development that would be identified as 'new' from 2021, are missing from the 2019 dataset but present in the dataset for previous and following years. These developments therefore should not be counted as 'new'. Satellite images confirm that this is in fact the case for some of the identified developments.



Figure B2-4: Satellite images of one of the identified 'new' developments within Zone A before, in and after 2019, and missing from the 2019 GeoDirectory data but present in previous and following year datasets

- Following 2021, population and number of dwellings within Zone A stayed stable.

Based on the above considerations, the 2019 Airport Noise Zoning has effectively prevented the construction of new residential developments within the Zone A and the encroachment of incompatible noise sensitive developments.

B3.1 Results and main findings of Test 2

The results of Test 2 presented in Section B1.2 suggest the increment in population exposure that was observed in 2023 may be due to different causes, depending on noise level thresholds and period of reference.

B3.1.1 NAO thresholds: 65 dB L_{den}

Marginal differences in population exposure have been found within each of the 65 dB L_{den} contours comparing population dataset of different years as shown in Figure B1-6.

The increment in the number of people exposed to 65 dB L_{den} observed in 2023 compared to 2019 is due to the different footprint and a small increment in the noise emissions from airport operations due to the introduction of operation from the North Runway since 2022.

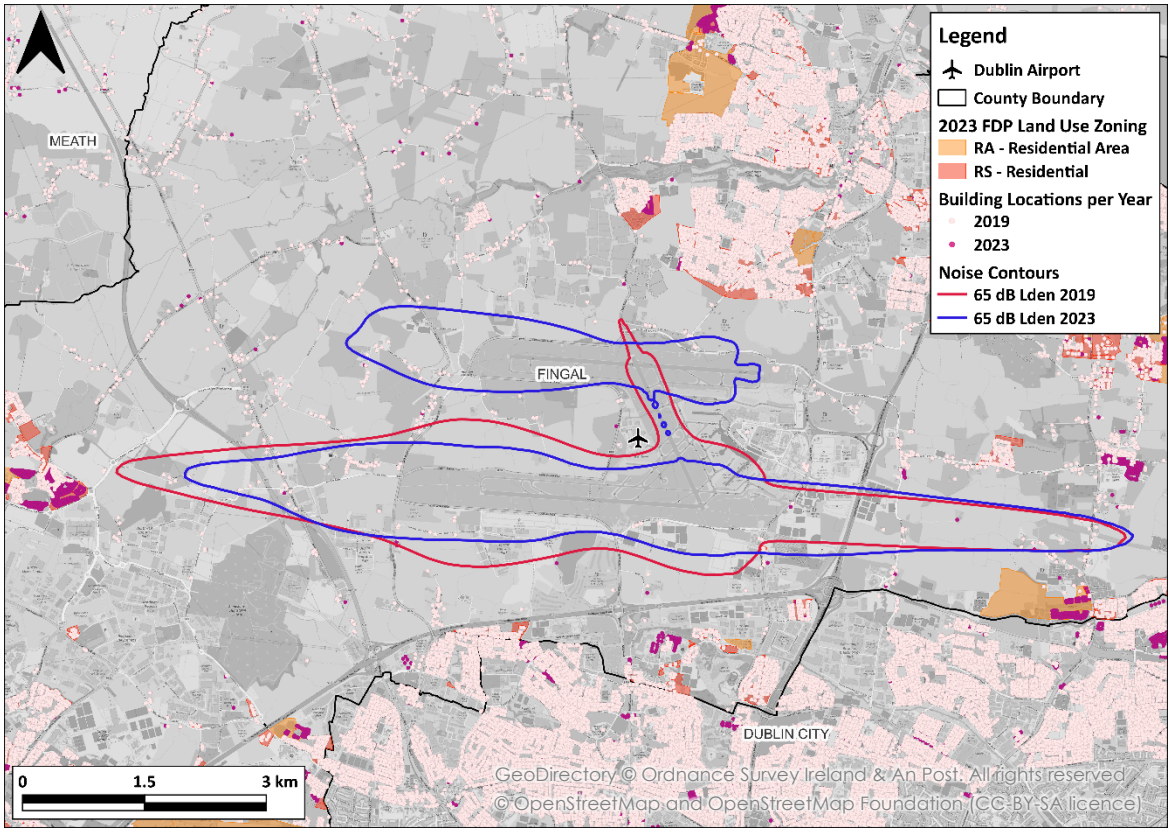


Figure B2-5: Comparison between residential developments in 2019 and 2023 within 2019 and 2023 65 dB L_{den} noise contours

B3.1.2 NAO thresholds: 55 dB L_{night}

The results against the 55 dB L_{night} contours (Figure B1-7) have shown a population exposure increment between 2019 and 2023, also when the comparison is carried out using population dataset from the same census years, even if there is no difference in the contour area extension.

This would suggest that the change in airport operations between 2019 and 2023 due to the opening of the new North runway in 2022, resulted in a different distribution of the noise footprint around Dublin Airport, which resulted in more people being exposed to the 55 dB L_{night} even if footprint areas result to be the same in the two years.

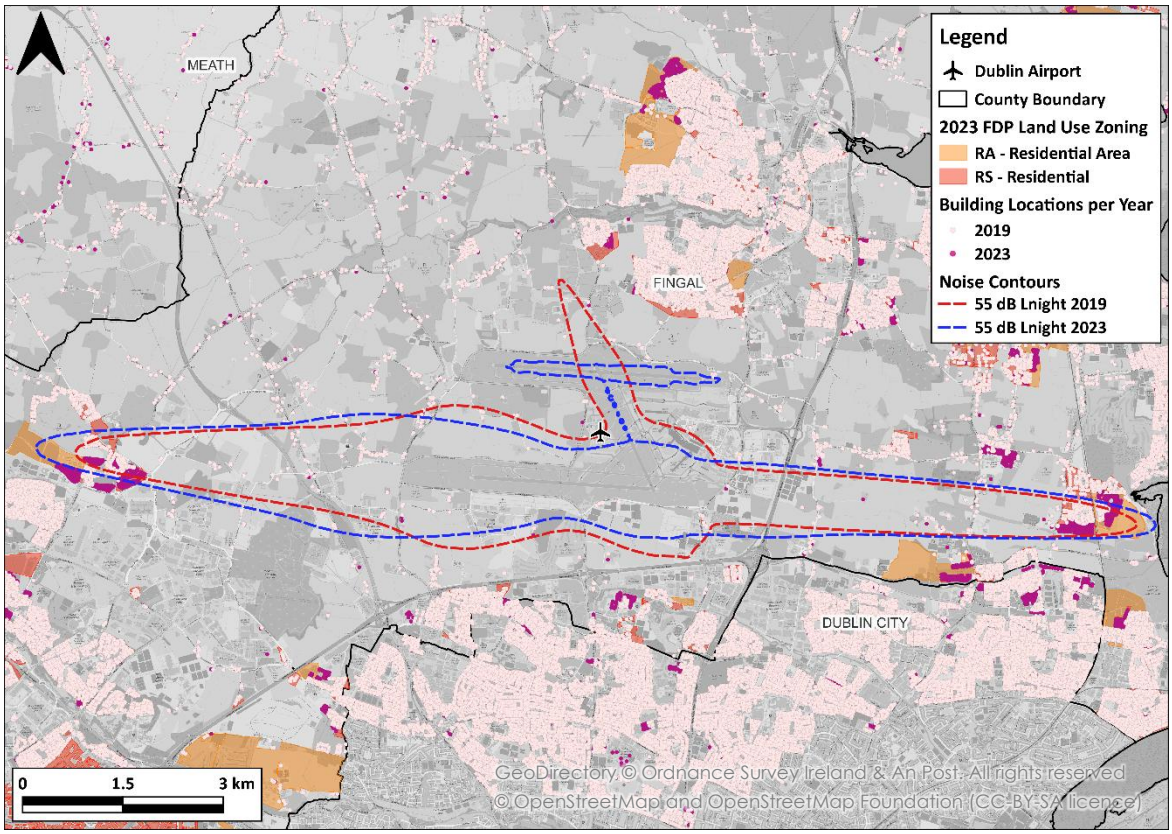


Figure B2-6: Comparison between residential developments in 2019 and 2023 within 2019 and 2023 55 dB L_{night} noise contours

However, an increment in the number of people within contours of the same assessment years is also observed. Whilst the introduction of the 2019 Airport Noise Zone has effectively prevented the construction of new residential developments within the Zone A, a growth in the number of developments is observed in the Zone B. The construction of new residential developments from 2019, which occurred within the areas designated for residential use by the FCC development Plan, has therefore contributed to the increment in the number of people exposed to 55 dB L_{night} contours observed in 2023.

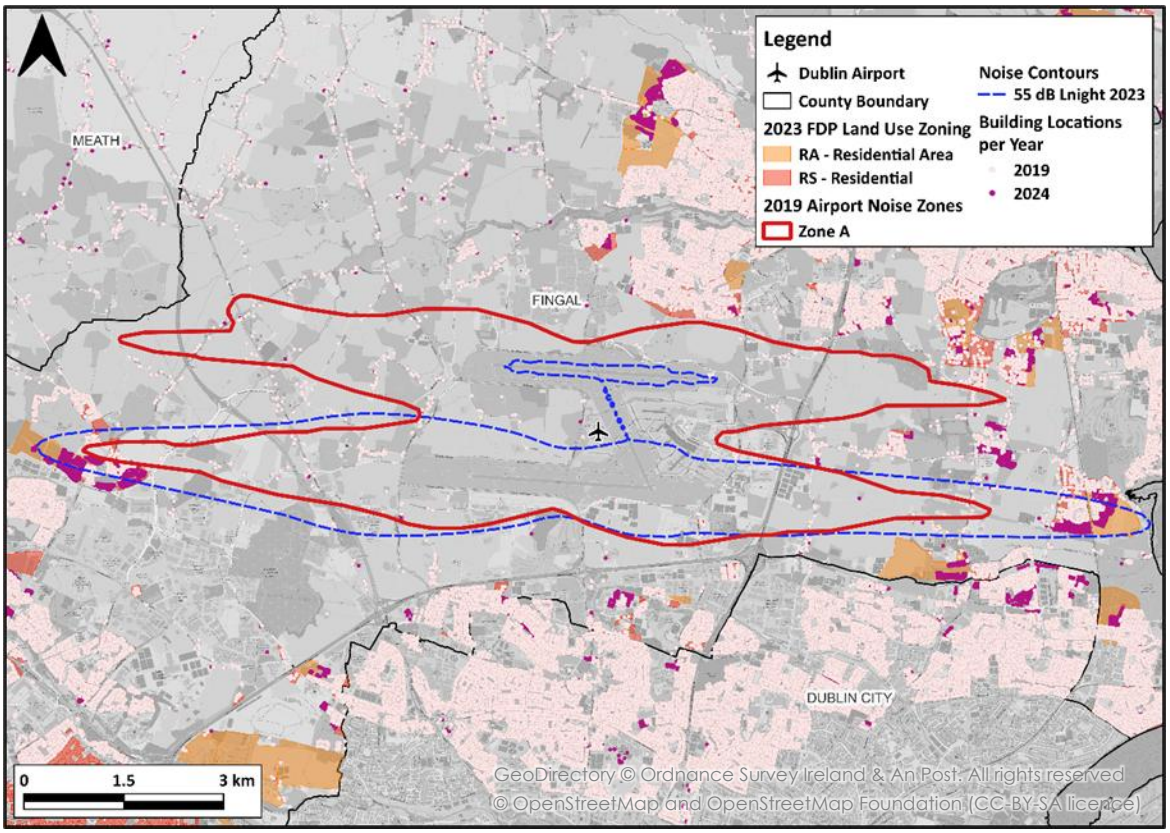


Figure B2-7: Comparison between residential developments in 2019 and the additional residential developments built up to 2024 within 2023 55 dB L_{night} noise contour

B3.1.3 WHO thresholds: 45 dB L_{den} and 40 dB L_{night}

The results against the 45 dB L_{den} and 40 dB L_{night} contours show no significant difference in population exposure using different census years. The increment in the number of people exposed observed in 2023 compared to 2021 and 2022 can be attributed to the increment in the noise emissions from airport operations, as in the previous years, airport operations were affected by the Covid-19 travel restrictions.

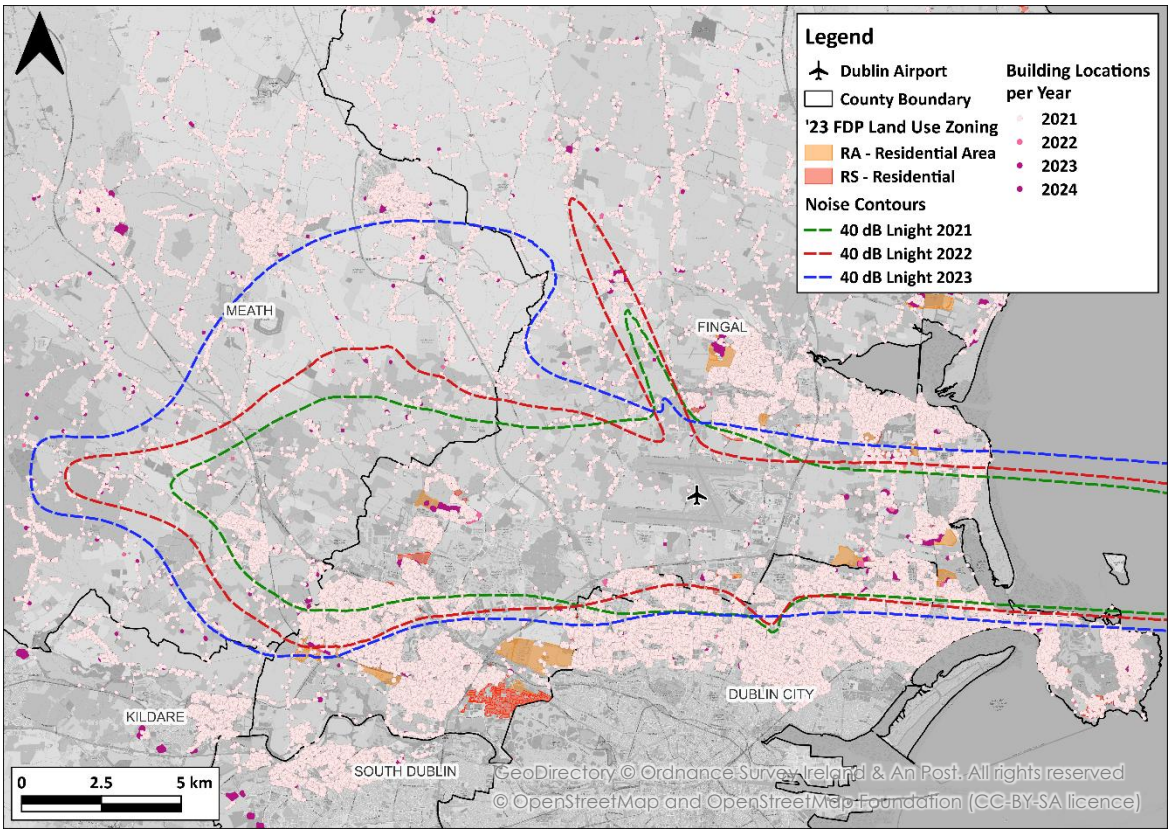


Figure B2-8: Comparison between residential developments in 2019 and the additional residential developments built up to 2024 within 2021, 2022 and 2023 40 dB L_{night} noise contours

However, by comparing population exposure using different census years against contours of the same assessment years, it can be observed an increment in the number of people which can be attributed to the growth in the number of residential developments that was observed within Zone B and Zone C (Section 0). This would suggest that the residential growth observed from 2019 is an additional factor that has contributed to the increment of the total number of people exposed to noise around Dublin Airport in 2023.

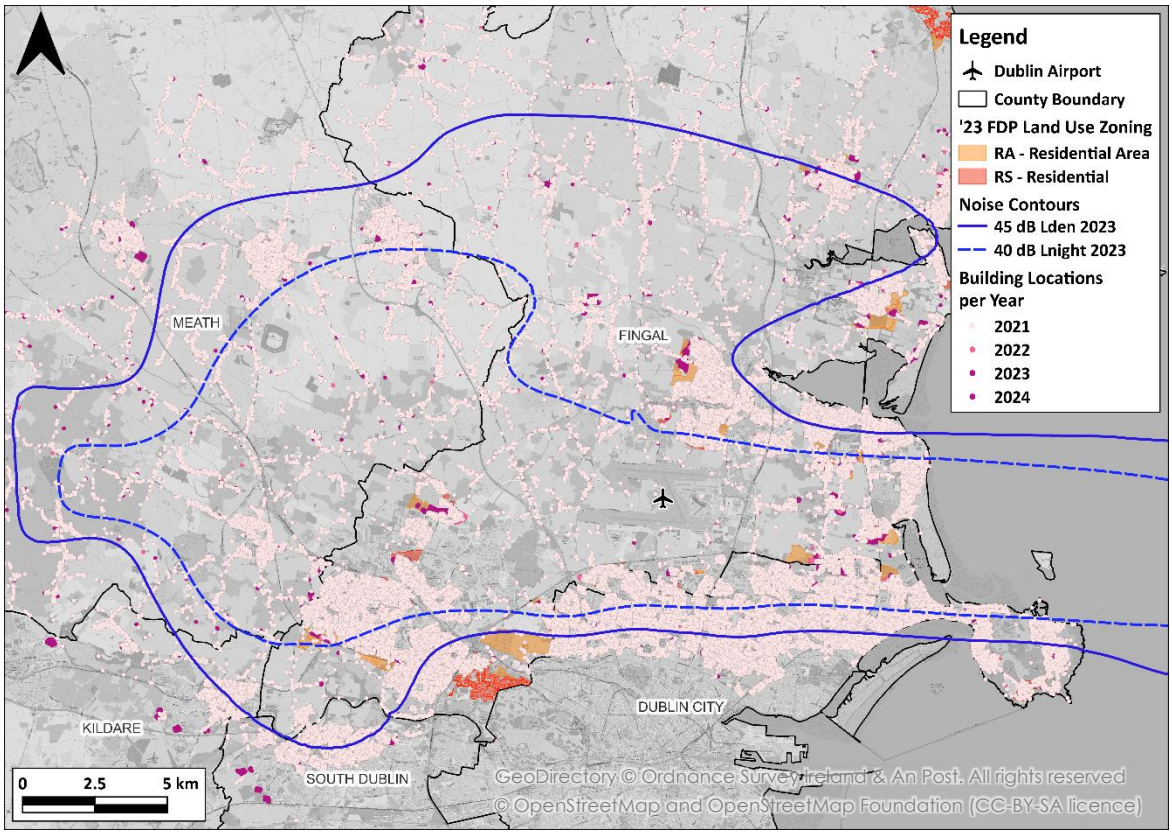


Figure B2-9: Comparison between residential developments in 2019 and the additional residential developments built up to 2024 within 2023 45 dB L_{den} and 40 dB L_{night} noise contours

Part C - Forward looking assessment of Population/Dwelling Growth

C1 Forward looking assessment of Population/Dwelling Growth

C1.1 Considering planned developments

The Fingal Development Plan allows for new residential developments in the areas designated for residential uses (RA and RS), subject to meeting the objectives of the airport noise zones, as highlighted previously in Section A1.2.

C1.1.1 Methodology

GeoDirectory data have been used to evaluate whether land designated to residential use has been fully built out. Estimates of future developments in these areas have been based on the average areas per building point of the developed areas near the adjacent areas not fully built out or yet to be developed:

Step 1: Estimating Buildings

- Using QGIS, not fully built areas were identified within the FDP land Zones assigned to Residential uses (RA – RS). These were the areas without GeoDirectory points for 2024;
- The developed areas near the not built ones were selected and their area (in m^2) calculated along with the average area per building;
- This average area has been applied to the area of the adjacent undeveloped areas, to estimate the number of new buildings.

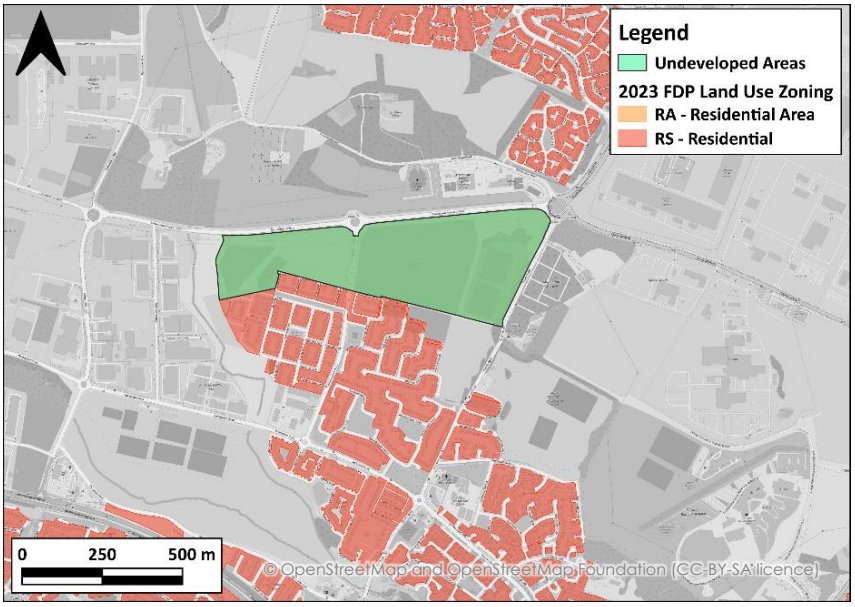


Figure C1-1: Representation of Undeveloped Land identified within FDP-designated residential areas

Step 2: Estimating Dwellings/People

- For each of estimated number of buildings per area, the total number of dwellings/people can be calculated in a similar way as before, i.e. by applying the average number of dwelling and people per point overlaying the developed areas to the adjacent undeveloped areas.

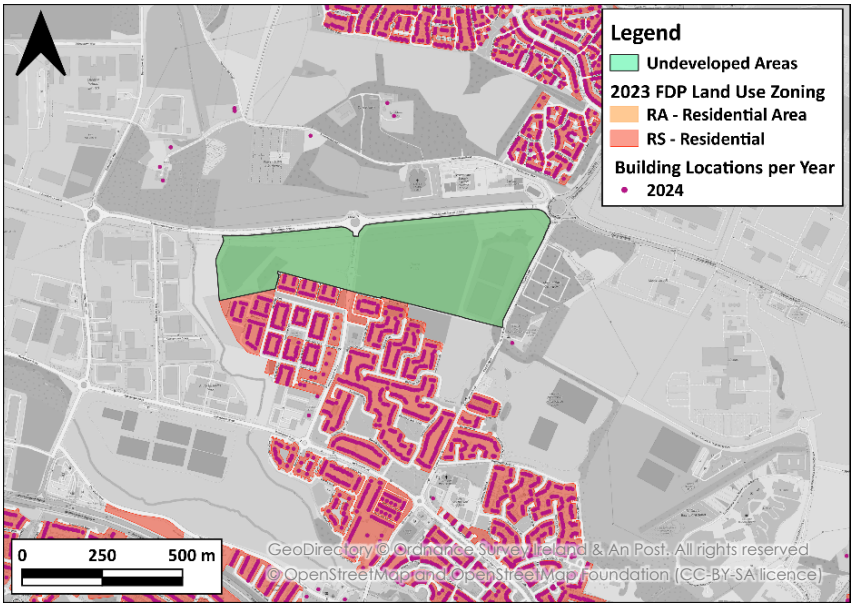


Figure C1-2: Representation of Undeveloped Land identified within FDP-designated residential areas with overlayed 2024 Residential Buildings points

Step 3 Generating the geometry

- The estimated total number of dwellings and people of the undeveloped areas was applied to each new building after generating building geometries using a random point generator. Population per building was then calculated by multiplying the estimated dwellings per building by the average number of people per household.

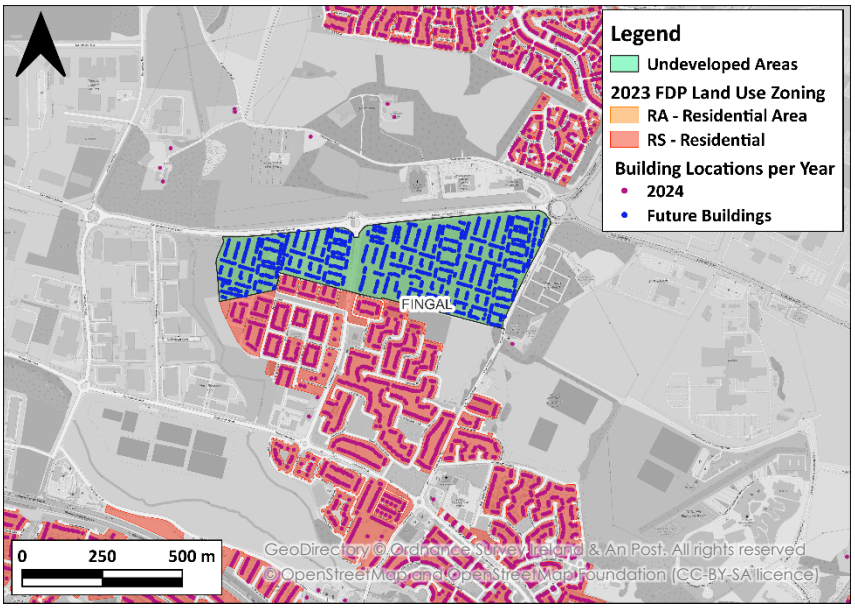


Figure C1-3: Representation of Undeveloped Land identified within FDP-designated residential areas with overlayed 2024 Residential Buildings points and Estimated Future Buildings

C1.2 Forward Looking Results of the Analysis

Test 1 and Test 2 were carried out to understand how the population and the number of dwellings have changed over time within the airport noise zones and contours. These tests have been repeated assuming all the areas designated for residential use were fully built out.

This 'forward looking' assessment is meant to provide an insight on whether the expected growth in these areas in the future years may conflict with the current acoustic zoning and/or the achievement of the Noise Abatement Objectives for Dublin Airport.

C1.2.1 Test 1: Population/Dwelling change within Airport Noise Zones

Test 1 assessment has been carried out against the 2019 Airport Noise Zones taking into consideration the estimated population expected in the future years if land use areas designated for residential developments were fully developed.

Figure C1-4 to Figure C1-5 report the results of Test 1 inclusive of the estimated future population against Zone A, Zone B and Zone C of the 2019 Airport Noise Zones, compared with the results of the analysis presented in the Part B of the document with the population dataset of the past years.

Table C1-1 presents the estimated forecasts in terms of number of dwellings that in future could be within the Zone A which, as per the definition of the ICAO guidelines, may be seen to represent an incompatible area for noise sensitive development. These are compared with the number of dwellings that have been constructed since 2019 up to 2024 within the Zone A.

Full results of the Test 1 analysis against the 2019 Airport Noise zoning with forecast results are reported in Table Appx-9 of Appendix 2.

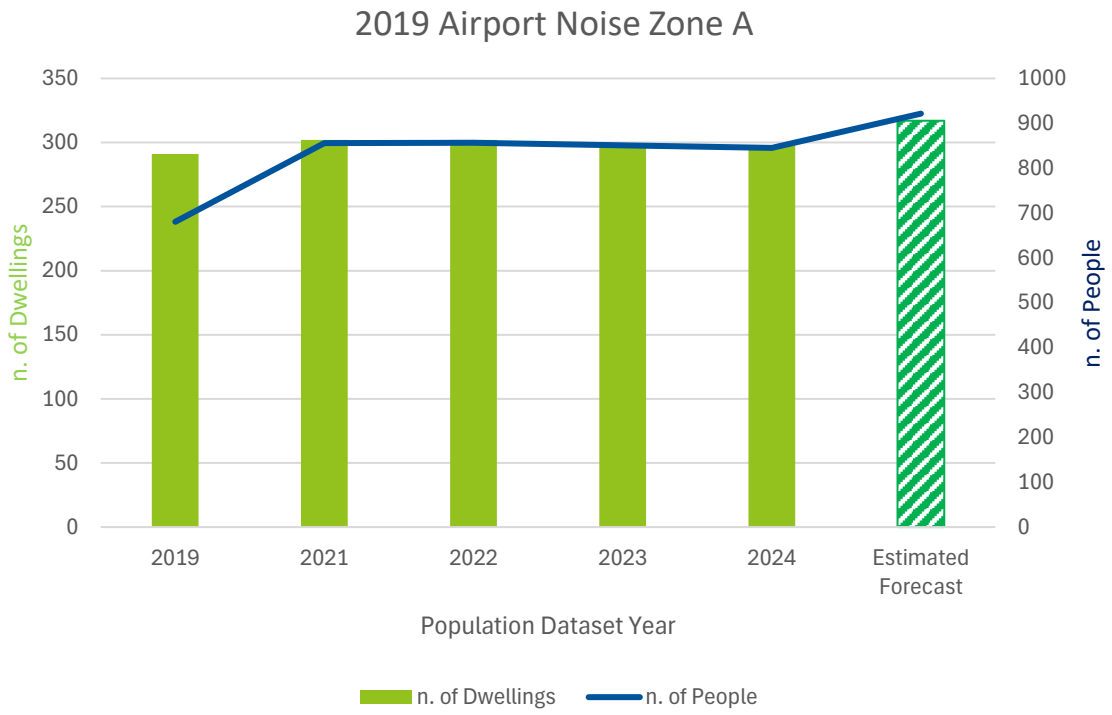


Figure C1-4: Number of dwellings and population within the 2019 Airport Noise Zone – A considering population data from 2019 onwards including Forecast

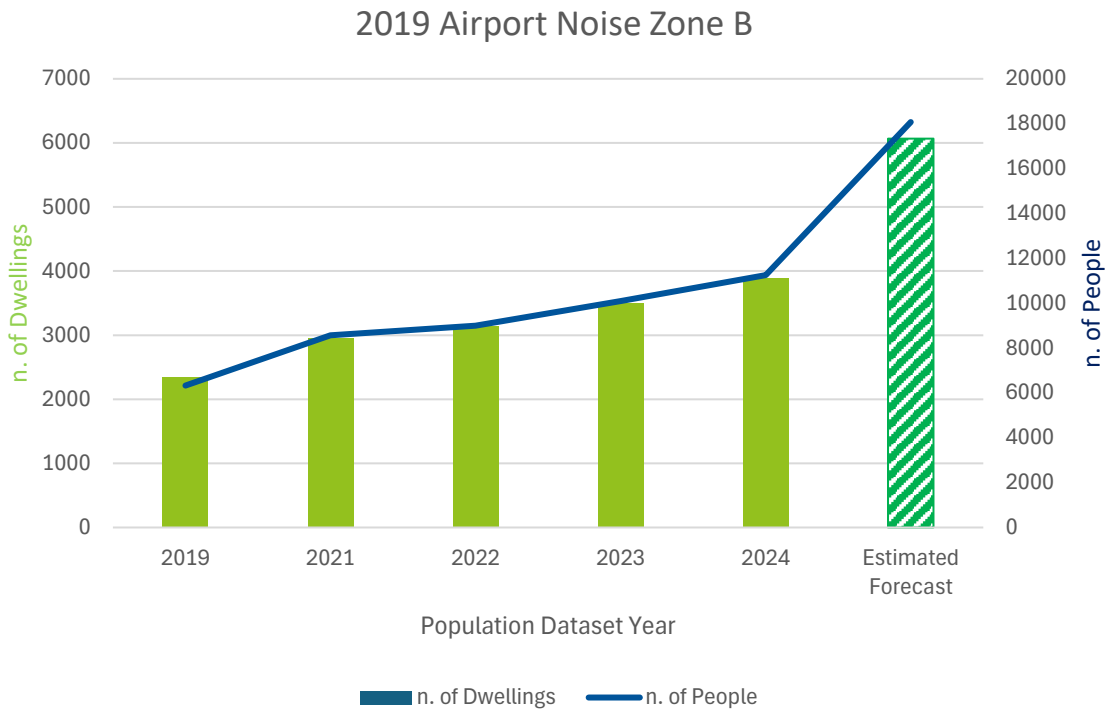


Figure C1-5: Number of dwellings and population within the 2019 Airport Noise Zone – B considering population data from 2019 onwards including Forecast

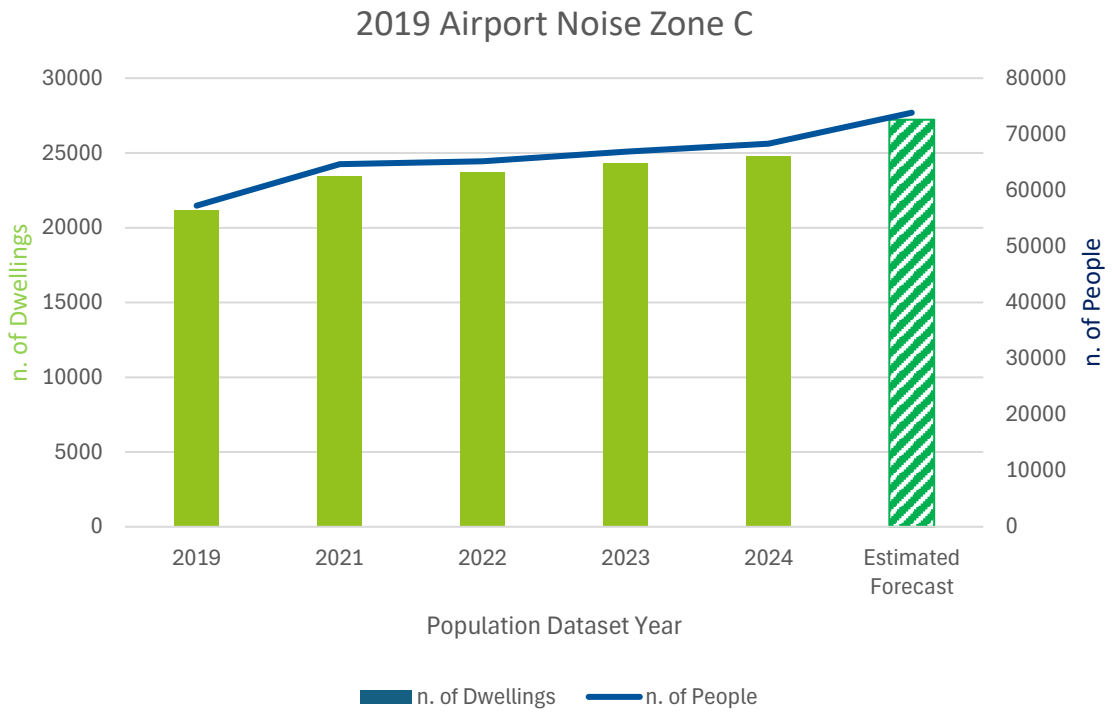


Figure C1-6: Number of dwellings and population within the 2019 Airport Noise Zone – C considering population data from 2019 onwards including Forecast

Table C1-1: Number of new dwellings within the 2019 Airport Noise Zone – A per each period since 2019

Number of new dwellings in Zone A per each period since 2019				
2019 - 2021	**2021 - 2022**	**2022 - 2023**	**2023 - 2024**	**Estimated Forecast**
+ 11	0	0 [33]	0 [34]	+ 19

C1.2.2 Test 2: Population/Dwelling change within airport noise contours

Test 2 assessment has been carried out taking into consideration the estimated population forecast if land use areas designated for residential developments were fully developed. Figure C1-7 to Figure C1-10 report the results of Test 2 inclusive of the estimated future population compared with the results of the analysis presented in the Part B of the document for the following noise thresholds:

- The NAO thresholds: 65 dB L_{den} and 55 dB L_{night};
- The WHO thresholds: 45 dB L_{den} and 40 dB L_{night}; and
- 69 dB $L_{Aeq,16hr}$.

Full results of the Test 2 analysis with forecast results are reported in Appendix 2.

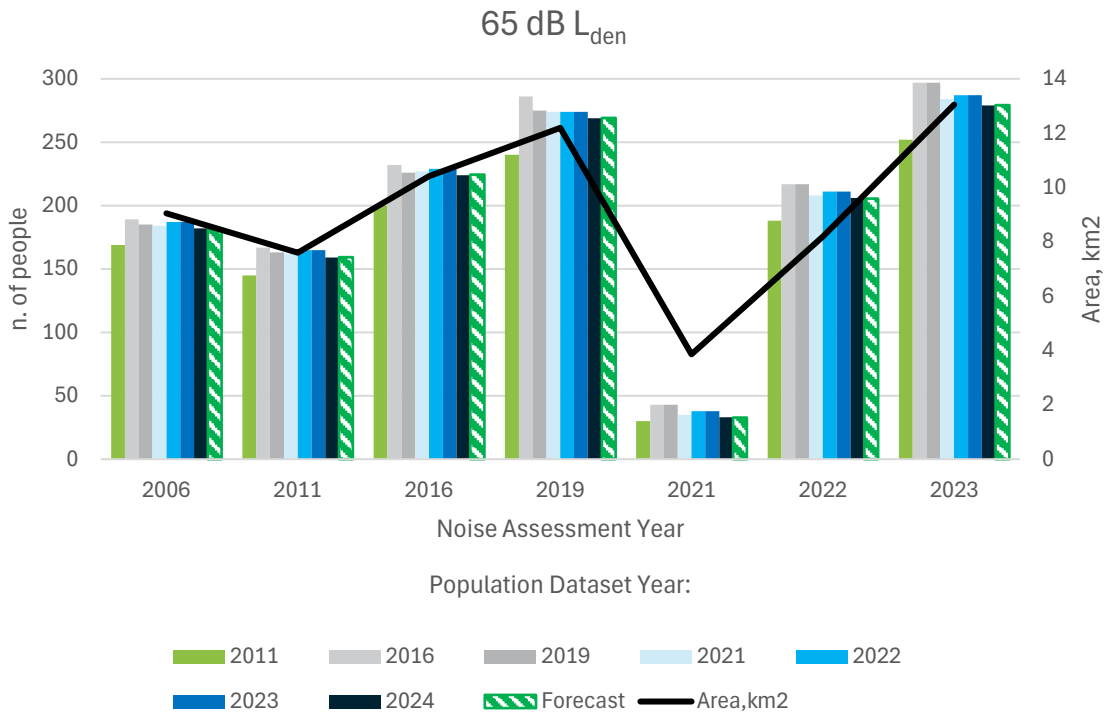


Figure C1-7: Population within 65 dB L_{den} contours from different assessment years using data from different population dataset years including forecast

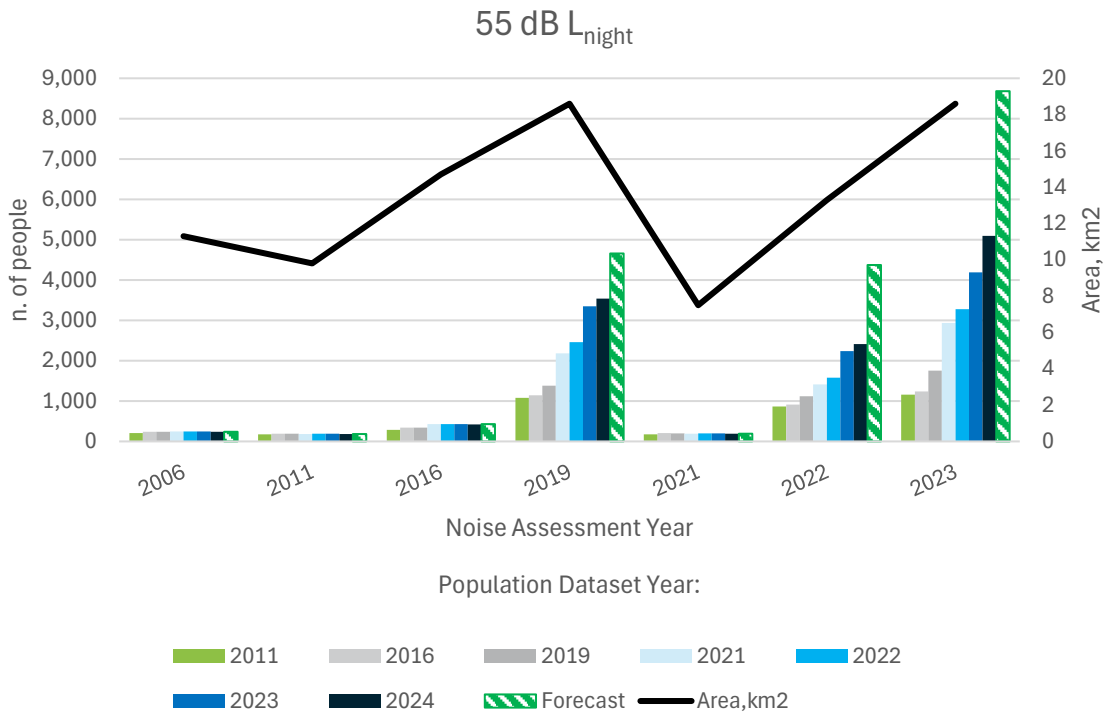


Figure C1-8: Population within 55 dB L_{night} contours from different assessment years using data from different population dataset years including forecast

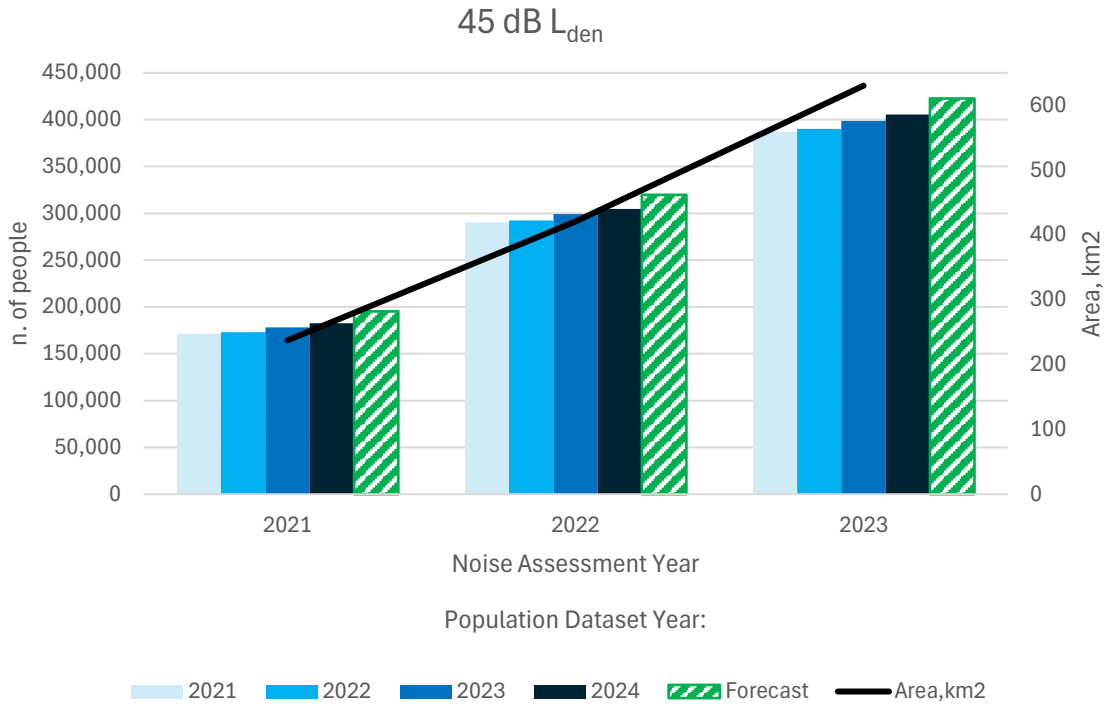


Figure C1-9: Population within 45 dB L_{den} contours from different assessment years using data from different population dataset years including forecast

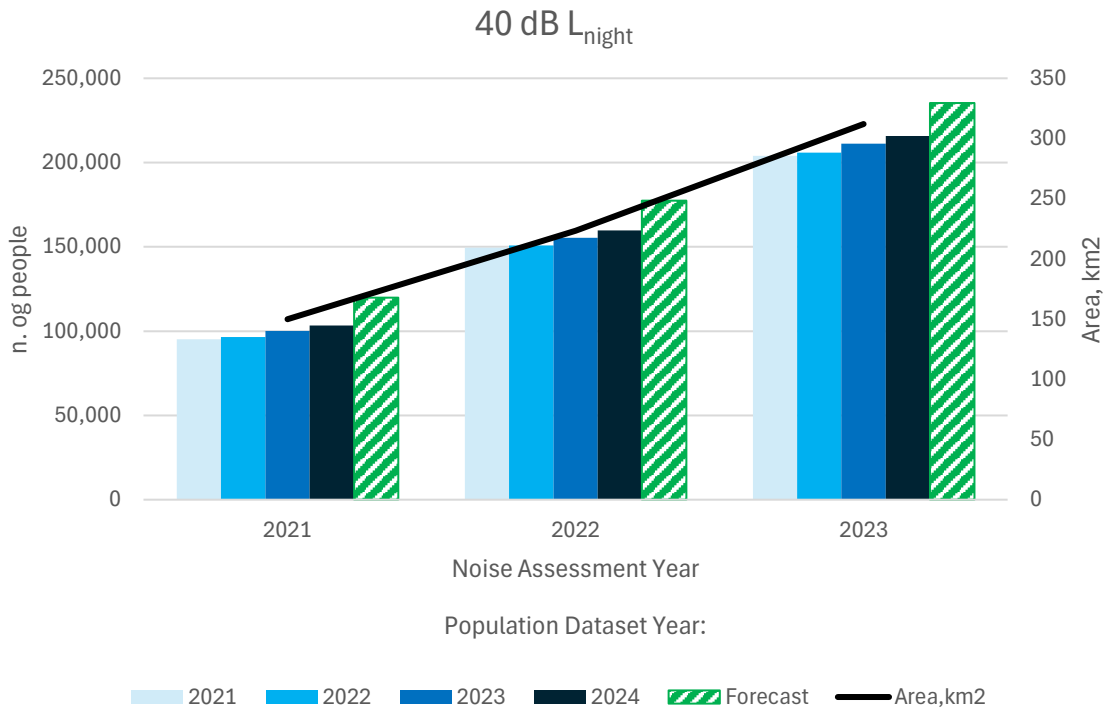


Figure C1-10: Population within 40 dB L_{night} contours from different assessment years using data from different population dataset years including forecast

C1.3 Forward Looking Analysis and Findings

The results of the Test 1 analysis against the 2019 Airport Noise Zones estimate a growth in population and number of dwellings within Zone A for the future years, which would result in the encroachment of 21 dwellings within an incompatible area for noise sensitive development as per the definition given within the ICAO guidelines.

A review of the planning applications on the FCC portal for the area identified in Figure C1-11, indicates that a planning consent has been granted in 2022 for the development of new residential dwellings. A review of the satellite images of that area show that the area is currently under construction. It should be noted that this development which consists of 52 no. residential units was refused planning permission by Fingal County Council. However, this decision was overturned on appeal and was granted planning permission by An Coimisiún Pleanála (Planning Authority Case Reference: FW21A/0003, An Coimisiún Pleanála - Case reference: PL06F.309833).

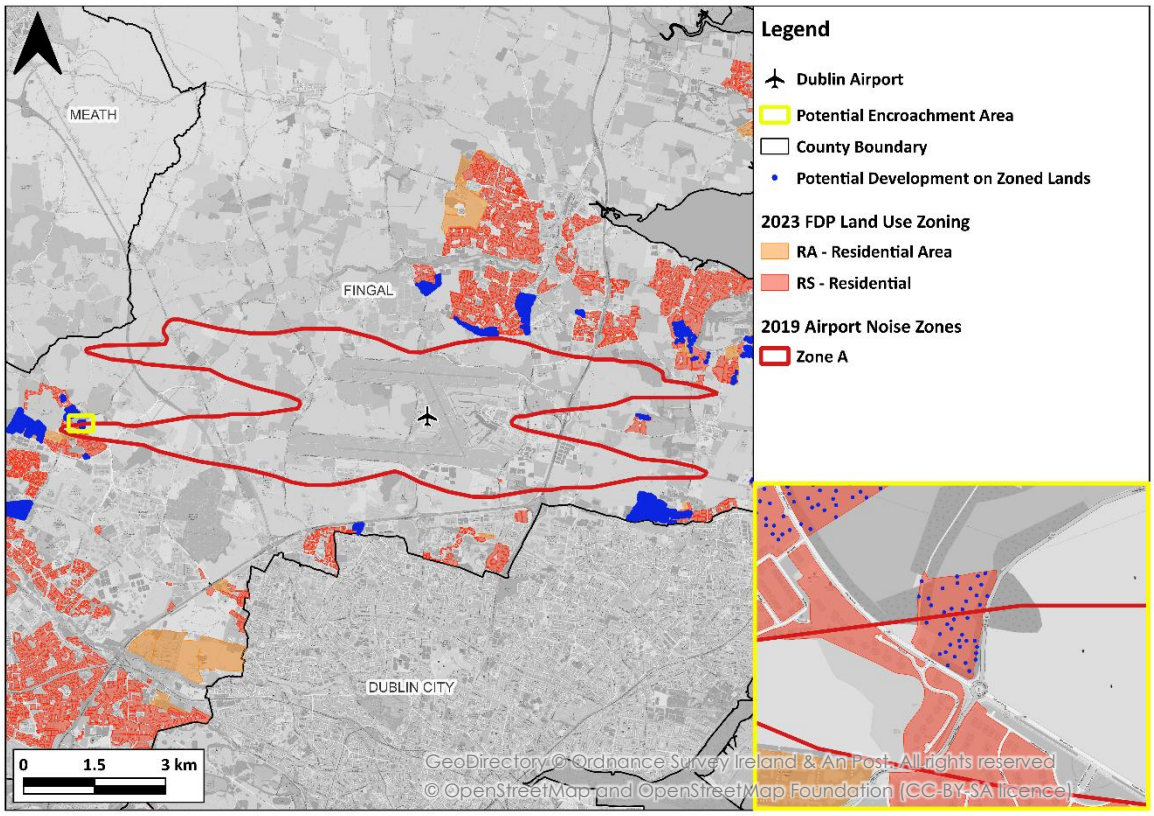


Figure C1-11: Estimated Encroachment Buildings within 2019 Airport Noise Zone - A

Growth in population and number of dwellings is forecast within Zone B (Figure C1-5), which according to the ICAO guidelines, may be seen to represent a compatible area for noise sensitive development provided that consented developments are subject to appropriate noise insulation.

Growth in population and number of dwellings is also estimated within Zone C (Figure C1-6) within which noise may cause annoyance and/or disturbance and may be seen to represent a compatible area for uninsulated or insulated noise sensitive developments, as appropriate, as per the ICAO guidelines.

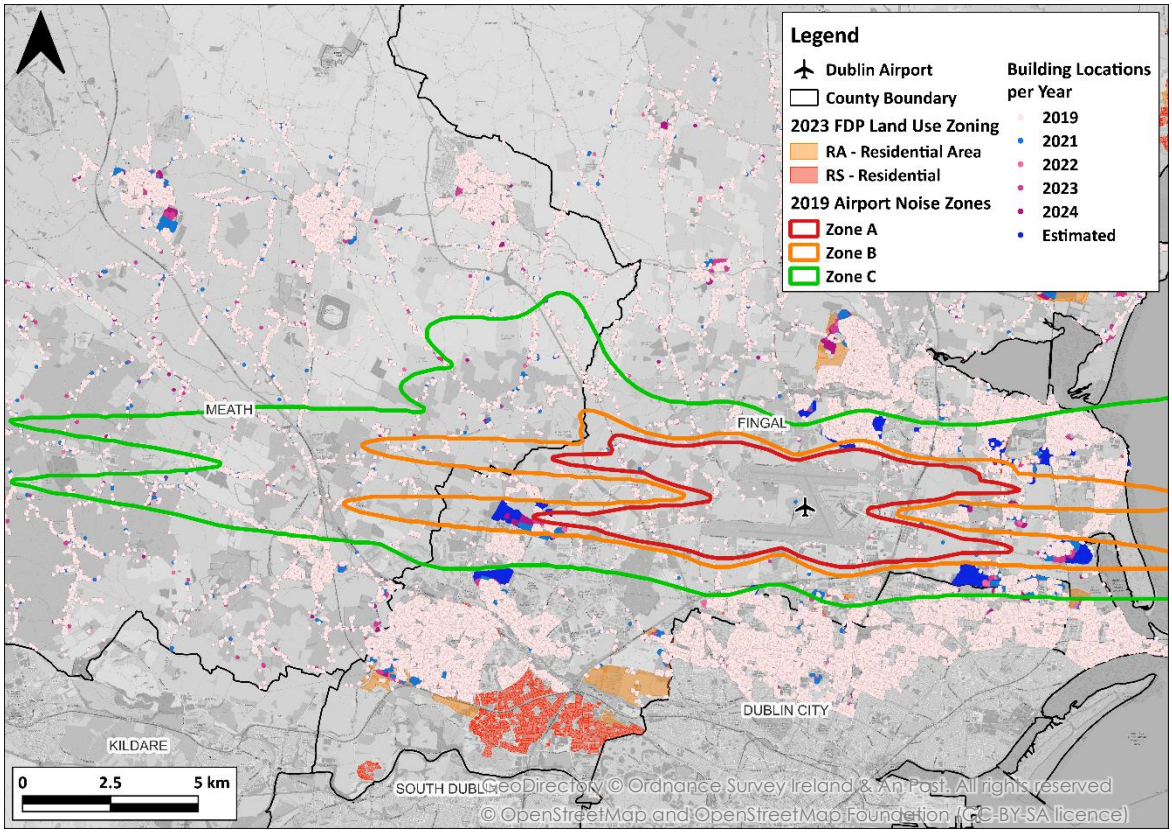


Figure C1-12: Comparison between residential developments in 2019 and additional residential developments built up to 2024 including forecast within 2019 Airport Noise Zones

Summary and Conclusions

An analysis has been carried out to quantify the growth of residential development over time at Dublin Airport through two tests.

- **Test 1:** Population/Dwellings changes within Airport Noise Zones;
- **Test 2:** Population/Dwellings and noise contour changes over time.

Test 1 describes how population and the number of dwellings has changed over time against the Airport Noise Zones and their objectives. In particular, the population/dwellings changes within the Inner Zone and Zone A indicates if development growth has occurred within the incompatible areas defined by the planning authority, resulting therefore in land-use encroachment of incompatible noise sensitive development around the airport, as defined in ICAO guidance.

Test 2 provides an indication whether development growth has occurred over time within the 55 dB L_{night} and the 65 dB L_{den} contours which are used to measure the achievement of Dublin Airports Noise Abatement Objectives. Development growth within the 69 dB $L_{Aeq,16hrs}$ contour, within which no dwellings shall be consented, would also indicate that encroachment has occurred.

The results of Test 1 indicate that the main growth in residential developments has occurred within Zones B and C of the 2019 Airport Noise Zones, whilst Zone A effectively prevented the constructions of new developments and land-use encroachment of incompatible noise sensitive development.

The results of Test 2 suggest the increment in population exposure that was observed in 2023 may be due to an increment or a different distribution of the noise footprint around Dublin Airport.

However, an increment in the number of people which can be attributed to the growth in the number of residential developments is observed within Zone B and Zone C. This would suggest that the residential growth observed from 2019 is an additional factor that has contributed to the increment of the total number of people exposed to noise around Dublin Airport in 2023.

In particular, while the introduction of the 2019 Airport Noize Zone has effectively prevented the constructions of new residential developments with Zone A, growth in the number of developments is observed in Zone B within the areas designated for residential use by the FCC development Plan, which has contributed to the increment in the number of people exposed to levels above the 55 dB L_{night}.

Appendices

Appendix 1

Results of the analysis on Population/Dwelling Growth Over Time and Encroachment at Dublin Airport

Table Appx-1: Population (POP) / Dwellings (DW) vs 2005 Airport Noise Zones

2005 Airport Noise Zone	Results	Census Data								
		2005 (Baseline)	2006	2011	2016	2019	2021	2022	2023	2024
Inner Noise Zone	n. of Dwellings	809	1,135	1,258	1,267	1,301	1,305	1,314	1,318	1,344
	n. of Occupied Dwellings	791	1,110	1,232	1,250	1,279	1,291	1,300	1,305	1,303
	n. of People	2,250	3,104	3,198	3,489	3,562	3,677	3,696	3,712	3,707
Outer Noise Zones	n. of Dwellings	7,988	9,065	13,135	13,502	14,478	15,721	15,992	16,815	17,303
	n. of Occupied Dwellings	7,962	9,020	13,027	13,374	14,282	15,629	15,936	16,752	17,171
	n. of People	22,334	25,020	32,824	36,396	39,090	43,950	44,689	47,078	48,448

Table Appx-2: Population (POP) / Dwellings (DW) vs 2019 Airport Noise Zones

2019 Airport Noise Zone	Results	Census Data								
		2005	2006	2011	2016	2019 (Baseline)	2021	2022	2023	2024
Zone A	n. of Dwellings	258	267	254	258	291	302	302	299	298
	n. of Occupied Dwellings	246	250	237	247	252	294	294	291	289
	n. of People	725	743	579	665	680	856	857	851	846
Zone B	n. of Dwellings	1,421	1,620	1,927	1,967	2,352	2,954	3,137	3,500	3,887
	n. of Occupied Dwellings	1,418	1,614	1,912	1,958	2,272	2,925	3,112	3,477	3,826
	n. of People	4,057	4,614	5,248	5,512	6,326	8,563	8,994	10,089	11,251
Zone C	n. of Dwellings	11,926	13,125	19,003	19,861	21,141	23,459	23,673	24,288	24,783
	n. of Occupied Dwellings	11,911	13,092	18,823	19,706	21,002	23,297	23,565	24,155	24,675
	n. of People	32,492	35,480	47,317	53,563	57,262	64,646	65,193	66,868	68,331

Table Appx-3: Population (POP) / Dwellings (DW) vs Noise change over time – 55 dB L_{den} metrics

Noise Contour	55 dB L_{den}	Census Data							
Year - Area (km²)	Results	2006	2011	2016	2019	2021	2022	2023	2024
2006 57.5 km²	n. of Dwellings	4,731	6,632	6,762	7,189	8,057	8,285	8,672	9,038
	n. of Occupied Dwellings	4,710	6,536	6,690	7,082	8,010	8,257	8,644	9,010
	n. of People	12,988	17,276	18,974	20,004	23,648	24,214	25,366	26,574
2011 48.2 km²	n. of Dwellings	3,187	4,390	4,508	4,917	5,635	5,820	6,196	6,552
	n. of Occupied Dwellings	3,166	4,332	4,439	4,810	5,595	5,797	6,173	6,529
	n. of People	8,565	11,373	12,369	13,366	16,675	17,134	18,255	19,434
2016 66.9 km²	n. of Dwellings	4,284	6,706	6,920	7,613	9,411	9,673	10,161	10,529
	n. of Occupied Dwellings	4,263	6,608	6,836	7,497	9,356	9,634	10,094	10,499
	n. of People	11,790	17,071	19,344	21,055	26,848	27,476	28,879	30,147
2019 88.2 - km²	n. of Dwellings	5,213	9,917	10,418	11,483	13,992	14,453	15,267	15,661
	n. of Occupied Dwellings	5,186	9,789	10,316	11,298	13,843	14,384	15,196	15,602
	n. of People	14,582	23,495	27,756	30,167	38,774	39,749	42,066	43,337
2021 38.8 km²	n. of Dwellings	1,998	3,113	3,205	3,637	4,382	4,566	4,934	5,279
	n. of Occupied Dwellings	1,990	3,056	3,143	3,536	4,349	4,551	4,918	5,262
	n. of People	5,826	8,278	9,254	10,282	13,417	13,875	14,969	16,115
2022 70.2 km²	n. of Dwellings	3,247	5,296	5,613	6,522	8,506	8,838	9,323	9,715
	n. of Occupied Dwellings	3,235	5,191	5,521	6,413	8,377	8,778	9,259	9,664
	n. of People	9,427	13,734	16,109	18,336	24,498	25,320	26,746	28,014
2023 105.0 km²	n. of Dwellings	4,578	7,580	8,165	9,180	11,484	11,802	12,479	13,218
	n. of Occupied Dwellings	4,546	7,422	8,054	9,061	11,345	11,732	12,402	13,143
	n. of People	13,157	18,818	22,260	24,948	32,503	33,283	35,188	37,393

Table Appx-4: Population (POP) / Dwellings (DW) vs Noise change over time – 50 dB L_{night} metrics

Noise Contour Year - Area (km^2)	50 dB L_{night} Results	Census Data							
		2006	2011	2016	2019	2021	2022	2023	2024
2006 28.3 km^2	n. of Dwellings	375	562	577	950	1,554	1,736	2,078	2,409
	n. of Occupied Dwellings	361	544	561	851	1,542	1,724	2,064	2,394
	n. of People	1,134	1,584	1,758	2,483	4,865	5,273	6,283	7,389
2011 24.4 km^2	n. of Dwellings	297	445	444	730	979	1,123	1,376	1,623
	n. of Occupied Dwellings	284	428	430	632	972	1,116	1,370	1,615
	n. of People	900	1,264	1,348	1,842	2,964	3,315	4,088	4,918
2016 38.7 km^2	n. of Dwellings	1,458	2,204	2,225	2,661	3373	3,557	3,914	4,245
	n. of Occupied Dwellings	1,441	2,171	2,166	2,559	3336	3,537	3,893	4,223
	n. of People	4,143	5,805	6,251	7,265	10,108	10,565	11,627	12,734
2019 52.3 km^2	n. of Dwellings	2,443	3,950	4,089	4,532	5,389	5,578	5,965	6,328
	n. of Occupied Dwellings	2,424	3,862	4,020	4,426	5,348	5,556	5,943	6,306
	n. of People	6,788	10,126	11,479	12,538	15,996	16,467	17,618	18,817
2021 23.8 km^2	n. of Dwellings	467	679	712	1,078	1,784	1,966	2,320	2,652
	n. of Occupied Dwellings	461	669	704	985	1,771	1,964	2,316	2,647
	n. of People	1,374	1,762	1,974	2,677	5,294	5,730	6,780	7,889
2022 39.3 km^2	n. of Dwellings	1,772	2,830	2,931	3,371	4,440	4,637	5,100	5,466
	n. of Occupied Dwellings	1,763	2,749	2,867	3,270	4,405	4,621	5,083	5,449
	n. of People	5,062	7,391	8,354	9,404	13,050	13,540	14,796	16,004
2023 55.9 km^2	n. of Dwellings	2,683	4,421	4,569	5,071	6,524	6,773	7,253	7,619
	n. of Occupied Dwellings	2,668	4,327	4,497	4,967	6,480	6,742	7,191	7,594
	n. of People	7,800	11,537	13,384	14,589	19,034	19,625	20,999	22,262

Table Appx-5: Population (POP) / Dwellings (DW) vs Noise change over time – 65 dB L_{den} metrics

Noise Contour Year - Area (km^2)	65 dB L_{den} Results	Census Data 2006	2011	2016	2019	2021	2022	2023	2024
2006 9.1 km^2	n. of Dwellings	81	78	75	73	75	76	76	75
	n. of Occupied Dwellings	79	73	74	73	75	76	76	74
	n. of People	244	169	189	185	184	187	187	182
2011 7.6 km^2	n. of Dwellings	71	68	67	65	67	68	68	67
	n. of Occupied Dwellings	69	63	66	65	67	68	68	66
	n. of People	214	145	167	163	162	165	165	159
2016 10.42 km^2	n. of Dwellings	95	90	90	87	89	90	90	89
	n. of Occupied Dwellings	91	85	89	87	89	90	90	88
	n. of People	283	200	232	226	227	229	229	224
2019 12.2 km^2	n. of Dwellings	112	106	111	104	108	108	108	107
	n. of Occupied Dwellings	108	101	109	104	108	108	108	106
	n. of People	339	240	286	275	274	274	274	269
2021 3.7 km^2	n. of Dwellings	15	15	15	14	14	15	15	14
	n. of Occupied Dwellings	15	13	14	14	14	15	15	13
	n. of People	40	30	43	43	35	38	38	33
2022 8.2 km^2	n. of Dwellings	84	81	82	81	83	84	84	83
	n. of Occupied Dwellings	84	79	81	81	83	84	84	82
	n. of People	263	188	217	217	208	211	211	206
2023 13.1 km^2	n. of Dwellings	112	108	111	110	113	114	114	112
	n. of Occupied Dwellings	109	104	110	110	113	114	114	111
	n. of People	339	252	297	297	284	287	287	279

Table Appx-6: Population (POP) / Dwellings (DW) vs Noise change over time – 55 dB L_{night} metrics

Noise Contour Year - Area (km²)	55 dB L_{night} Results	Census Data 2006	2011	2016	2019	2021	2022	2023	2024
2006 11.3 km²	n. of Dwellings	98	92	95	94	100	99	99	98
	n. of Occupied Dwellings	94	87	93	94	100	99	99	97
	n. of People	291	203	236	237	248	246	246	241
2011 9.8 km²	n. of Dwellings	83	79	76	74	76	77	77	76
	n. of Occupied Dwellings	80	74	75	74	76	77	77	75
	n. of People	249	173	190	187	186	189	189	184
2016 14.7 km²	n. of Dwellings	130	125	130	155	156	156	156	155
	n. of Occupied Dwellings	125	120	127	129	156	156	156	153
	n. of People	392	290	340	345	426	427	427	419
2019 18.6 km²	n. of Dwellings	233	364	366	555	706	815	1,119	1,185
	n. of Occupied Dwellings	228	359	363	468	706	815	1,119	1,183
	n. of People	737	1,076	1,140	1,385	2,184	2,459	3,352	3,538
2021 7.5 km²	n. of Dwellings	80	77	78	75	77	78	78	77
	n. of Occupied Dwellings	80	75	77	75	77	78	78	76
	n. of People	250	177	203	196	192	195	195	190
2022 13.3 km²	n. of Dwellings	194	285	289	381	482	544	790	853
	n. of Occupied Dwellings	190	280	287	381	482	544	790	851
	n. of People	621	866	916	1,117	1,412	1,580	2,240	2,414
2023 18.6 km²	n. of Dwellings	242	393	399	696	958	1,091	1,404	1,675
	n. of Occupied Dwellings	237	384	390	603	956	1,089	1,402	1,671
	n. of People	771	1,157	1,236	1,753	2,939	3,274	4,191	5,097

Table Appx-7: Population (POP) / Dwellings (DW) vs Noise change over time – 45 dB L_{den} metrics

Noise Contour	45 dB L_{den}	Census Data			
Year - Area (km^2)	Results	2021	2022	2023	2024
2021 237.4 km^2	n. of Dwellings	59,736	60,645	62,570	64,236
	n. of Occupied Dwellings	59,509	60,513	62,421	64,044
	n. of People	171,468	173,160	178,277	182,627
2022 420.9 km^2	n. of Dwellings	104,241	105,379	107,947	109,894
	n. of Occupied Dwellings	103,907	105,140	107,653	109,557
	n. of People	290,265	292,507	299,346	304,655
2023 630.2 km^2	n. of Dwellings	140,201	141,681	144,868	147,252
	n. of Occupied Dwellings	139,692	141,263	144,295	146,762
	n. of People	387,192	390,117	398,517	405,627

Table Appx-8: Population (POP) / Dwellings (DW) vs Noise change over time – 40 dB L_{night} metrics

Noise Contour	40 dB L_{night}	Census Data			
Year - Area (km²)	Results	2021	2022	2023	2024
2021 149.9 km²	n. of Dwellings	33,053	33,805	35,124	36,260
	n. of Occupied Dwellings	32,880	33,708	35,018	36,115
	n. of People	95,162	96,555	100,090	103,301
2022 223.4 km²	n. of Dwellings	52,024	52,791	54,433	56,081
	n. of Occupied Dwellings	51,813	52,654	54,285	55,885
	n. of People	149,433	150,867	155,410	159,693
2023 312.0 km²	n. of Dwellings	72,452	73,541	75,494	77,230
	n. of Occupied Dwellings	72,203	73,352	75,269	76,956
	n. of People	203,964	205,969	211,135	215,700

Appendix 2

Results of the 'Forward Looking' analysis on Population/Dwelling Growth Over Time and Encroachment at Dublin Airport

Table Appx-9: Population (POP) / Dwellings (DW) vs 2019 Airport Noise Zones with Forecast

2019 Airport Noise Zone	Results	Census Data									
		2005	2006	2011	2016	2019 Baseline	2021	2022	2023	2024	Estimated Forecast
Zone A	n. of Dwellings	258	267	254	258	291	302	302	299	298	317
	n. of People	725	743	579	665	680	856	857	851	846	922
Zone B	n. of Dwellings	1,421	1,620	1,927	1,967	2,352	2,954	3,137	3,500	3,887	6,086
	n. of People	4,057	4,614	5,248	5,512	6,326	8,563	8,994	10,089	11,251	18,488
Zone C	n. of Dwellings	11,926	13,125	19,003	19,861	21,141	23,459	23,673	24,288	24,783	28,235
	n. of People	32,492	35,480	47,317	53,563	57,262	64,646	65,193	66,868	68,331	76,109

Table Appx-10: Population (POP) / Dwellings (DW) vs Noise change over time with Forecast – 65 dB L_{den} metrics

Noise Contour	65 dB L_{den}	Census Data								
Year - Area (km^2)	Results	2006	2011	2016	2019	2021	2022	2023	2024	Estimated Forecast
2006 9.1 km^2	n. of Dwellings	81	78	75	73	75	76	76	75	75
	n. of People	244	169	189	185	184	187	187	182	182
2011 7.6 km^2	n. of Dwellings	71	68	67	65	67	68	68	67	67
	n. of People	214	145	167	163	162	165	165	159	159
2016 10.42 km^2	n. of Dwellings	95	90	90	87	89	90	90	89	89
	n. of People	283	200	232	226	227	229	229	224	224
2019 12.2 km^2	n. of Dwellings	112	106	111	104	108	108	108	107	107
	n. of People	339	240	286	275	274	274	274	269	269
2021 3.7 km^2	n. of Dwellings	15	15	15	14	14	15	15	14	14
	n. of People	40	30	43	43	35	38	38	33	33
2022 8.2 km^2	n. of Dwellings	84	81	82	81	83	84	84	83	83
	n. of People	263	188	217	217	208	211	211	206	206
2023 13.1 km^2	n. of Dwellings	112	108	111	110	113	114	114	112	112
	n. of People	339	252	297	297	284	287	287	279	279

Table Appx-11: Population (POP) / Dwellings (DW) vs Noise change over time with Forecast – 55 dB L_{night} metrics

Noise Contour	55 dB L_{night}	Census Data								
Year - Area (km^2)	Results	2006	2011	2016	2019	2021	2022	2023	2024	Estimated Forecast
2006 11.3 km^2	*n. of Dwellings*	98	92	95	94	100	99	99	98	98
	n. of People	291	203	236	237	248	246	246	241	241
2011 9.8 km^2	n. of Dwellings	83	79	76	74	76	77	77	76	76
	n. of People	249	173	190	187	186	189	189	184	184
2016 14.7 km^2	n. of Dwellings	130	125	130	155	156	156	156	155	158
	n. of People	392	290	340	345	426	427	427	419	431
2019 18.6 km^2	n. of Dwellings	233	364	366	555	706	815	1,119	1,185	1,574
	n. of People	737	1,076	1,140	1,385	2,184	2,459	3,352	3,538	4,655
2021 7.5 km^2	n. of Dwellings	80	77	78	75	77	78	78	77	77
	n. of People	250	177	203	196	192	195	195	190	190
2022 13.3 km^2	n. of Dwellings	194	285	289	381	482	544	790	853	1,570
	n. of People	621	866	916	1,117	1,412	1,580	2,240	2,414	4,371
2023 18.6 km^2	n. of Dwellings	242	393	399	696	958	1,091	1,404	1,675	2,839
	n. of People	771	1,157	1,236	1,753	2,939	3,274	4,191	5,097	8,678

Table Appx-12: Population (POP) / Dwellings (DW) vs Noise change over time with Forecast – 45 dB L_{den} metrics

Noise Contour	45 dB L_{den}	Census Data				
Year - Area (km^2)	Results	2021	2022	2023	2024	Estimated Forecast
2021 237.4 km^2	n. of Dwellings	59,736	60,645	62,570	64,236	71,223
	n. of People	171,468	173,160	178,277	182,627	201,618
2022 420.9 km^2	n. of Dwellings	104,241	105,379	107,947	109,894	118,117
	n. of People	290,265	292,507	299,346	304,655	327,257
2023 630.2 km^2	n. of Dwellings	140,201	141,681	144,868	147,252	159,106
	n. of People	387,192	390,117	398,517	405,627	439,386

Table Appx-13: Population (POP) / Dwellings (DW) vs Noise change over time with Forecast – 40 dB L_{night} metrics

Noise Contour	40 dB L_{night}	Census Data				
Year - Area (km^2)	Results	2021	2022	2023	2024	Estimated Forecast
2021 149.9 km^2	n. of Dwellings	33,053	33,805	35,124	36,260	42,501
	n. of People	95,162	96,555	100,090	103,301	119,893
2022 223.4 km^2	n. of Dwellings	52,024	52,791	54,433	56,081	62,632
	n. of People	149,433	150,867	155,410	159,693	177,407
2023 312.0 km^2	n. of Dwellings	72,452	73,541	75,494	77,230	84,439
	n. of People	203,964	205,969	211,135	215,700	235,374



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