Comhairle Contae
Fhine Gall
Fingal County
Council

Noise Action Plan for Dublin Airport 2024-2028

December 2024

Acknowledgements

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Executive Summary

The Noise Action Plan for Dublin Airport details the regulatory framework and processes for managing aircraft noise at Dublin Airport for the period 2024-2028. It details the roles and responsibilities of the various authorities with responsibility for the assessment, reporting and management of aircraft noise at Dublin Airport.

The regulatory framework for a noise action plan is established by the European Communities (Environmental Noise) Regulations 2018 (the Regulations) which transposes European Directive 2002/49/EC (commonly referred to as the 'Environmental Noise Directive') into Irish law. The regulations require strategic noise maps and an associated action plan to be produced every five years for major airports (defined as having more than 50,000 aircraft movements a year).

Under the Regulations, the airport authority for Dublin Airport (daa) is responsible for preparing strategic noise maps and are defined as the Noise Mapping Body (NMB) with FCC responsible for the preparation and revision of the Dublin Airport noise action plan in the role of the Action Planning Authority (APA).

This Noise Action Plan, covering the period 2024 to 2028 is the second dedicated noise action plan prepared for Dublin Airport and is based on the results of the strategic noise maps which are based on noise exposure for the relevant review year of 2021.

Dublin Airport is Ireland's busiest airport by total air traffic movements and passenger numbers. It is located approximately 10 km north of Dublin City Centre, near the M50 and M1 motorways. The airport has three operational runways:

- Runway 10R/28L 'South Runway' (2,637m long) which runs in an east-west direction;
- Runway 10L/28R 'North Runway' (3,110m long), operational since August 2022; and
- Runway 16/34 'Crosswind Runway' (2,072m long) which lies on a north-west to south-east orientation.

There are planning conditions in place that govern the preferential selection and use of the runways.

An overview is provided of the aircraft noise situation in the communities around Dublin Airport, highlighting areas for improvement and potential future developments that may affect future noise levels, such as changes to noise management measures and infrastructure upgrades.

The plan provides information on the sources of aircraft noise, both ground and air, and the indicators that are used to quantify and present the impact of aviation activity.

The management of aircraft noise at Dublin Airport is subject to a regulatory framework of controls which are established at international, European, national and local level. At international level, the main controls are described as part of the International Civil Aviation Organization's (ICAOs) 'Balanced Approach' to aircraft noise. Regulation (EU) No. 598/2014 requires that 'major airports' within the European Union follow the Balanced Approach where a noise problem has been identified. This regulation has been given further effect

in Ireland and for Dublin Airport through the Aircraft Noise (Dublin Airport) Regulation Act 2019 (the Act of 2019). A full description of the legal and policy context that applies to aircraft noise at Dublin Airport is detailed in **Section 4**.

Section 5 of the document sets out the noise management measures in place at Dublin Airport, and where available, information indicating performance against these. These measures are described with reference to their origin, and against the relevant aspect of the Balanced Approach.

Strategic noise maps are prepared on a five-year cycle and 2021 is the operative year for the presentation of noise maps in this plan. Due to the impact of travel restrictions associated with the global COVID-19 pandemic and operational changes at the airport however, the results of the 2021 strategic noise maps are not considered representative of the current noise climate at Dublin Airport. For this reason, the Noise Action Plan has been supplemented with noise exposure data for the calendar year of 2023, which better reflects the post COVID-19 noise climate and the airport operating in three-runway format.

The results of the noise mapping (including the supplementary year of 2023) are presented in **Section 6**. They show that the areas exposed to aircraft noise (an indication of the total noise produced by Dublin Airport) significantly reduced in 2021 compared to the previous round of strategic noise mapping carried out for the calendar year of 2016. The decrease corresponds with the reduction in airport activity due to COVID-19 travel restrictions. The opposite trend is observed between 2016 and 2023 with an increase observed in the areas exposed to at least 55 dB L_{den} and 50 dB L_{night}. The number of dwellings and people exposed to aircraft noise from 55 dB L_{den} and 50 dB L_{night} are also presented which show that exposure to aircraft noise above these thresholds has continued to increase since the first round of strategic noise mapping in 2006.

The plan emphasises the importance of public consultation and stakeholder engagement in developing and implementing noise management measures at the airport.

There are no statutory noise limits in Ireland that apply to aircraft noise from Dublin Airport. However, a Noise Abatement Objective (NAO) for Dublin Airport has been set by Aircraft Noise Competent Authority (ANCA), a directorate established within FCC through the Aircraft Noise (Dublin Airport) Regulation Act 2019 (the Act of 2019). The NAO requires that the harmful effects of aircraft noise be reduced in the medium to long-term compared to the noise situation at Dublin Airport in 2019. The NAO also requires, as a priority, the number of people exposed to levels above 65 dB L_{den} and 55 dB L_{night} do not exceed the number exposed in 2019. The Noise Action Plan, having consideration of the noise situation reported for 2023 and the future situations reported in **Section 7**, indicates that the medium to long-term objectives of the NAO are on track to be achieved. However, night-time noise exposure remains a concern with the number of people exposed to levels above 55 dB L_{night} being higher in 2023 than in 2019.

The plan highlights the problematic aspects of aircraft noise exposure at the airport, identifies areas for improvement and proposed actions to address issues of concern.

Contents

Tables

Figures

1 Introduction

1.1 Purpose of this Noise Action Plan

Noise action plans are made and revised every five years through the provisions of the European Communities (Environmental Noise) Regulations 2018 (as amended), (the Regulations), which provide for the implementation in Ireland of a common approach within the European Union (EU) to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise.

The Noise Action Plan provides an overview of the Regulations with a review of the results of the latest strategic noise maps for Dublin Airport and sets out an approach for the strategic management and control of environmental noise associated with aircraft activity at Dublin Airport over the period 2024 to 2028 having regard to the existing noise management framework.

A full glossary of terms used within this Noise Action Plan can be found in **Appendix A1**.

1.2 Background to this Noise Action Plan

EU Council Directive 2002/49/EC (commonly referred to as the Environmental Noise Directive or 'the END') relates to the assessment and management of environmental noise. It is the main instrument of the EU to quantify noise pollution levels and trigger action within both Member States and at EU level. The END has the aim of establishing a common approach to avoiding, preventing or reducing the harmful effects due to exposure to environmental noise within the EU.

The END focuses on three action areas:

- The determination of exposure to environmental noise through noise mapping, by methods of assessment common to the Member States.
- Ensuring that information on environmental noise and its effects is made available to the public.
- Preventing and reducing environmental noise where necessary and preserving environmental noise quality where it is good.

Aircraft noise is a matter considered by the END which requires that EU Member States prepare and publish, at least once every five years, strategic noise maps and noise action plans for 'major airports', which are defined as those with more than 50,000 civil aircraft movements per year.

The END is transposed into Irish law by the European Communities (Environmental Noise) Regulations 2018 (S.I. 549/2018) and amended through the European Communities (Environmental Noise) (Amendment) Regulations 2021[1](S.I. 663/2021) ('the Regulations').

This Noise Action Plan has been prepared for Dublin Airport, through its designation as a major airport. Under the Regulations, this Noise Action Plan applies to the period 2024 to 2028.

The previous Noise Action Plan for Dublin Airport (2019-2023) had the following key objective with respect to noise management at Dublin Airport:

"to avoid, prevent and reduce, where necessary, on a prioritised basis the effects due to long term exposure to aircraft noise, including health and quality of life through implementation of the International Civil Aviation Organization's 'Balanced Approach' to the management of aircraft noise as set out under EU Regulation 598/2014."

In 2022, the ANCA defined an NAO for Dublin Airport. The policy objective of this 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 Regulations require that strategic noise maps for Round 4 be based on the annual noise situation around the airport for the relevant year of 2021.

The noise climate at and around Dublin Airport was significantly affected by COVID-19 flight restrictions during 2021, and the commencement of operations from Dublin Airport's North Runway in 2022. For these reasons, the results of 2021 strategic noise mapping are not considered representative of the current noise situation at the airport.

Consequently, the noise situation for 2023 has been requested from the daa in their role under the Regulations as the noise mapping body. Whilst the results of the noise mapping for 2021 are presented in this Noise Action Plan to provide a common basis of reporting across the EU, the noise situation at Dublin Airport in 2023 has also been included to better reflect the post COVID-19 noise climate and the airport operating in three-runway format.

1.2.1 Appropriate Assessment

The primary purpose of the Directive 92/43/EEC ('Habitats Directive') is to promote the conservation of natural habitats and wild fauna and flora across the European Union. The Habitats Directive is

[1] https://www.irishstatutebook.ie/eli/2021/si/663/made/en/print [Accessed March 2024]

transposed into Irish law by the European Communities (Birds and Natural Habitats) Regulations, 2011[2] (S. I. 477/2011) ('Habitats Regulations').

The European Environment Agency (EEA) has designated a network of protected areas ('Natura 2000' sites) covering Europe's most valuable and threatened species and habitats.

The Noise Action Plan has been assessed to determine if it is required to be subject to an 'Appropriate Assessment' under the Habitats Directive. The screening assessment determined that there is no likelihood of a significant impact on a Natura 2000 site. Consequently, there is no need to conduct a 'Stage 2 Appropriate Assessment' for the purposes outlined in Article 6(3) of the Habitat Regulations.

1.3 Roles and Responsibilities

FCC is designated as the action planning authority, through Regulation 7 of the Regulations, for the preparation and revision of noise action plans for Dublin Airport.

FCC is the local authority for the administrative county of Fingal, located to the north of Dublin City, bordered also by South County Dublin, Meath and Kildare, and the Irish Sea to the east. The county covers an area of c. 448 sq. km. Fingal has a population of 330,506 making it the third most populous local authority area in the country.

Table 1-1 sets out a summary of the roles and responsibilities of authorities in the creation of the Dublin Airport Noise Action Plan designated under the Regulations and other relevant legislation.

[2] https://www.irishstatutebook.ie/eli/2011/si/477/made/en/print [Accessed March 2024]

Table 1-1 – Roles and responsibilities

Authority	Roles and Responsibilities	Legislation
Environmental Protection Agency (EPA)	**National Authority** under the Regulations The Regulations designate the EPA as the national authority responsible for overseeing the implementation of the Regulations and for reporting information relating to strategic noise mapping and action planning to the European Commission. The EPA provides draft guidance ("EPA draft Guidance") on the required activities to be undertaken during the implementation of the Regulations. These have been fully accounted for in the preparation of this Noise Action Plan for Dublin Airport.	European Communities (Environmental Noise) Regulations 2018
The airport authority for Dublin Airport (daa)	**Noise Mapping Body (NMB)** under the Regulations Under the Regulations, and with respect to noise from Dublin Airport, the daa is the designated noise mapping body. The daa is responsible for undertaking strategic noise mapping of the annual average airport movements on a five-year cycle.	European Communities (Environmental Noise) Regulations 2018
Fingal County Council (FCC)	**Action Planning Authority (APA)** for Dublin Airport under the Regulations FCC is designated as the action planning authority under the Regulations with responsibility for preparing a Noise Action Plan for Dublin Airport.	European Communities (Environmental Noise) Regulations 2018
Aircraft Noise Competent Authority (ANCA)	FCC was designated as the competent authority for the purposes of aircraft noise regulation at Dublin Airport. ANCA is the directorate established within FCC for the implementation of this function.	The Aircraft Noise (Dublin Airport) Regulation Act 2019 (the Act of 2019) which gives further effect to Regulation (EU) 598/2014 (the Aircraft Noise Regulation).

1.4 Aircraft Noise Regulation

FCC is responsible for making and approving a noise action plan for Dublin Airport and, through the functions of ANCA, is also the competent authority for the purposes of aircraft noise regulation at Dublin Airport through the Act of 2019.

1.4.1 Aircraft Noise Regulation (ANR)

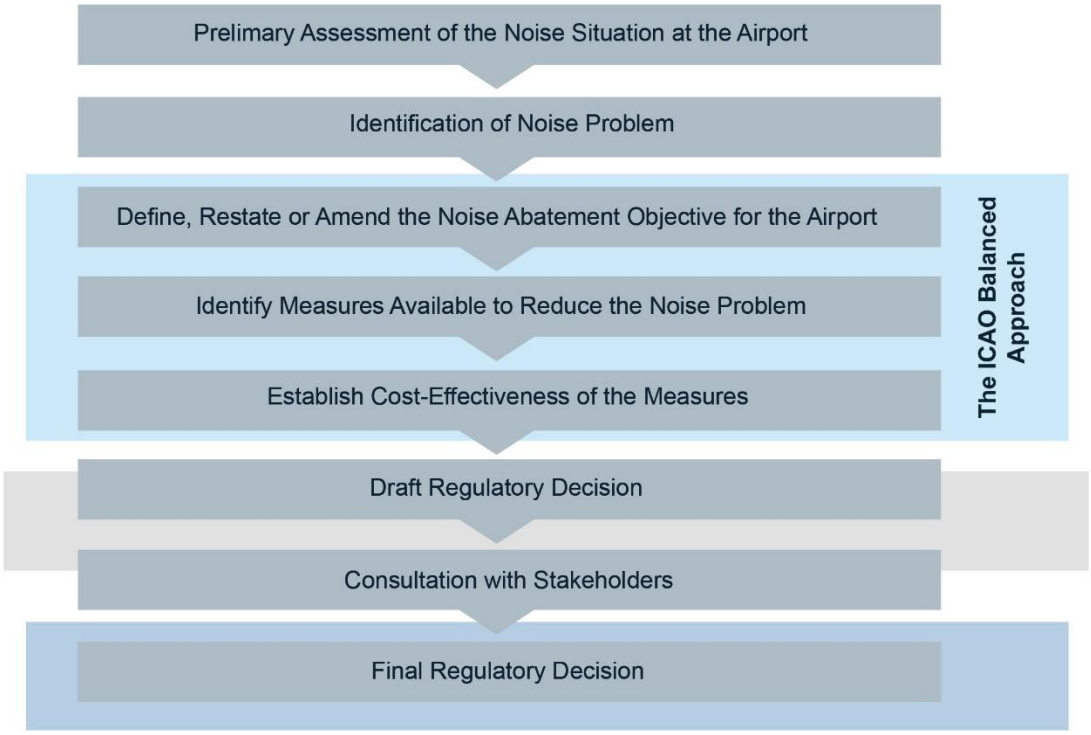
The Act of 2019 requires ANCA to monitor, and regulate where necessary, for the management of aircraft noise in the communities around Dublin Airport. The Act of 2019 defines a process of aircraft noise regulation which means the rules and procedures set out in Regulation (EU) No 598/2014 of the European Parliament and of the Council of 16 April 2014 which requires the ICAO's Balanced Approach to Airport Noise Management to be applied as part of any decision leading to the introduction of noise-related operating restrictions at a major airport.

The primary functions of aircraft noise regulation through the Act of 2019 are to:

- Regulate aircraft noise at Dublin Airport in line with ANR.
- Assess the noise situation at Dublin Airport and adopt the Balanced Approach where a noise problem is identified in line with the ANR and the Regulations.
- Define, restate or amend an NAO for Dublin Airport where appropriate where a noise problem has been identified;
- Assess for potential impacts of aircraft noise through the planning process to determine whether a noise problem may arise as a result of development at Dublin Airport;
- Amend existing or impose new noise mitigation measures and / or operating restrictions to address aircraft noise from Dublin Airport as appropriate; and
- Monitor the implementation of noise mitigation measures and operating restrictions at Dublin Airport.

The Act of 2019 requires that noise generated by aircraft activity at Dublin Airport is assessed in accordance with the Regulations. Through the process of assessment, the application of the ICAO Balanced Approach is required to manage any identified noise problem at Dublin Airport within the wider context of sustainable development. This process may or may not lead to the introduction of mitigation measures or noise-related operating restrictions. This process is set out in Section 9 of the Act of 2019 which is summarised in **Figure 1**.

Figure 1 – Process of Aircraft Noise Regulation as described under Section 9 of the Act of 2019



Through a process of noise assessment and regulation, an NAO was established for Dublin Airport in 2022 as a policy objective for managing the effects of aircraft noise exposure on the surrounding communities and environment at the airport. It is a plan to ensure that any growth at the airport occurs in the most sustainable manner possible. The NAO set specific, timebound and measurable targets with short, medium and long-term outcomes that will require the airport authority to identify and implement best practice in aircraft noise management.

1.4.2 Aircraft noise regulation and the planning and development process

Amendments to the Act of 2000 through Section 34B and 34C, require the planning authority of FCC to refer all planning applications for development at Dublin Airport to ANCA for consideration of potential aircraft noise impacts. This process determines whether the application contains a proposal requiring the assessment for the need for a noise–related action, or indicates that a new operating restriction may be required. Where that is the case, the process of ANR through the Act of 2019 is carried out.

In addition, the planning authority must also refer all applications for permission to revoke, amend or replace an operating restriction at Dublin Airport to ANCA. The process of aircraft noise assessment and regulation as described by the Act of 2019 must be carried out in relation to the proposed changes.

Although the planning process provides for the process of aircraft noise assessment by ANCA, a decision on whether a planning application for development at Dublin Airport should be granted or refused is the function of the planning authority of FCC. Any noise mitigation measures or operating

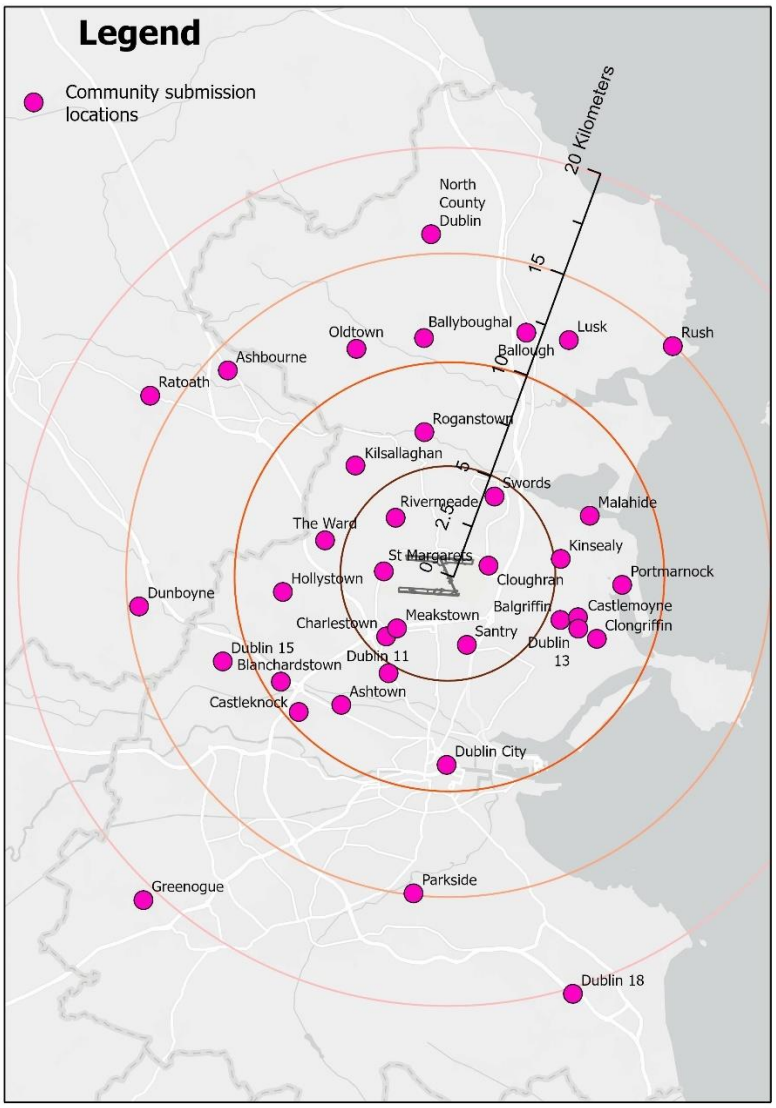
restrictions identified through the process of noise assessment that are required to manage the impact of aircraft noise are incorporated into the decision of the planning authority.

1.5 Consultation

Noise action plans must be reviewed and revised every five years through a process that includes public consultation. EPA guidance recommends consultation with additional consultee bodies and agencies as listed in **Appendix A2**.

The consultation period opened on 3rd September 2024 and accepted submissions for 6 weeks to 15 October 2024. In total, 256 submissions were received from residents, businesses, elected representatives and community groups and organisations. A map illustrating the grouped submission locations is shown in **Figure 2**.

Figure 2 – Map of community submission location



A submission was received from daa as a statutory consultee the noise mapping body for Dublin Airport. Submissions were received from APAs for adjacent counties.

A review of the submissions categorised the responses into 12 themes, a summary of the themes is given in **Appendix A6**. These submissions provided the basis for the final noise action plan.

Two additional actions have been added to the Noise Action Plan, having had regard to the submissions received in the period of consultation.

Noise Action No. 3

A review of the Noise Abatement Objective for Dublin Airport shall be carried out to support sustainable community and airport development in accordance with relevant plans and policies.

Noise Action No. 4

Undertake an encroachment analysis to ensure that relevant plans and objectives remain effective to ensure that land use planning is an effective component of the ICAO balanced approach at Dublin Airport.

2 Description of Dublin Airport

2.1 Location and Context

Dublin Airport is located approximately 10 km north of Dublin City Centre, near the M50 and M1 motorways.

The National Aviation Policy for Ireland recognises the significant benefits that Dublin Airport brings to the broader economy and supports the development of the airport as a vibrant secondary hub than can compete effectively with the UK and other European airports for the expanding global aviation services market. The three principal goals of the National Aviation Policy are:

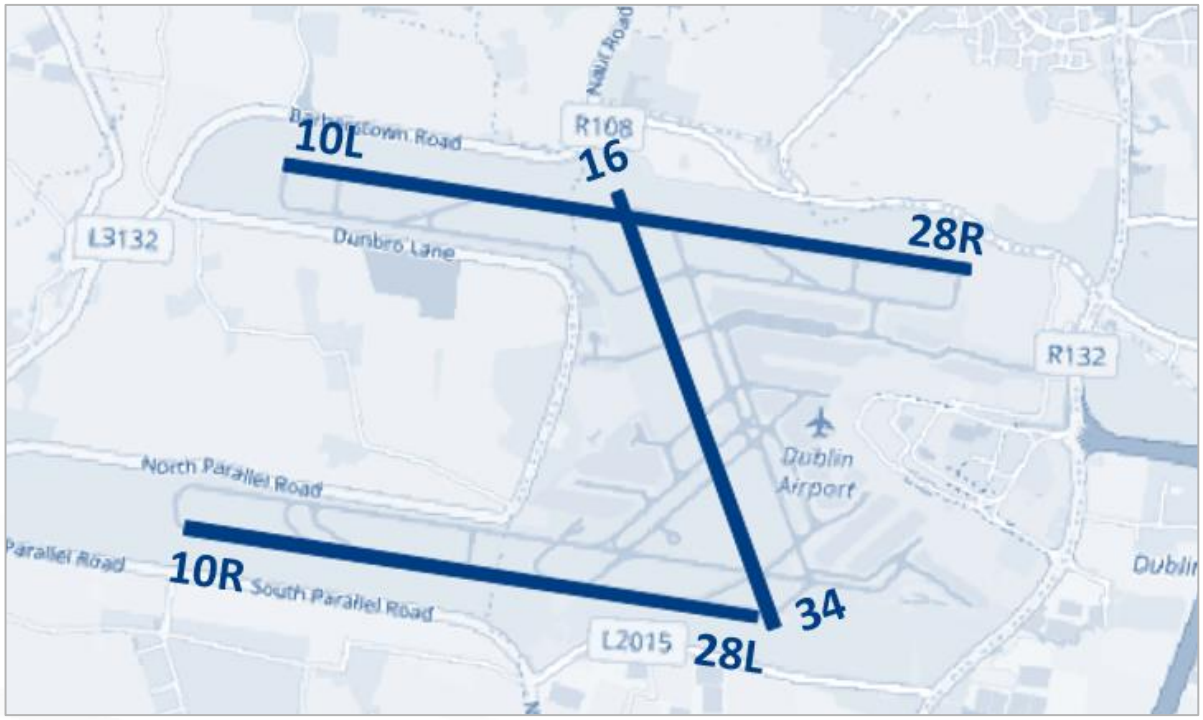
- To enhance Ireland's connectivity by ensuring safe, secure and competitive access responsive to the needs of business, tourism and consumers;
- To foster the growth of aviation enterprise in Ireland to support job creation and position Ireland as a recognised global leader in aviation; and
- To maximise the contribution of the aviation sector to Ireland's economic growth and development.

National aviation policy is also reflected at local level through the Fingal County Council Development Plan 2023-2029 that recognises Dublin Airport as the primary international gateway to Ireland that plays a vital role in providing international connectivity that is an important economic driver to Fingal, the mid-east region and nationally. The development plan contains policies to promote the sustainable development of the airport by balancing a number of key issues such as climate change, infrastructure provision and community engagement while ensuring that the core operational transport function of the Airport is protected.

Dublin Airport covers over 1,000 hectares and has three operational runways illustrated in **Figure 3**:

- Runway 10R/28L 'South Runway' (2,637m long) which runs in an east-west direction;
- Runway 10L/28R 'North Runway' (3,110m long), operational since August 2022; and
- Runway 16/34 'Crosswind Runway' (2,072m long) which lies on a north-west to south-east orientation.

Figure 3 – Dublin Airport



Dublin Airport has its origins as a wartime aerodrome, converting to a civil airport in 1940. Over the last 80 years Dublin Airport has been subject to major developments in terms of the growth of its infrastructure, passenger numbers, aircraft movements and changes to its airspace. A timeline for Dublin Airport is summarised in **Figure 4**.

Figure 4 details a chronology of the development of Dublin Airport over the period 2006 to 2019, including the opening of a second terminal. In 2007, An Bord Pleanála granted Dublin Airport planning permission to build a north parallel runway which was constructed between 2019 and 2022. The planning permission for Dublin Airport's north runway included several noise-related planning conditions requiring various noise mitigation measures, monitoring systems and noise-related operating. These are described in **Section 5** as part of the noise management measures in place at Dublin Airport.

Figure 4 also shows that, over the last five years and the period of the previous Noise Action Plan, there have been several key events and developments at Dublin Airport affecting the noise situation. These include the:

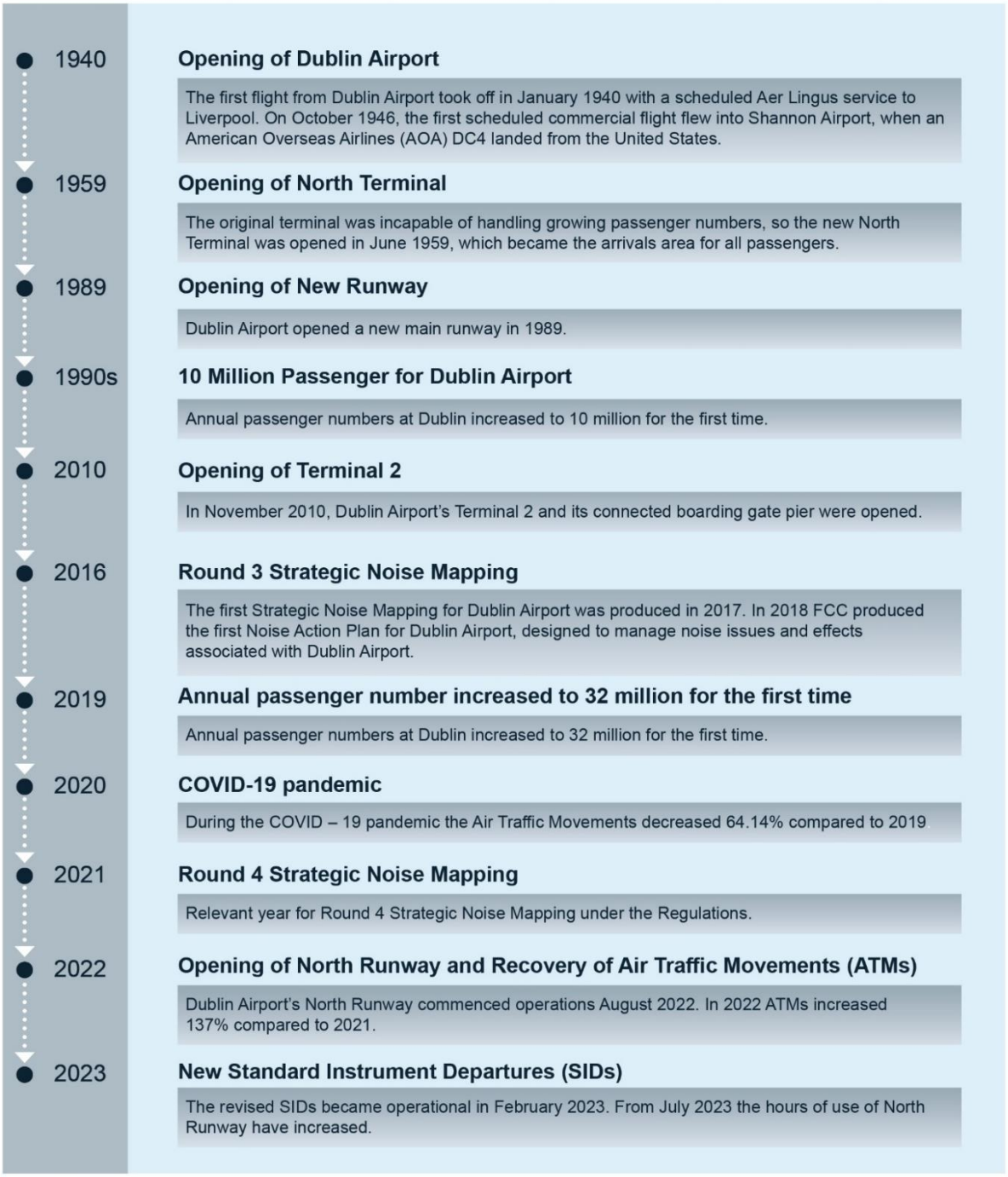
- impact of and recovery from travel restrictions due to the COVID-19 pandemic from March 2020; and
- opening of the North Runway in August 2022 following its construction, and corresponding airspace changes.

In addition to these, Dublin Airport has made several planning applications to change permitted operations and increase passenger capacity through new infrastructure.

The nature and status of these planning applications along with other possible future situations are discussed in detail in **Sections 2.4**. Information regarding the possible future noise situations arising

from the determination of these planning applications over the period of this Noise Action Plan is provided in **Section 7**.

Figure 4 – Timeline for Dublin Airport

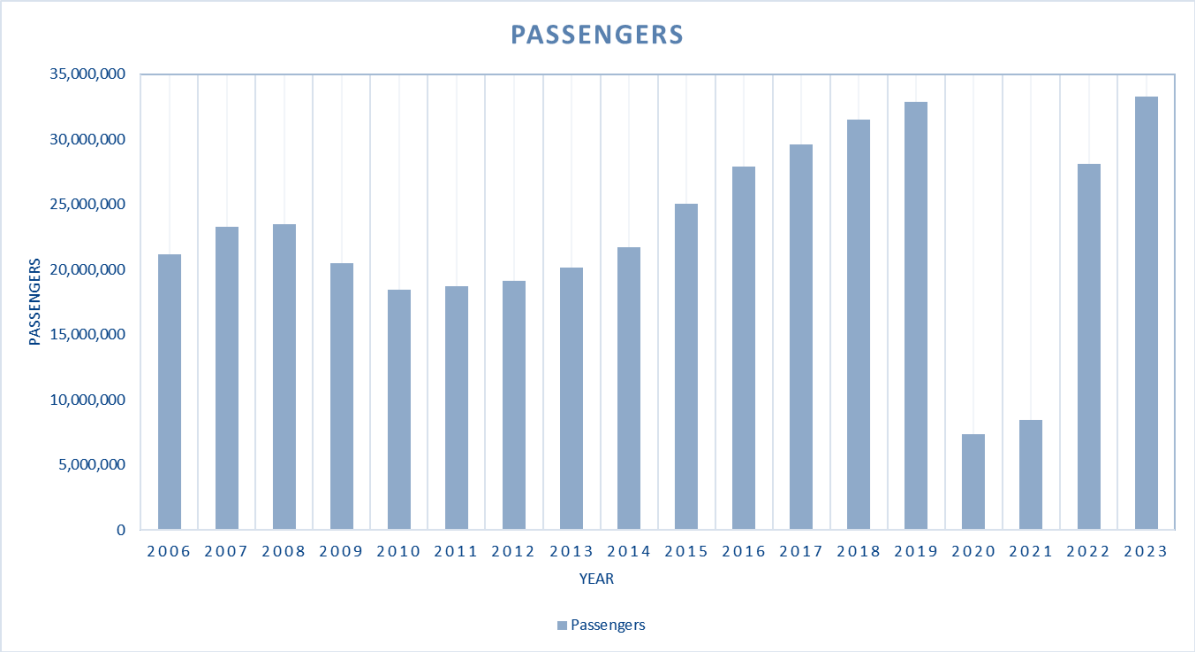


2.2 Overview of Passenger Numbers and Aircraft Movements

Dublin Airport experienced a strong increase in passenger demand prior to the recession in 2008, returning to growth in 2011. During the recession, passenger demand fell dramatically from a then high of 23.5 million in 2008 to 18.4 million in 2010, returning to growth thereafter. Trends in passenger numbers since the first round of the Regulations in 2006 are shown in **Figure 5**.

Prior to the COVID-19 pandemic in 2019, 32.9 million passengers passed through Dublin Airport. Due to the pandemic in 2020 and 2021, passenger numbers reduced significantly during this time. Post pandemic disruption and subsequent recovery in economic activity, passenger numbers reached 33.5 million in 2023.

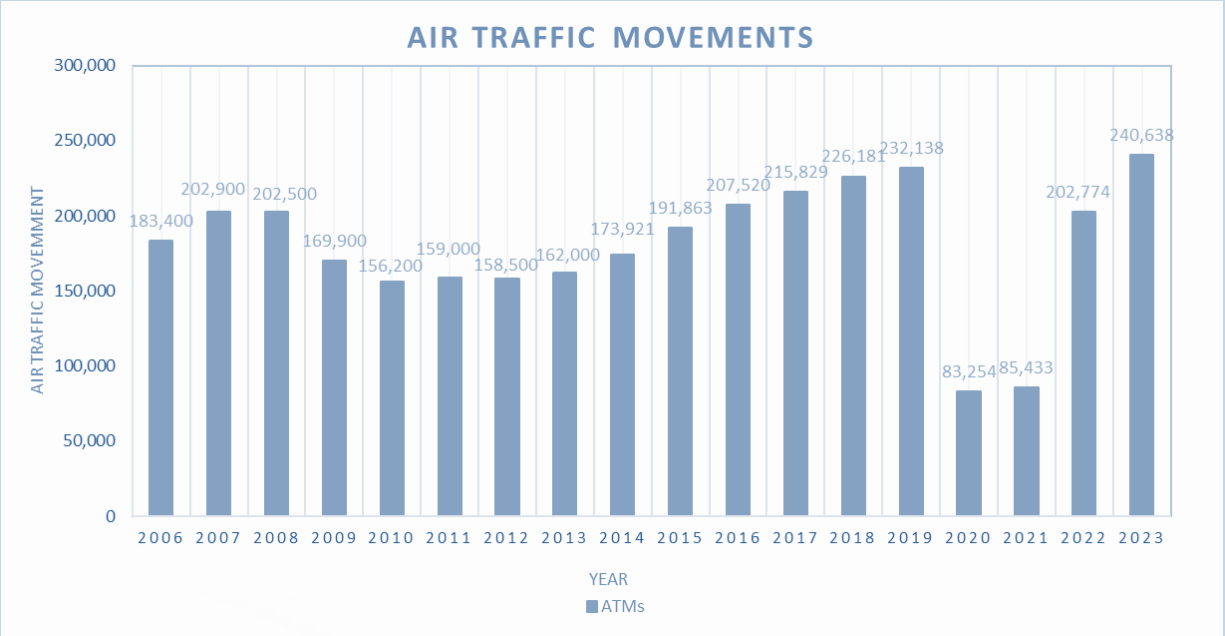
Figure 5 – Passenger Numbers 2006 – 2023[3]



The increase in passenger numbers was also reflected in increases in Air Traffic Movements (ATM). In 2020 and 2021, ATMs were significantly impacted by the pandemic with less than 90,000 ATMs occurring in both years. The growth of ATMs and their historic trend since the first round of strategic noise mapping under the Regulations in 2006 are presented in **Figure 6**.

[3] https://www.cso.ie/en/releasesandpublications/ep/p-as/aviationstatisticsquarter4andyear2022/

Figure 6 – Air Traffic Movements (ATMs) 2006 – 2023[4]



2.3 North Runway and Flight Paths

Dublin Airport's North Runway commenced operations in August 2022 on a staged basis - initially over the period 09:00 to 13:00 and increased incrementally to its permitted hours of operation of 07:00 to 23:00 from July 2023.

Airspace changes that were required for the commencement of north runway operations in 2022 to accommodate parallel runway operations led to changes in the distribution of aircraft noise around the airport. In February 2023, a further airspace change was made to westerly departure flight paths from the north runway.

Figure 7 to **Figure 10** present examples of flight paths at Dublin Airport for a typical easterly and westerly days in 2022 prior to the commencement of North Runway operations, and in August 2023 following the most recent airspace change in February 2023 and the full use of the North Runway in July 2023.

[4] https://www.cso.ie/en/releasesandpublications/ep/p-as/aviationstatisticsquarter4andyear2022/

Figure 7 – Dublin Airport – Easterly Tracks Pre-North Runway

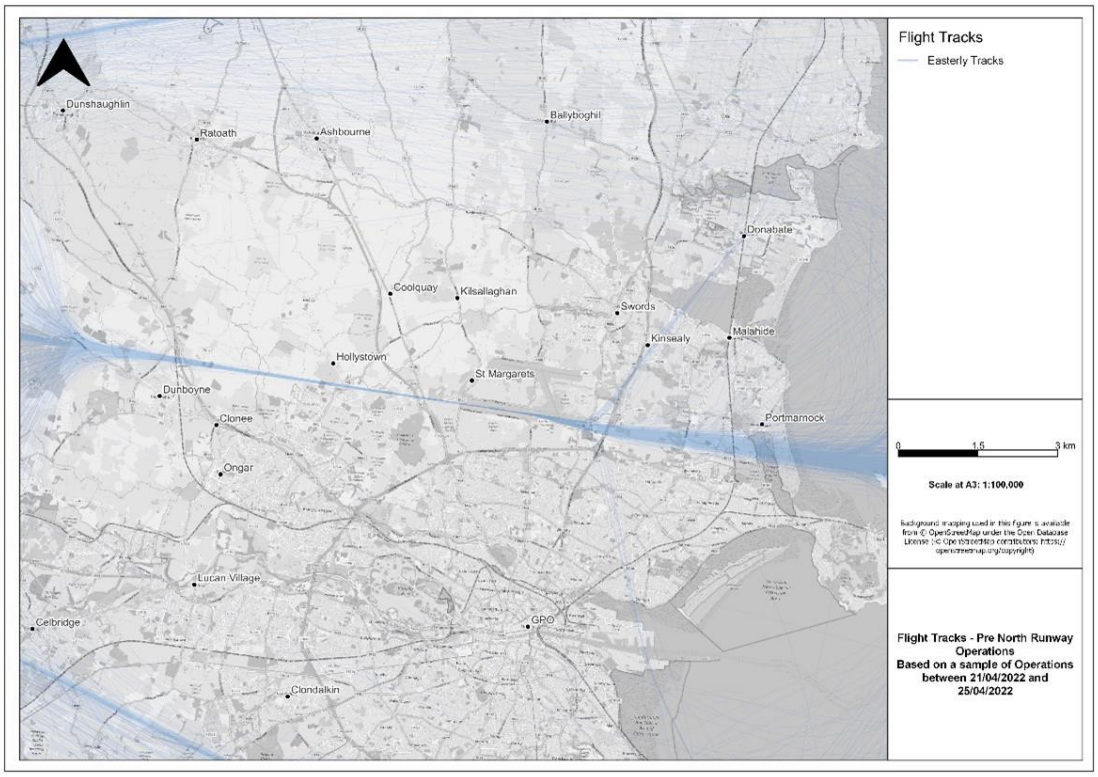


Figure 8 – Dublin Airport – Westerly Tracks Pre-North Runway

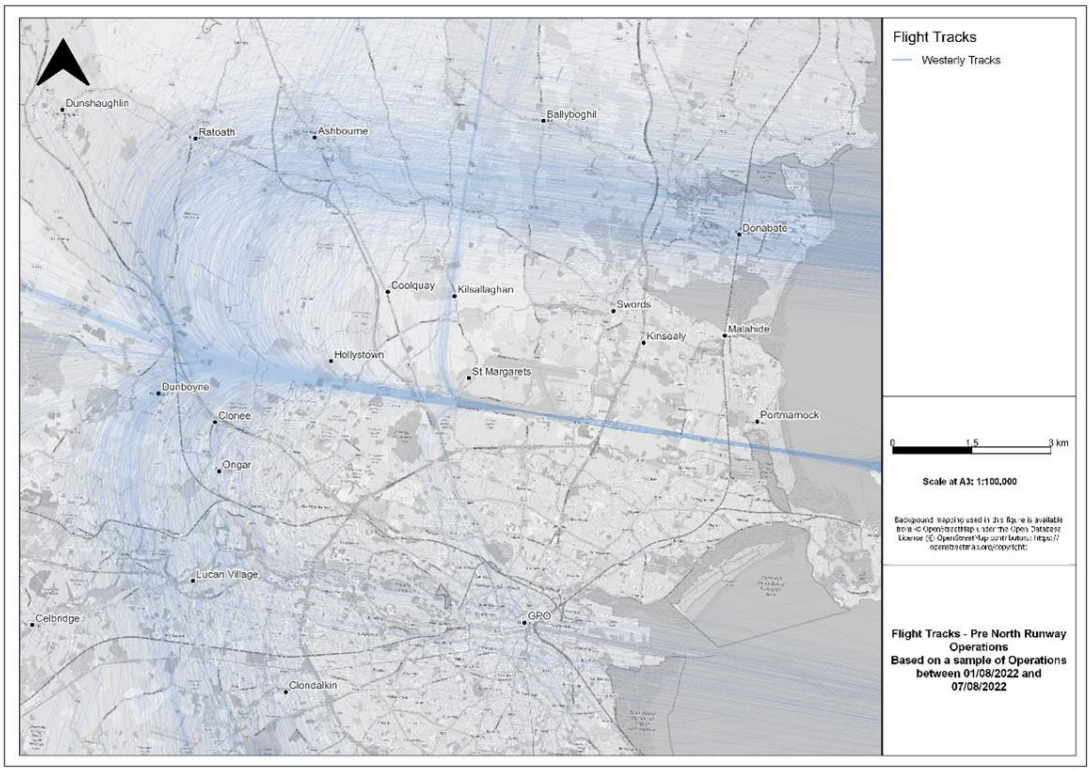


Figure 9 – Dublin Airport – Easterly Tracks Post-North Runway

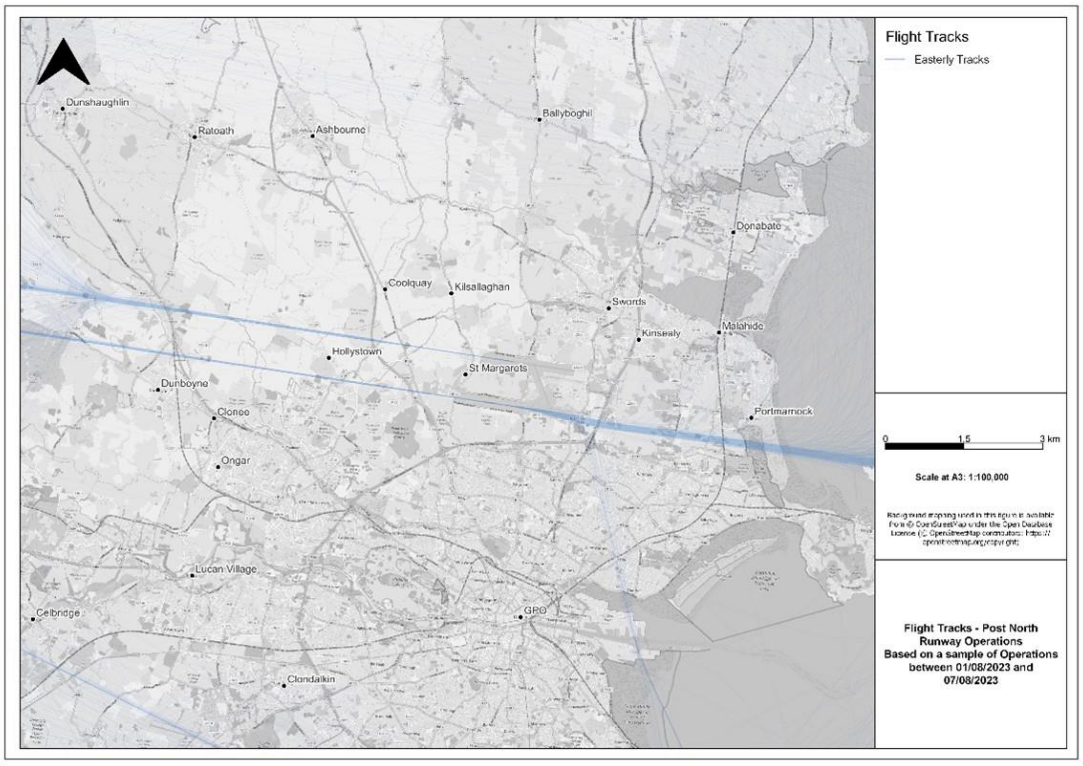
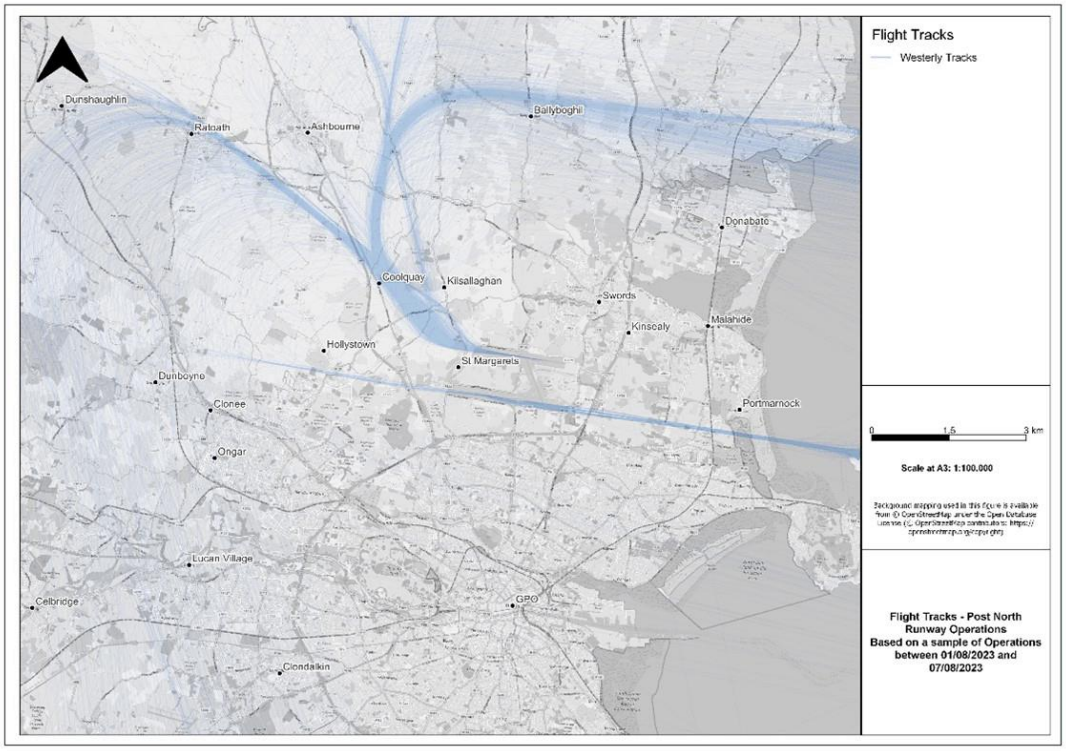


Figure 10 – Dublin Airport – Westerly Tracks Post-North Runway



2.4 Potential Future Developments

There are number of potential future development scenarios that may affect the future noise situation at Dublin Airport:

2.4.1 North Runway Relevant Action (PL06F.314485, F20A/0668)

In December 2020, daa submitted a planning application for a 'relevant action' (NRRA) (under Section 34C of the Planning and Development Act 2000 (The Act of 2000). A 'relevant action' is a proposal that relates to proposed changes to an airport operating restriction within a planning application.

The relevant action sought by daa in this application related to amendments of operating restrictions set out in Condition 3(d) and the replacement of the operating restriction set out in Condition 5 of the grant of planning permission for Dublin Airport's North Runway (F04A/1755; ABP PL06F.217429 as amended by F19A/0023; ABP-305289-19) (the 'North Runway Planning Permission') (NRPP), as well as proposing new noise mitigation measures. A list and description of the relevant noise-related planning conditions attached to the NRPP can be found in **Section 5**.

Condition 3(d) and Condition 5 of the NRPP relate to night-time operating restrictions following the commencement of operations from the North Runway. Condition 5 of the NRPP imposed a limit of 65 flights per night (23:00 to 07:00) with Condition 3(d) restricting all but exceptional use of the North Runway during night.

The 'relevant action' proposed by daa sought to amend Condition 3(d) to provide for use of the North Runway between 06:00 and 00:00, thus allowing it to be used for two hours during the night, along with Condition 5 being replaced by a Noise Quota Scheme. A night-time noise insulation scheme was also proposed.

Through Section 34C, ANCA commenced an assessment of the proposals, carrying out the process of Aircraft Noise Regulation and exploring alternatives to the proposals made by daa. A 14-week consultation on ANCA's draft regulatory decision on the proposals and an NAO for Dublin Airport commenced in November 2021, with a final Regulatory Decision in June 2022.

The Regulatory Decision provided for:

- Condition 5 of the NRPP to be revoked and replaced with a Night-time Noise Quota Scheme (NQS). This scheme set an annual noise quota for the period 23:00 to 07:00;
- Condition 3(d) of the NRPP to be revised to apply over the period 00:00 to 05:59. This revised condition would provide for use of the North Runway for the first and last hour of the night-time period; and
- A night-time Residential Sound Insulation Grant Scheme (RSIGS). This scheme focussed on providing noise insulation to residential dwellings exposed to noise above 55 dB L_{night} a priority value within the NAO. Eligibility to this scheme was also afforded to residential dwellings that would observe a 9 dB increase and be exposed above 50 dB L_{night} due to the Relevant Action.

The decision of the planning authority of August 2022, incorporating ANCA's Regulatory Decision as a series of planning conditions was appealed to An Bord Pleanála (ABP). The ABP decision, whatever the outcome is, will likely have an impact on the noise climate at Dublin Airport.

2.4.2 Infrastructure Application (F23A/0781)

In December 2023, daa submitted a planning application for the Infrastructure Application (IA) (F23A/0781). The IA seeks planning permission for a range of infrastructure upgrades to facilitate the projected growth of passenger numbers through Dublin Airport. The proposed development seeks to increase passenger numbers at Dublin Airport to 40 million passengers per annum (mppa) through:

- An increase in the capacity of the airport from the permitted combined capacity of Terminal 1 together with Terminal 2 of 32mppa (as referenced by condition no. 3 of ABP Ref. No. PL06F.220670 (F06A/1248) and condition no. 2 under ABP for Ref No. PL06F.223469 (F06A/1843)) to 40 mppa.
- The provision of infrastructure to include the following elements, namely:
    - Project Element 1: North Apron
    - Project Element 2: South Apron
    - Project Element 3: Terminal 1 Central Search
    - Project Element 4: New Apron 7
    - Project Element 6: Airfield Drainage Project
    - Project Element 7: Ground Transportation Centre
    - Project Element 9: Long Term Car Park (Red)
    - Project Element 10: Staff Car Park North
    - Project Element 11: Junction Improvements.

In January 2024, ANCA screened the IA under Section 34B of the Act concluding that the proposal requires an assessment for a noise-related action. This conclusion was reached having regard for potential increases in aircraft movements and change in airport operations facilitated by the proposed development, along with the need to fully examine the impact of the proposed development against the achievement of NAO.

2.4.3 Section 9 Process

In December 2022, ANCA commenced a review of the impact of aircraft noise on the communities around Dublin Airport under Section 9 of the Act of 2019. This review commenced with daa being directed to provide operational data to ANCA to inform the review.

The purpose of this review is to examine how Dublin Airport has operated since the opening of the North Runway on 24 August 2022, and to consider how aircraft operations may affect locations around the airport in future. The outcome of a section 9 review may be a regulatory decision containing noise mitigation measures or / and operating restrictions.

Subsequent to the commencement of the assessment, changes to westerly departure routes occurred and this required consideration within the review. This change extended the timeframe of the assessment. In addition, the airport authority lodged a planning application for physical infrastructure and an increase to the permitted airport passenger capacity to 40 million passengers per annum. It is required that a noise review considers the potential aircraft noise impacts of this application, and the

ongoing noise assessment was expanded to include this. The airport authority has been directed by both ANCA and the planning authority to provide additional information to inform the noise and planning assessments in early 2024.

2.4.4 Condition 5 Enforcement Notice

The planning authority of FCC issued an enforcement notice related to Condition 5 of the North Runway Permission (F04A/1755 ABP PL06F.217429) in July 2023. Judicial review proceedings in this matter are ongoing. The outcome of these proceedings will likely have an impact on the noise climate at Dublin Airport.

3 Aviation Noise

3.1 Introduction to Aircraft Noise

Noise can be characterised as “unwanted sound” or “sound that is loud, unpleasant or unexpected”[5] and that can eventually cause disturbance, impairment or damage to health.

Sound levels are expressed in decibels (dB) on a logarithmic scale, where 0 dB is nominally the "threshold of hearing”, and 120 dB is nominally the "threshold of pain". One effect of using the decibel scale is that a doubling of the sound energy results in a 3 dB increase in the sound level.

Noise from aircraft is produced both on the ground and in the air. In general, these sources are considered separately and are typically described as:

- Air noise; and
- Ground noise

3.1.1 Air Noise

Air noise is created by aircraft in the air or on the runway when taking off or landing.

The primary source of air noise is engine noise, which is produced by the engines of aircraft and their various components. This means engine noise can sound different at different positions around the aircraft. Towards the front of the aircraft, the engines fan and combustor can be heard. Towards the rear, the sound of hot air exiting the engine and mixing with cooler aircraft produces a rumble which can be heard. Engine noise is most dominant during aircraft departures.

The secondary source is the aerodynamic noise, which occurs when the air passes over the body of the aircraft. This results in drag which produces turbulence which in turn produces noise. The amount of airframe noise produced by an aircraft depends on its type, along with its speed and how it is configured in flight. For example, on approach when the landing gear is in the down position, an aircraft produces more drag, creating more noise than if the gear was in the up position.

3.1.2 Ground Noise

Whilst the focus of the Regulations is air noise, noise from aircraft ground operations can also give rise to adverse effects. Ground noise is usually only experienced near to the airfield and is often related to the following activities:

- aircraft travelling (taxiing) between the runway and stands, including holding;
- aircraft at their stands with their auxiliary power units (APU) running; and

[5] Future Noise Policy Available European Commission COM (96) 540 final. https://op.europa.eu/en/publication-detail/-/publication/8d243fb5-ec92-4eee-aac0-0ab194b9d4f3 [Accessed 03/16/2024].

- Testing (ground running) of aircraft engines.

Common measures adopted by airports to reduce the impact of ground noise on the community include restricting engine testing to daytime periods, unless in exceptional circumstances, and also requesting that aircraft do not use reverse thrust during the night-time.

3.2 Aircraft Noise Metrics

There are a range of noise metrics that can be used to describe and manage aircraft noise. It is universally recognised that there is not one single noise metric that can be used for assessing, describing and communicating aircraft noise effects. For example, some noise metrics are better for describing long-term health effects, whereas others are best used to describe the amount of noise and aircraft activity experienced as part of an airport's operations.

Some of these noise metrics are used to help develop policies and describe overall exposure to noise, namely L_{eq} metrics. These metrics describe 'equivalent continuous sound level' and are a measure of the average sound energy over time. Whilst these are often described as 'an average' it is important to note that these allow comparison of the total amount of noise exposure in one location as opposed to another taking into account the level and nature of individual aircraft events, their duration and occurrence.

In the context of this Noise Action Plan and under the Regulations, the key noise metrics are the L_{den} and L_{night} noise metrics. Another key noise metric used at Dublin Airport is the $L_{Aeq,\ 16hr}$ which underpins several of the noise-related planning conditions attached to the NRPP.

An overview of the L_{den}, L_{night} and $L_{Aeq,16hr}$ metrics is presented in **Table 3-1** alongside other relevant noise metrics under the Regulations.

Table 3-1 – Examples of equivalent continuous noise exposure 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.

3.3 Harmful Effects on Health and Quality of Life

Noise can have a significant and disruptive effect on everyday life. Since the implementation of the Regulations, there have been extensive studies into the links between environmental noise exposure and health.

The WHO in its publication 'Environmental Noise Guidelines for the European Region 2018'[6] ('the ENG18') and 'Night Noise Guidelines for Europe 2009'[7] has also presented several key health outcomes including:

- Noise annoyance
- Sleep disturbance
- Cardiovascular health
- Mental health, wellbeing, and quality of life
- Children's learning

The ENG18 provides recommendations for protecting human health from exposure to environmental noise originating from various sources including road traffic, railway and aircraft noise.

The recommendations include guideline values for aircraft noise, road traffic noise and railway noise using L_{den} and L_{night} metrics in terms of the onset of health effects.

These guidelines strongly recommend for annual average noise exposure, reducing noise levels produced by aircraft below 45 dB L_{den}, as aircraft noise above this level is associated with adverse health effects. For night noise exposure, the guideline strongly recommends reducing noise levels

[6] Environmental Noise Guidelines for the European Region, World Health Organization, 2018.
[7] Night Noise Guidelines for Europe, World Health Organization, 2009.

produced by aircraft during night-time below 40 dB L_{night}, as night-time aircraft noise above this level is associated with adverse effects on sleep.

In addition to the guideline values, the ENG18 provides a set of Exposure Response Functions (ERF) which can be used to indicate the percentage of the population Highly Annoyed (% HA) or Highly Sleep Disturbed (% HSD) by aircraft noise at a given level of exposure.

The ERFs provided by the ENG18 have been incorporated into the END through a revised Annex III, as set out in Directive 2020/367 which describes the establishment of methods for the harmful effects of environmental noise.

Directive 2020/367 states that:

"At the time of adoption of this Directive, the high quality and statistically significant information that could be used was that of the World Health Organization (WHO) Environmental Noise Guidelines for the European Region, presenting dose-effect relations for harmful effects induced by the exposure to environmental noise.

Consequently, the dose-effect relations introduced in Annex III to Directive 2002/49/EC should be based on those guidelines. In particular concerning the statistical significance, the WHO studies were based on representative populations, and the results of these assessment methods are consequently considered relevant when applied to representative populations."

The revised Annex III of the END has been transposed into Irish Law through the European Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I. 663/2021), which replaced the Second Schedule of the Regulations.

The quantification of harmful effects in line with the ERFs provided in the ENG18 and as formalised by Directive 2020/367, and the Second Schedule of the Regulations, has been incorporated into the Noise Abatement Objective for Dublin Airport as described in **Section 4.7**.

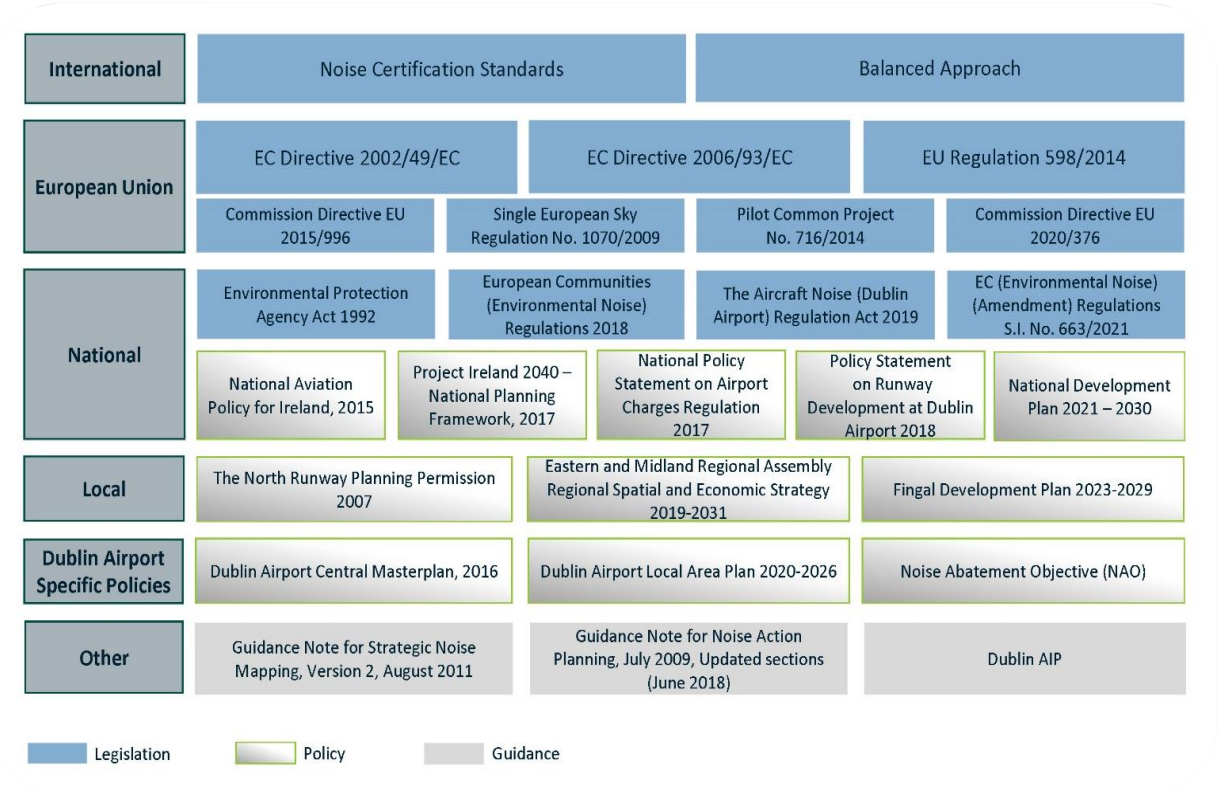
4 Legal and Policy Context

The management and assessment of aircraft noise is addressed across various legislation, policy and guidance as it applies to Dublin Airport. This legislation originates from several international agreements, European regulations and directives which describe the processes and methods for the management and assessment of aircraft noise. These have been transposed into, or given further effect by Irish law and are effective at Dublin Airport.

In addition to international, European and national regulations, local rules and controls installed through local policies and planning consents also provide controls over noise management at Dublin Airport.

Figure 11 presents an overview of the relevant legal and policy context at Dublin Airport. These are described in turn in the following sections.

Figure 11 – Dublin Airport's aircraft noise regulation and controls



4.1 International Aviation Policy

Dublin Airport is subject to ICAO rules and procedures. The ICAO is a specialised agency of the United Nations created to promote the safe and orderly development of international civil aviation throughout the world. It aims to develop the principles and techniques of international civil air navigation and foster the planning and development of international air transport. The ICAO establishes international standards, recommended practices and procedures regarding the technical areas of aviation, including aircraft noise. After a standard is adopted, it is put into effect by each ICAO member state in its own country.

In relation to the management of aircraft noise, ICAO is responsible for:

- Aircraft noise certification standards; and
- The ICAO Balanced Approach to Aircraft Noise Management

4.1.1 Certification Standard

ICAO is responsible for the setting of aircraft noise standards through a process of certification. The primary purpose of noise certification is to ensure that the latest available noise reduction technology is incorporated into aircraft design and that this is demonstrated by procedures that are relevant to day-to-day operations. This aims to ensure that noise reductions offered by technology are reflected in reductions around airports.

Since their introduction, ICAO has set progressively tighter noise certification standards for civil aircraft. Aircraft which operate in ICAO member states must conform to these certification standards, which are specified into one of four categories, known as 'Chapters'. The Chapters set maximum acceptable noise levels for different aircraft at three specific points during landing and take-off.

CAN 1973 - Chapter 2 aircraft
• Aircraft falling in this category are all banned from operating within the EU since 1 April 2002 • Example aircraft - Hawker Siddeley HS 748
CAN 1977 - Chapter 3 aircraft
• Currently no international agreements in relation to phasing out Chapter 3 aircraft, however EU Regulation 598/2014 specifies scenarios where aircraft that are 'marginally compliant' with the Chapter 3 requirements may be withdrawn. • Example aircraft - Boeing 757-200 & Airbus A320-231
CAEP/5 2001 - Chapter 4 aircraft
• 10 dB overall noise reduction when compared to Chapter 3 aircraft. • Example aircraft - Boeing 737-800
CAEP/9 2013 - Chapter 14 aircraft
• 7 dB overall noise reduction when compared to Chapter 4 aircraft. • Example aircraft - Boeing 737 MAX 200 and Airbus A320 NEO

4.1.1 Balanced Approach

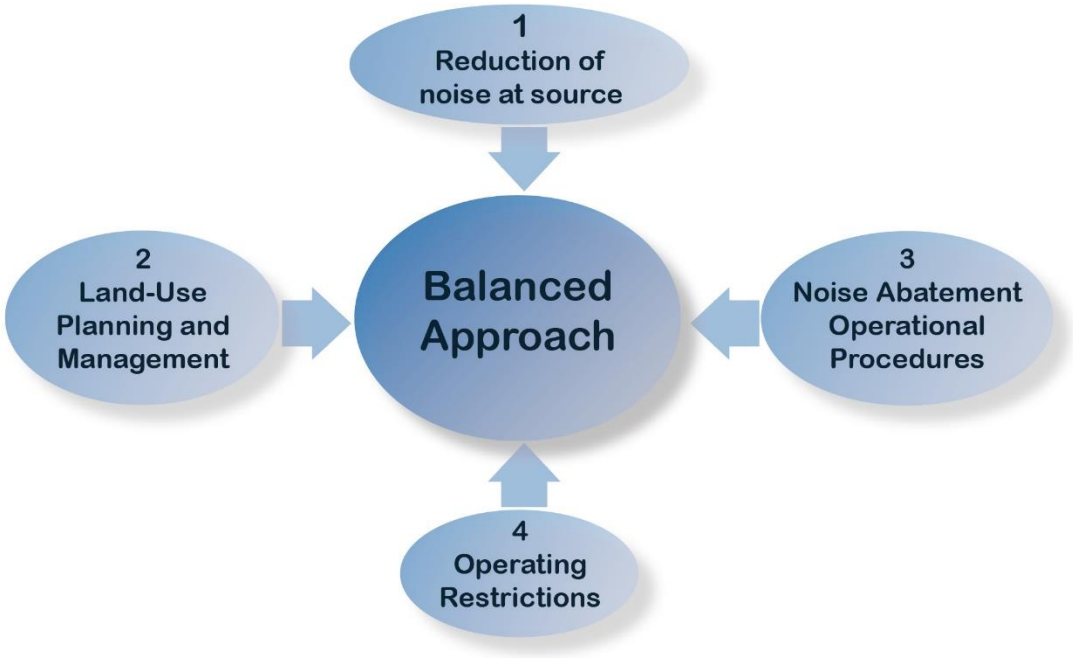
Resolution A33/7 of ICAO introduces the concept of a 'Balanced Approach' to address aircraft noise. The Balanced Approach is considered as the foundation of noise regulation for aviation as a global industry setting international rules and standards implemented in the EU under the Aircraft Noise Regulation. While Resolution A33/7 is not, of itself, binding in Irish law, the Balanced Approach is an integral part of the Aircraft Noise Regulation, which is binding in Irish law through the Act of 2019 and Regulation EU 598/2014.

The Balanced Approach provides for an airport-specific solution which identifies measure to reduce noise at and around airports. It is a framework for analysis of the various measures available so that policy decisions can be made in the most effective manner.

The four elements of the Balanced Approach are: reduction of noise at source; effective land-use planning and management; noise abatement operational procedures; and operating restrictions, as summarised in **Figure 12**.

Under the Balanced Approach, operating restrictions should only be applied as the last resort. The Balanced Approach has been implemented in legislation in the European Union (EU) through the Aircraft Noise Regulation, and in Ireland through the Act of 2019.

Figure 12 – Four Principal Elements of the ICAO Balanced Approach



4.2 European Union

European Union directives and regulations seek to define a common aviation policy in Europe and to implement international regulations set by ICAO. Those which are most relevant to aircraft noise are set out below.

4.2.1 EC Directive 2006/93/EC

Sets out the requirements of EU Member States for the regulation of Chapter 3 civil subsonic aircraft and replaces the repealed EU Directive 92/14/EEC.

The EU Member States are required to ensure that all civil subsonic aircraft operating from airports in their territory comply with the Chapter 3 requirements, barring specific exemptions, such as those of specific historical interest.

4.2.2 EC Directive 2002/49/EC

EU Directive 2002/49/EC (commonly referred to as the Environmental Noise Directive or the 'END') relates to the assessment and management of environmental noise. It is the main instrument of the EU to quantify noise pollution levels and trigger actions within Member States. The aim of the END is to:

"… define a common approach intended to avoid, prevent or reduce on a prioritized basis the harmful effects, including annoyance, due to exposure to environmental noise."

Aircraft noise is considered by the END, which requires that Member States prepare and publish strategic noise maps and noise action plans for major airports (defined as having more than 50,000 movements a year) every five years. The END is implemented in Ireland through the European Communities (Environmental Noise) Regulations 2018 (S.I. 549/2018) (as amended), which is discussed below.

4.2.3 EU Regulation 598/2014

The Aircraft Noise Regulation establishes rules and procedures with regard to the introduction of noise-related operating restrictions at EU airports within the ICAO Balanced approach.

A fundamental requirement of the Balanced Approach as implemented within EU Regulation 598/2014 is that in determining the most appropriate combination of noise mitigation measures for a given airport, operating restrictions should only be introduced after consideration of the other three elements.

4.2.4 Single European Sky Regulation

Since the 1990s the EU has been working to improve the efficiency of air traffic management systems across Europe through the Single European Sky (SES) programme. The SES legislative framework consists of four Basic Regulations (N° 549/2004, 550/2004, 551/2004 and 552/2004) and the main goal is to define, develop and deploy the technological solutions needed to increase the performance and digitalisation of Europe's ATM system in the most cost-efficient and environmentally friendly conditions. This is now aligned with the ICAO GANP approach.

4.2.5 Pilot Common Project

One of the first Single European Sky projects (which became EU Law (EU) 716/2014) was to make binding the implementation of the six first ATM functionalities. This became the first Common Project, referred to as the 'Pilot Common Project' (PCP). The PCP mandates airports under this regulation to implement a set of ATM functionalities and procedures.

4.2.6 Commission Directive EU 2015/996

Commission Directive EU 2015/996 replaced Annex II of the END and established the common noise assessment methodology for the END. The Annex to the Directive describes methodology of calculation for noise from roads, railway, industry and aircraft.

4.2.7 Commission Directive EU 2020/367

Commission Directive EU 2020/367 replaced Annex III of Directive 2002/49/EC and established methods for the assessment of harmful effects due to environmental noise under END. The directive adopts the Exposure Response Functions published within WHO Environmental Noise Guidance, 2018 for the number of people HA and HSD from aircraft noise.

4.2.8 Commission Delegated Directive (EU) 2021/1226

Commission Delegated Directive 2021/1226 introduced a number of amendments to Annex II of the END, including the alignment of the aircraft noise section with European Civil Aviation Conference (ECAC) noise calculation method, called ECAC Doc. 29 4th Edition.

4.3 National Legislation and Policies

4.3.1 Environmental Protection Agency Act 1992

In Ireland, statutory provisions relating to environmental noise pollution come primarily from the Environmental Protection Agency Act (1992).

The Act identifies noise as a form of environmental pollution and contains provisions for dealing with noise deemed 'a nuisance or would endanger human health or damage property or harm the environment'.

With regards to noise, Section 106-107 is most relevant:

- Section 106 Regulates for control of noise and
- Section 107 Power of local authority or Agency to require measures to be taken to prevent or limit noise.

Section 108 is also relevant to environmental noise except it excludes aircraft noise.

4.3.2 European Communities (Environmental Noise) Regulations 2018

These Regulations replace Environmental Noise Regulations 2006[8] (S.I. No. 140 of 2006) and transpose EU Directive 2002/49/EC relating to the assessment and management of environmental noise as amended by Commission Directive (EU) 2015/996 establishing common noise assessment methods, replacing Annex II of EU Directive 2002/49. The Regulations provide for the implementation in Ireland of a common approach within the European Community to avoid, prevent or reduce, on a prioritised basis, the harmful effects, including annoyance, due to exposure to environmental noise.

The Regulations designate daa as the noise mapping body for the purpose of making and approving strategic noise maps of Dublin Airport. The Regulations also designate FCC as the action planning authority for making and approving noise action plans for Dublin airport. The Regulations designate the EPA as the National Authority for the purposes of the Regulations. The Agency's role includes supervisory, advisory and coordination functions in relation to both noise mapping and action planning, as well as reporting requirements for the purpose of the Directive.

4.3.3 The Aircraft Noise (Dublin Airport) Regulation Act 2019

The Balanced Approach is given additional legal effect in Ireland through the Act of 2019 which also makes additional provision for the regulation of aircraft noise at Dublin Airport. This act also amends the Act of 2000 to cater for the situation where development at Dublin Airport may give rise to an aircraft noise problem; and to provide for related matters. FCC was designated as the competent authority for the purposes of aircraft noise regulation at Dublin Airport by the Act of 2019. The FCC Chief Executive established the authority as a separate Directorate – ANCA.

4.3.4 European Communities (Environmental Noise) (Amendment) Regulation 2021

Statutory Instrument No. 663/2021 – European Communities (Environmental Noise) (Amendment) Regulations 2021 (S.I 663/2021)[9] transposes the European Commission Delegated Directive (EU) 2021/1226[10] into Irish Law. It sets out the assessment methods for harmful effects, which considers the number of people Highly Annoyed (HA) & number of people Highly Sleep Disturbed (HSD) for roads, railways and aircraft; and instances of Ischemic Heart Disease (IHD) for roads.

4.3.5 Zero Pollution Action Plan (ZPAP)

In 2021 the EU published its ZPAP[11]. This publication sets a vision for 2050 that air, water and soil pollution is reduced to levels no longer harmful to health and natural ecosystems. The targets by 2030 include *"reducing the share of people chronically disturbed by transport noise by 30%"*, compared to 2017. The ZPAP sets out a policy ambition at European level but places no legislative requirement on individual member states.

[8] https://www.irishstatutebook.ie/eli/2006/si/140/made/en/print [Accessed June 2024].
[9] https://www.irishstatutebook.ie/eli/2021/si/663/made/en/print [Accessed June 2024].
[10] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021L1226 [Accessed June 2024].
[11] https://environment.ec.europa.eu/strategy/zero-pollution-action-plan_en [accessed October 2022]

4.4 Relevant National Policy

4.4.1 A National Aviation Policy for Ireland, 2015

National policies and actions in relation to the mitigation of adverse environmental impacts, including noise, are set out within the Department of Transport, Tourism and Sport (DTTAS) 'National Aviation Policy for Ireland' (NAPI, 2015), which specifies the requirement for Irish airports to adopt the ICAO 'Balanced Approach' to noise management.

National Government plays an important role in setting policy for aviation noise management. The NAPI sets out the goals for aviation policy in Ireland, which look to enhance connectivity, whilst ensuring the maintenance of appropriate levels of safety, security and sustainability.

With regards to Dublin Airport, Action 4.5.1 states:

"The process to develop the second runway at Dublin Airport will commence, to ensure the infrastructure necessary for the airport's position as a secondary hub and operate to global markets without weight restrictions is available when needed."

The National Aviation Policy for Ireland (NAPl) shares the responsibility between Dublin Airport, the Irish Aviation Authority (IAA) and the airlines that operate there for the reduction of aircraft noise on communities close to the airport.

4.4.2 Project Ireland 2040 – National Planning Framework, 2018

The National Planning Framework (NPF) is a high-level strategic plan to guide development and investment over the coming years. In addition to setting aims associated with infrastructure and investment, targets are also set around social outcomes.

The Framework (2018-27) supports the implementation of the National Aviation Policy and identifies the importance of high-quality international connectivity as being: *'crucial for overall international competitiveness and addressing opportunities and challenges from Brexit through investment in airports in line with sectoral priorities already defined through National Aviation Policy and signature projects such as the second runway for Dublin Airport…'*

The NPF has ten National Strategic Outcomes, including 'High-Quality International Connectivity', which specifies the development of the approved additional runway and terminal facilities at Dublin Airport.

Project Ireland 2040 – the NPF recognises the importance of noise management which is implemented through the following objectives 52 and 65:

National Policy Objective 52

"The planning system will be responsive to our national environmental challenges and ensure that development occurs within environmental limits, having regard to the requirements of all relevant environmental legislation and the sustainable management of our natural capital."

National Policy Objective 65

"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."

4.4.3 National Policy Statement on Airport Charges Regulation 2017

This Policy Statement meets a commitment contained in the National Aviation Policy (August 2015) to review and restate Government policy on airport charges regulation in Ireland. The policy Statement seek to ensure that current and future airport customers are presented with choice, value and quality services which also meet the highest international safety and security standards.

In terms of environmental requirements, the Policy Statement requires the Regulator to have regard to Government policy on climate change and sustainability as part of the regulatory determination process. This is to ensure that future airport capacity development is advanced in accordance with the broad objectives of the National Mitigation Plan, which aims to enable transition to a low carbon, climate-resilient and environmentally sustainable economy by 2050.

4.4.4 Policy Statement on Runway Development at Dublin Airport 2018

This repeats the aim of National Aviation Policy, that the Irish Government supports the building of a second runway at Dublin Airport and the development of Dublin Airport as hub airport. In terms of environmental requirements, the Policy Statement outlines that the Government is required to ensure full compliance with the Aircraft Noise Regulation which governs the imposition of noise related operating restriction at airports. It additionally states that FCC must set out noise mitigation measures or abatement objectives for Dublin Airport in accordance with the Balanced Approach.

4.4.5 National Development Plan 2021 – 2030

The National Development Plan set out the ten-year capital ceilings to 2030 which will support economic, social, environmental and cultural development across all parts of the of the country under Project Ireland 2040. The NDP supports also the implementation of the NPF and the National Aviation Policy, with particular reference to the importance of significant investment in the north runway.

4.4.6 National Climate Action Plan 2024

The Climate Action Plan (CAP24) is the third update to Ireland's Climate Action Plan. It sets out a roadmap for actions to halve emissions by 2030 and reach net zero no later than 2050.

CAP24 implements carbon budgets and sectoral emissions ceiling with a view to accelerating the actions required to respond to the climate crisis, putting climate solutions at the centre of Ireland's social and economic development.

4.5 Local Policies and Regulations

4.5.1 The North Runway Planning Permission (NRPP)

Permission for Dublin Airport's north runway was granted in 2007 and was subject to a total of 31 planning conditions.

Two of these conditions place restrictions on night flights and come into force upon completion of the construction of the north runway. These are:

- *Condition 3(d) "On completion of the runway hereby permitted Runway 10L-28R (the 'North Runway') shall not be used for take-off or landing between 2300 hours and 0700 hours except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse*

weather, technical faults in air traffic control systems or declared emergencies at other airports."

- *Condition 5 "On completion of construction of the runway hereby permitted, the average number of night time aircraft movements at the airport shall not exceed 65/night (between 2300 hours and 0700 hours) when measured over the 92 day modelling period."*

4.5.2 Eastern and Midland Regional Assembly Regional Spatial and Economic Strategy 2019-2031

The Eastern and Midland Regional Assembly (EMRA), which was established on 1st January 2015, is part of the regional tier of governance in Ireland. The Fingal and Dublin City regions fall within the EMRA region and, therefore, EMRA Regional Spatial and Economic Strategies are implemented for the area. The Regional Spatial and Economic Strategies (RSES) 2019 – 2031 set out the strategic plan and investment framework for the EMRA region and include specific policies relating to Dublin Airport.

The strategy recognises Dublin Airport is a key national asset to Ireland's economic success which is linked with its global connectivity to trade and tourism markets and requires support to ensure it continues as an economic driver.

Regional policy objectives related to noise for Dublin Airport are as follow:

- *RPO 8.17*: Support the National Aviation Policy for Ireland and the growth of movements and passengers at Dublin Airport to include its status as a secondary hub airport. In particular, support the provision of a second runway, improved terminal facilities and other infrastructure.
- *RPO 8.19*: Spatial planning policies in the vicinity of the airport shall protect the operation of Dublin Airport in respect to its growth and the safe navigation of aircraft from non-compatible land uses. Policies shall recognise and reflect the airport noise zones associated with Dublin Airport. Within the Inner Airport Noise Zone, provision of new residential and/or other noise sensitive development shall be actively resisted. Within the Outer Noise Zone, provision of new residential and/or other noise sensitive development shall be strictly controlled and require appropriate levels of noise insulation in all cases.

4.5.3 Fingal Development Plan 2023-2029

The Fingal Development Plan 2023 - 2029 identifies the 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 Dublin Airport. It is a Strategic Policy Objective of the Development Plan to:

"Safeguard the current and future operational, safety, technical and developmental requirements of Dublin Airport and provide for its ongoing development in accordance with the Dublin Airport Local Area Plan 2020, or any subsequent LAP or extension of same, having regard to both the environmental impact on local communities and the economic impact on businesses within the area."

The Development Plan includes key policy in relation to how aircraft noise from Dublin Airport will be managed through the planning system. This is addressed through the inclusion of noise zones around Dublin Airport.

The noise zones are established by FCC with reference to wider policy as described in the Government of Ireland's National Planning Framework 2040. 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 specific development plan policy objectives related to Dublin Airport presented in **Table 4-1**.

Table 4-1 – Fingal Development Plan 2023-2029 Policy Objectives relating to Dublin Airport

Reference	Objective
Objective DAO1	Facilitate the operation and future development of Dublin Airport, in line with Government policy, and the Dublin Airport Local Area Plan (LAP) 2020, or any subsequent LAP or extension of same, recognising its role in the provision of air transport, both passenger and freight.
Objective DAO2	Safeguard the current and future operational, safety, technical and developmental requirements of Dublin Airport and provide for its ongoing development in accordance with the Dublin Airport Local Area Plan 2020, or any subsequent LAP or extension of same, having regard to both the environmental impact on local communities and the economic impact on businesses within the area.
Objective DAO3	Engage and collaborate with key stakeholders, relevant agencies and sectoral representatives to ensure that Dublin Airport is developed and promoted as a secondary hub to capitalise on the associated wider economic benefits for Fingal and the wider region.
Objective DAO4	Ensure that the required infrastructure and facilities are provided at Dublin Airport so that the aviation sector can develop further and operate to its maximum sustainable potential, whilst taking into account the impact on local residential areas, and any negative impact such proposed developments may have on the sustainability of similar existing developments in the surrounding area, and the impact on the environment, including the climate.
Objective DAO11	Strictly control inappropriate development and require noise insulation where appropriate in accordance with Table 8.1 in the Development Plan 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, as shown on the Development Plan maps, while recognising the housing needs of established families farming in the zone. To accept that time based operational restrictions on usage of the runways are not unreasonable to minimise the adverse impact of noise on existing housing within the inner and outer noise zone.
Objective DAO15	Review the operation of the Noise Zones on an ongoing basis in line with the most up to date legislative frameworks in the area, the ongoing programme of noise monitoring in the vicinity of the Airport flight paths, and the availability of improved noise forecasts.

4.6 Dublin Airport Specific Policies

4.6.1 Dublin Airport Central Masterplan, 2016

The Dublin Airport Central Masterplan 2016 (DACP) was prepared by FCC in consultation with the daa and their consultancy team. The masterplan comprises a framework for the future development of lands located adjacent to Dublin Airport, covering an area of 21.7 hectares.

The proposed development is largely planned commercial office space with provision for associated parking and road network links.

4.6.2 Dublin Airport Local Area Plan 2020-2026

Since the adoption of the last LAP in 2006, Dublin Airport has grown significantly in size and importance. The environmental and aviation policy has also substantially changed.

This LAP provides an updated strategy for the continued growth of Dublin Airport in line with relevant aviation, planning and environmental policy within the context of a sustainable growth framework. The LAP sets the baseline passenger and ATM forecasts for Dublin Airport at 40 mppa and 265,000 ATMs by 2030, and 54 mppa and 365,000 ATMs by 2050.

The LAP specifically considers the environmental effects associated with airport growth at global level (the need to reduce emissions, tackle climate change and build resilience to the impacts of climate change) and at local level (noise, air quality, water quality, waste, traffic, natural and built heritage and community). The LAP includes measures intended to mitigate and manage environmental effects.

4.7 Noise Abatement Objective for Dublin Airport

An NAO is a plan to manage noise at an airport where a noise problem has been identified. The NAO must provide for the management of aviation noise in the context of sustainable development. ANCA established an NAO for Dublin Airport in June 2022 following consultation in November 2021.

The NAO for Dublin Airport has five parts:

Part 1	**Policy Objective** 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.

Part 2	**Explaining the Objective** 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.

Part 3	**Measurable Criteria** The NAO will be primarily measured through the number of people highly sleep disturbed and highly annoyed 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, taking into account noise exposure from 45 dB L_{den} and 40 dB L_{night}. These metrics describe those chronically disturbed by aircraft noise. These metrics 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 the harmful effects. These are the number of people exposed to aircraft noise above: • 55 dB L_{night} (a level of night-time noise exposure described by the WHO as representing a clear risk to health) • 65 dB L_{den} (where a large proportion of those living around Dublin Airport can be considered highly annoyed. In order to measure performance, these metrics shall be completed 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 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.
Part 4	**Expected Outcomes** In context of its recovery from the global pandemic, noise exposure from Dublin Airport is expected to increase up to 2025. Whilst the resultant health effects are expected to be lower than those which occurred prior to the pandemic and in the years 2018 and 2019, these effects should then reduce over the medium to long-term, to improve the noise situation at Dublin Airport whilst allowing for sustainable growth. ANCA therefore expects the following outcomes to be achieved through this NAO as set against the measures described in Part 3. The number of people highly sleep disturbed and highly annoyed shall reduce so that compared to conditions in 2019: • The number of people highly sleep disturbed and highly annoyed in 2030 shall reduce by 30% compared to 2019; • The number of people highly sleep disturbed and highly annoyed in 2035 shall reduce by 40% compared to 2019

	• The number of people highly sleep disturbed and highly annoyed in 2040 shall reduce by 50% compared to 2019 and; • The number of people exposed to aircraft noise above 55 dB Lnight and 65 dB L_{den} shall be reduced compared to 2019

Part 5	**Monitoring** Monitoring of the NAO will 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.

4.7.1 Fingal County Council Climate Action Plan 2024 - 2029

The Plan covers a broad spectrum of climate actions across six thematic areas, including the newly introduced Community Engagement category, reflecting the Council's ambitious objectives. Other focal points encompass Energy and Buildings, Transport, Flood Resilience, Nature-Based Solutions, Circular Economy, and Resource Management. This Plan underscores the Councils steadfast commitment to climate action by proposing innovative adaptation and mitigation measures. It revolves around four key targets:

- 50% improvement in the Council's energy efficiency by 2030.
- 51% reduction in the Council's greenhouse gas emissions by 2030.
- To make Dublin a climate resilient region, by reducing the impacts of future climate change-related events; and
- To actively engage and inform our communities on climate action.

4.7.2 Aviation Emissions

Dublin Airport is Ireland's largest and busiest airport with air services operated by almost 50 airlines to 200 destinations in 42 countries. Dublin Airport is pivotal for national economic growth and connectivity however the airport is also one of the most significant contributors to Ireland's carbon emissions. The ongoing management and reduction of carbon emissions at Dublin Airport is therefore key to reaching the national target of becoming net zero by 2050.

In aviation, the European Green Deal aims to achieve net-zero emissions by 2050. This reflects the global long-term aspirational goal for international aviation of net-zero carbon emissions by 2050, as agreed by the ICAO. Due to the inherent cross-border and international nature of aviation emissions, efforts to reduce aviation emissions are best undertaken within an international framework.

Dublin Airport monitors and reports on its carbon footprint to the Sustainable Energy Authority of Ireland's Monitoring and Reporting System, the European Union's Emissions Trading Scheme through the Irish EPA and the ACI's Airport Carbon Accreditation programme. The daa in its Carbon Reduction Strategy presents their approach to decarbonise Dublin Airport and charts an emissions reduction pathway to 2030 as part of an interim step in their transition to Net Zero Carbon emissions by 2050.

Though aviation emissions go beyond the remit of the local authority and are a matter for European and National Aviation Policy. FCC takes a proactive role through its facilitatory, and coordination roles to assist the daa (and others) in reducing its emissions through support and facilitation of more sustainable transport modes serving the airport and provision of active travel options in the vicinity of the airport. The Council also contributes through various environmental working groups. An action relating to aviation emissions is included in the Community Engagement Section of the Fingal Climate Action Plan – action C19.

C19	Publish in annual progress reports of the LACAP, any publicly available figures relating to Dublin Airport emissions, and invite the daa to provide progress updates and plans to meet the national carbon neutrality objective	figures published annually	Annually	Mitigation	Influence	Environment, Climate Action, Active Travel and Sports	daa

4.8 Other Relevant Guidance

4.8.1 EPA draft noise action plan guidance

The EPA has prepared guidance to help relevant designated APAs in the preparation of noise action plans under the ENR. The scope of the guidance is limited to and applicable only to the preparation of noise action plans and is not for use under any other application. This Noise Action Plan has been made in consultation with the EPA guidance.

The guidance provides APAs with:

- information regarding the process of process developing a noise action plan;
- information on the regulatory context at EU and Irish levels;
- guidance on the requirements for noise action plans;
- guidance on how to identify priorities for reduction of environmental noise;
- a recommended methodology for assessment of cost-effective noise mitigation measures;
- guidance on quiet areas and preserving environmental noise quality;
- guidance for strategic environmental assessment and appropriate assessment screening; and
- guidance on public consultation, publication and report of the noise action plans.

4.8.2 Ireland Aeronautical Information Publication (AIP)

The AIP is designed to be an operations manual containing thorough details of regulations, procedures and other information pertinent to flying aircraft in Ireland. It covers aspects such as noise abatement procedures, which for Dublin Airport can be found at:

https://www.airnav.ie/getattachment/480a0c8d-52ab-4bf8-bb8f-29a93ee3ae8b/Dublin-1.pdf?lang=en-IE

4.9 Statutory Limit Values in Place

In the context of the Regulations, a limit value is a level of noise which is subject to a legal limit. There are no statutory noise limit values currently in place in Ireland for environmental noise, including aircraft noise.

5 Noise Management Measures

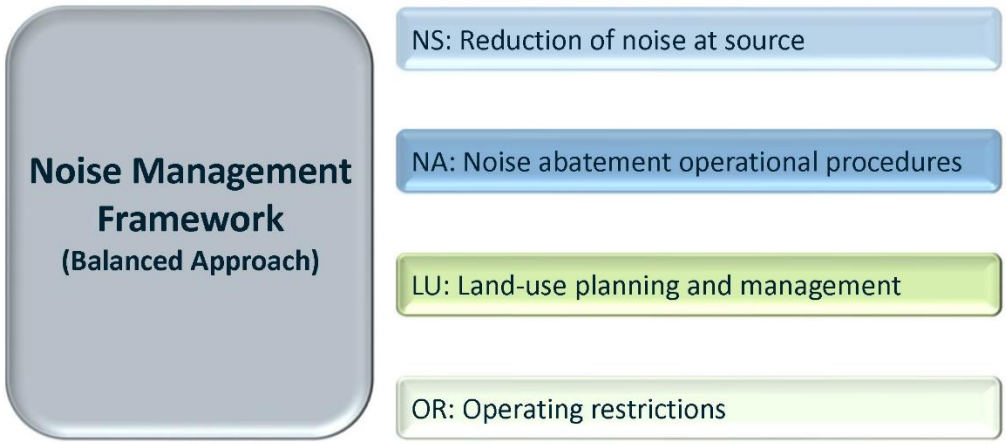
5.1 Introduction

Noise management measures at Dublin Airport can be introduced in several ways:

- Voluntarily by the airport authority;
- Through new technology developed by aircraft manufacturers;
- Flight procedures implemented by aircraft operators and the air navigation service provider;
- Prescribed by planning conditions to mitigate the impact of development proposals;
- Prescribed following the process of Aircraft Noise Regulation by ANCA following an aircraft noise assessment; and
- Identified and implemented through the noise action planning process.

Figure 13 presents an overview of the categories of noise management and mitigation measures by reference to the ICAO Balanced Approach. The four key elements reflect the principal elements of ICAO's Balanced Approach to Aircraft Noise Management.

Figure 13 – Noise Management framework at Dublin Airport



In addition to four pillars described by the ICAO Balanced Approach, effective stakeholder and community engagement is also a key factor in airport noise management. Stakeholder and community engagement allows the concerns of those affected by aircraft noise to be considered and provide people with an understanding of how and why they may be affected by aircraft noise. In reporting noise management measures at Dublin Airport, stakeholder and community engagement has been also considered.

These are contained in the Airport's Annual Compliance Report for 2023.

Table 5-1 – Noise Mitigation Measures at Dublin Airport as reported by the airport authority[12]

Item	Description	Introduced through
NS-1	Promote quieter aircraft through incentives such as Fly Quiet programmes	2019 – 2023 Noise Action Plan
NS-2	Work with airline partners to introduce quieter aircraft, particularly at night – including consideration of incentives	2019 – 2023 Noise Action Plan
NA-1	Preferential Runway Use	NRPP Condition 3(a)-(c)
NA-2	Noise Preferential Routes (NPRs) and Flight-Track Keeping	AIP
NA-3	Noise Abatement Departure Procedures (NADPs) Climb Profile	AIP
NA-4	Visual Approach Jet Aircraft (Category C/D)	AIP
NA-5/6	Continuous Climb Operations / Continuous Descent Approach	AIP
NA-7	Reverse Thrust	AIP
NA-8	Engine Ground Running	AIP, NRRP Condition 11
NA-9	Monitor and Report	daa / the Act of 2019
CE-1	Stakeholder Engagement	NRPP Condition 7
CE-2	Community Engagement Programme	NRPP Condition 9
CE-3	Noise & Flight Track Monitoring System	NRPP Condition 6
CE-4	Noise Complaint Management Systems	daa
PC-1	Runway 10L-28R shall not be used for take-off or landing between 23:00 and 07:00	NRPP Condition 3(d)

[12] daa Annual Compliance Report 2023 available at: https://www.fingal.ie/sites/default/files/2024-09/d00001-daa-xxx-xx-xxx-rp-v-xxx-0003-annual-compliance-report-section-19-2023-v1.0_0.pdf

PC-2	The average number of nighttime aircraft movements at the airport shall not exceed 65/night (between 23:00 and 07:00 when measured over the 92-day modelling period	NRPP Condition 5
LU-4	Residential Noise Insulation Scheme (RNIS)	NRPP Condition 7
LU-6	Voluntary Dwelling Purchase Scheme (VDPS)	NRPP Condition 9
LU-7	Voluntary School Insulation Scheme (SIS)	NRPP Condition 6

On an annual basis, through Section 19 of the Act of 2019, daa prepares a report on the compliance or otherwise of airport users with noise mitigation measures and operating restrictions. This report is published on the ANCA website. The following sections adopt information reported to ANCA under Section 19. Other sources of information such as noise reporting templates, and daa consultant reports have also been used.

5.2 NS - Reduction of Noise at Source

NS-1 and NS-2

NS-1 and NS-2 require Dublin Airport to promote quieter aircraft through incentives such as Fly Quiet programmes, and to work with airline partners to introduce quieter aircraft, particularly at night.

These measures were promoted by Actions 1 and 2 of the Noise Action Plan for Dublin Airport 2019 – 2023.

The annual compliance report of the airport authority, prepared through Section 19 of the Act of 2019, details the introduction of environmental charges at Dublin Airport.

An initial noise charging consultation outlining questions relating to the implementation of the noise charging and the potential methodology was circulated by daa to airlines at the end of 2020. The daa reports that discussions with the airlines continued throughout 2022 in relation to the promotion of quieter aircraft and the appropriate use of metrics and methodology to track performance improvements.[13]

[13] daa Annual Compliance Report 2022 available at: fingal.ie/sites/default/files/2023-12/2023 12 15 Version 2_2022 Annual Compliance Report.pdf

A live charging for noise was introduced on 1st July 2022. The most recent set of noise charges at Dublin Airport are published on the airport's website[14]. The noise charges are based on aircraft Quota Count and the Tonnage of the aircraft.

The Annual Compliance Report for 2023 states that the monitoring of the airport's fleet is achieved through quarterly fleet declaration reviews.NA – Noise Abatement Operational Procedures consultant reports have also been used.

5.3 NS – Reduction of Noise at Source

NA-1 – Preferential Runway Use

Condition 3(a)-(c) of the NRPP describes a three-runway preferential runway use programme. The aim of the measure is for the Airport to use its runways in a preferential order in the interest of the protection of the amenities of the surrounding area.

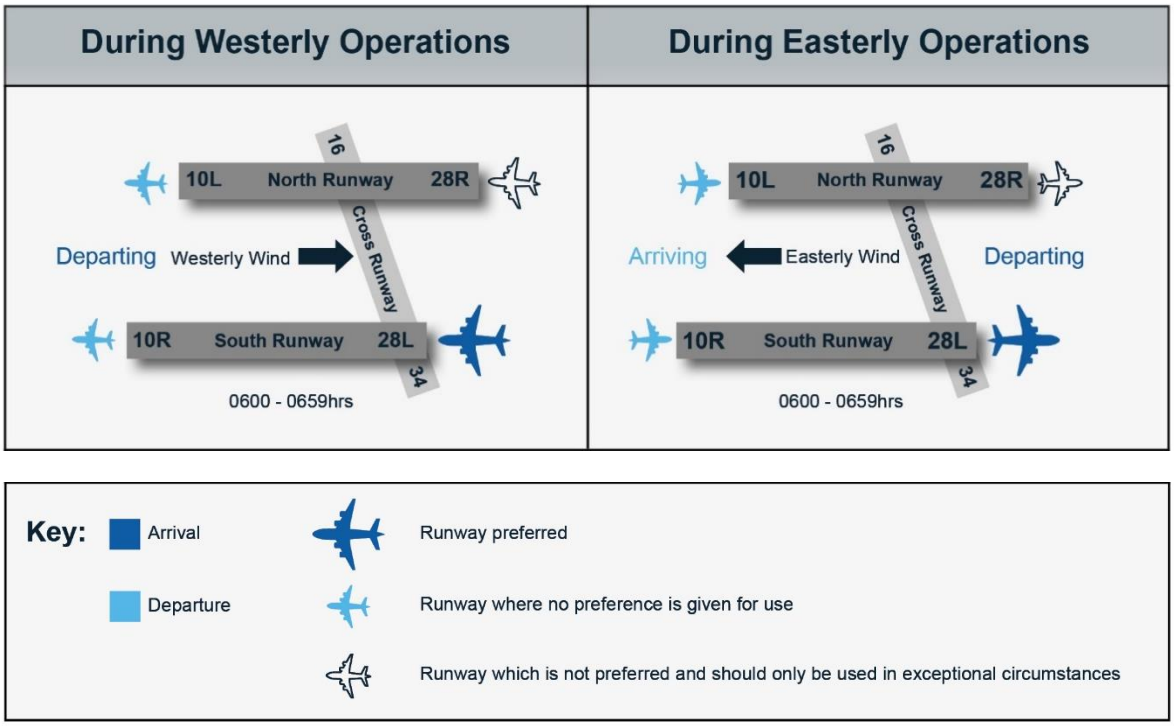
Condition 3(a)-(c) states that:

> On completion of construction of the runway hereby permitted, the runways at the airport shall be operated in accordance with the mode of operation – Option 7b – as detailed in the Environmental Impact Statement Addendum, Section 16 as received by the planning authority on the 9th day of August, 2005 and shall provide that –
>
> (a) the parallel runways (10R-28L and 10L-28R) shall be used in preference to the cross runway, 16-34
>
> (b) when winds are westerly, Runway 28L shall be preferred for arriving aircraft. Either Runway 28L or 28R shall be used for departing aircraft as determined by air traffic control,
>
> (c) when winds are easterly, either Runway 10L or 10R as determined by air traffic control shall be preferred for arriving aircraft. Runway 10R shall be preferred for departing aircraft.
>
> except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports.

A further part of Condition 3, Condition 3(d) is presented under OR-2 in **Section 5.5** as this constitutes a noise-related operating restriction. The effect of Condition 3(a)-(c) is presented in **Figure 14**.

[14] https://www.dublinairport.com/docs/default-source/corporate/summary-table-of-dublin-airport-charges-2024.pdf?Status=Temp&sfvrsn=8d7d63ad_2

Figure 14 – Illustration of Option 7b, Condition 3(a)-(c) of the NRPP



Under Section 19 of the Act of 2019 the daa have reported that flight track keeping is used to monitor the use of its runways is achieved using its airport noise monitoring system, ANOMS. In June 2024, the daa informed ANCA that although ANOMS has been used historically as the basis of annual noise modelling and contouring, it is not daa's official record of aircraft movements and that instead a database called TARGIT is used to record operations for corporate reporting, the charging of landing fees and documents supporting planning applications. Whilst ANOMS is based on flight radar data, TARGIT is based on slot schedules and the airport's movement records.

Based on data provided with the 2023 noise contours presented in this Noise Action Plan, based on the TARGIT data, Dublin Airport reported the following runway utilisation statistics as presented in **Table 5-2** and **Table 5-3** for arrivals and departures for the 2023 calendar year.

Table 5-2 – Summary of Arrival Runway Use by Period as a percentage of all arrivals

Operating Direction	Runway End	Day (0700-1900)	Evening (1900-2300)	Night (2300-0700)
Easterly (10L/10R)	10L	82%	29%	4%
	10R	18%	71%	96%
Westerly (28L/28R)	28L	99.7%	98%	96%
	28R	0.3%	2%	4%

Table 5-3 – Summary of Departure Runway Use by Period as a percentage of all departures

Operating Direction	Runway End	Day (0700-1900)	Evening (1900-2300)	Night (2300-0700)
Easterly (10L/10R)	10L	0.3%	0%	1%
	10R	99.7%	100%	99%
Westerly (28L/28R)	28L	15%	44%	99%
	28R	85%	56%	1%

Table 5-2 and **Table 5-3** show that during westerly operations during daytime period Dublin Airport prioritised use of the North Runway for departures and the South Runway for arrivals. This was lesser the case for the evening period however it should be noted that only full use of the North Runway over the period 07:00 to 23:00 commenced in July 2023.

During easterly operations, **Table 5-2** and **Table 5-3** indicate that on average across 2023, the South Runway was used more or less exclusively for departures with arrivals using both the North and South runways.

Night-time use of the North Runway (10L/28R) is currently restricted under Condition 3(d) of the NRPP. This is described further in **Section 5.5** under PC-1.

NA-2 – Noise Preferential Routes (NPRs) and Flight-Track Keeping

Dublin Airport operate a flight track keeping system which monitors aircraft against their prescribed routes. In their report prepared under Section 19 of the Act of 2019, the daa state that the *"daa Noise Management Plan sets out track keeping procedures and where required processes to escalate investigations to IAA-ANSP and relevant airport uses as necessary"*.

In 2023, daa published an 'Indicative Noise Corridors' map for easterly and westerly departures from the north runway. These corridors are in addition to the environmental noise corridors that have been in place for many years for the South and Crosswind runways.

Figure 15 – Noise corridors north, south and cross wind runways

Although track keeping is in place to monitor adherence with all noise and environmental corridors at Dublin Airport, there is no data available to show that the current departure routes from the North Runway have been optimised from a noise perspective with evidence as to the alternatives considered.

NA-3 – Noise Abatement Departure Procedures (NADP) Climb Profile

On departure there are two families of noise abatement procedures where a stepped departure climb is being used. They are called "NADP 1" and "NADP 2". NADP are based on the guidance included in ICAO's Procedures for Air Navigation Services Aircraft Operations Document 8168 Volume 1.

NADPs describe how an aircraft is to perform a stepped departure climb depending on whether the objective is a reduce noise at noise-sensitive areas that are either in proximity or more distant from the airport.

The NADP that is operated at Dublin Airport is mandated within the AIP. The daa engages with airport users on their implemented NADP. In 2023, daa reported to ANCA under Section 19 of the Act of 2019 that 13 airlines responded to a survey of NADP usage that NADP 2 procedures are used at Dublin Airport. For the 13 airlines that responded, the daa reports that these made up 75.3% of all departures at Dublin Airport in 2023 up to the publication of their report under Section 19.

Action 5 of the Noise Action Plan for Dublin Airport 2019 to 2023 required that FCC *"Request daa to undertake a review of Departure Noise Abatement Procedures and to publish the findings"*. No specific report has been published as part of this Action 5.

In 2023 under Section 19 of the Act of 2019 and in the 2023 Annual Compliance Report, the daa reported to ANCA that there is currently no known method to automatically track compliance with NADP.

NA-4 – Visual Approach Jet Aircraft (Category C/D)

For noise reasons, the AIP for Dublin Airport requires that Category C and D jet aircraft on visual approach to all runways:

- must start the final approach procedures prior to reaching a distance from touchdown not lower than six nautical miles
- must follow a descend path higher or equal than the Instrument Landing System (ILS) approach path

daa have reported to ANCA that whilst their systems currently monitor all approaches, it cannot distinguish between a visual and instrument approach.

NA-5 – Continuous Climb Operations (CCO)

CCO is a procedure designed to avoid periods of level flight during departure so to reduce noise on the ground and reduce fuel consumption.

This is achieved by limiting any interruption in the aircraft's climb profile to a cruise altitude and reduce the noise experienced on the ground caused by changing thrust levels as well as increasing the height of the aircraft above noise-sensitive areas.

The design of the airspace at Dublin Airport facilitates this with the support of Air Traffic Control (ATC). The performance of this measure is monitored and tracked at Dublin Airport by a Performance Review division of EUROCONTROL.

daa reported to ANCA under Section 19 of the Act of 2019 that in 2022, 99.6% of aircraft flew a continuous climb operation to an altitude of 10,500ft. The Annual Compliance Report for 2023 indicates that in 99.57% of aircraft operated a continuous climb below 10,000ft.

NA-6 – Continuous Descent Operations (CDO)

CDO is a procedure in which an aircraft descends from an optimal position with minimum thrust and avoids periods of level flight so to keep the aircraft as high as possible for as long as possible. This procedure is in place at Dublin Airport and aims to reduce the noise on the ground.

Like CCO, the performance of this measure is monitored and tracked at Dublin Airport by a Performance Review division of EUROCONTROL.

For 2022, the daa reported that 55.1% of aircraft flew a CDO below an altitude of 7,500ft. The Annual Compliance Report for 2023 indicates that 54.7% of aircraft flew a CDO below 7,000ft in 2023 as measured by EUROCONTROL.

NA-7 – Reverse Thrust

Reverse thrust is used to assist in the deceleration of aircraft on landing through the use of the aircraft's engines. The use of reverse thrust significantly increases noise from aircraft when on the runway following landing.

Limits on the use of reverse thrust is described as a noise abatement procedure within the Airport's AIP. This requires pilots to avoid using reverse thrust during the period 23:00 to 06:00 except where operational and safety reasons dictate otherwise.

In 2023 daa reported to ANCA under Section 19 of the Act of 2019 that as of 2022, there was no method of monitoring the use of reverse thrust however this could be investigated as part of a wider technical review and assessment the airport's monitoring systems. This position was restated in the Annual Compliance Report for 2023.

NA-8 – Engine Ground Running

Engine Ground Running is required as part of ongoing maintenance and aircraft testing. There can be several levels of engine testing, all dependent on the nature of the maintenance and testing required. For example, engine maintenance will usually require aircraft engines to be tested up to take-off power where other types of maintenance such as pressurization test may require the aircraft engines to be set to idle.

To reduce noise impacts during the most noise sensitive hours, any engine ground running at Dublin Airport is not allowed to be undertaken between 20:00 and 07:00. Only aircraft smaller than Code C aircraft types are allowed to perform engine tests between 07:00 and 09:00. These measures are set out in AIP, which also prescribes specific locations and operational hours for aircraft engine test runs. Permission for all such tests need to be obtained from Dublin Airport. Condition 11 of the NRRP required that:

Prior to commencement of construction of the new runway, aircraft engine testing at the northern end of the airfield shall cease and shall be relocated away from populated neighbouring areas to a sound-controlled area in accordance with the objectives of the Dublin Airport Local Area Plan, 2006.

The engine testing facility has been relocated to the centre of the airfield. daa reports under Section 19 that it monitors these tests through its Airside Management Unit who gather operation logs and that in 2022, there was 85% compliance with the restrictions between 20:00 and 07:00, and 100% compliance with the restrictions applicable between 07:00 and 09:00. The Annual Compliance Report for 2023 indicates that in 2023 compliance was 95.8% and 99.1% respectively.

NA-9 – Monitor and report

Reports are prepared by the airport authority and ANCA on a quarterly and annual basis relating to noise management and compliance with noise mitigation measures. These reports are published on the Dublin Airport and ANCA websites.

5.4 LU – Land Use Planning

LU-4 – Residential Noise Insulation Scheme (RNIS)

The RNIS was established in response to Condition 7 of the NRPP. Prior to RNIS, a voluntary Home Sound Insulation Programme (HSIP) was in place which provided insulation to households based on their exposure to aircraft noise in 2016.

The RNIS initial eligibility contour was based on households located within a forecast 2022 63 dB $L_{Aeq,16hr}$ noise contour with a requirement for eligible properties participating within the scheme receiving their insulation before the operation of the north runway. The scheme provides for a review every two years of the dwellings eligible for insulation.

The eligibility contour for both schemes may be examined on the ANCA website.

The Annual Compliance Report for 2023 states that the scheme is proceeding with a review of the scheme underway.

LU-6 – Voluntary Dwelling Purchase Scheme (VDPS)

The VDPS was established in response to Condition 9 of the NRPP. Eligibility to the scheme is currently based on a forecast 2022 69 dB $L_{Aeq,16hr}$ noise contour, provided at the time the scheme was approved in 2016. The scheme is voluntary and places no obligation on any household to participate.

The scheme comprises an offer to purchase the eligible household with a premium on the current market value of the residence.

LU-7 – Schools Sound Insulation Scheme (SIS)

The SSIS was established in response to Condition 6 of the NRPP. The scheme was approved by FCC in 2016 and provides voluntary sound insulation for all schools and registered pre-schools located within a predicted 2022 60 dB $L_{Aeq,16hr}$ noise contour provided at the time the scheme was approved. Condition 6 requires that maximum noise levels within the school buildings shall not exceed 45 dB $L_{Aeq,8hr}$ where the 8-hour period relates to a “typical school day”.

The Annual Compliance Report for 2023 states that the scheme is proceeding with a review of the scheme underway.

Land Use Compatibility Management Framework

Land-use planning is the responsibility of local authority planning authorities and relies on appropriate provisions to be made during the planning process to determine the acceptability of development in areas affected by aircraft noise and public safety. It is critical that land-use planning does not lead to inappropriate development and encroachment which could result in the creation of future noise and safety issues.

These matters were addressed through county development plans. Four aircraft noise zones and the associated objective of each zone have been prepared along with an indication of the potential noise exposure from operations at Dublin Airport. The zones are based on potential noise exposure levels due to the airport using either the new northern or existing southern runway for arrivals or departures. **Figure 16** presents the current noise zones at Dublin Airport.

Table 5-4 presents the associated objective of each zone.

Figure 16 – Dublin Airport Noise Zones

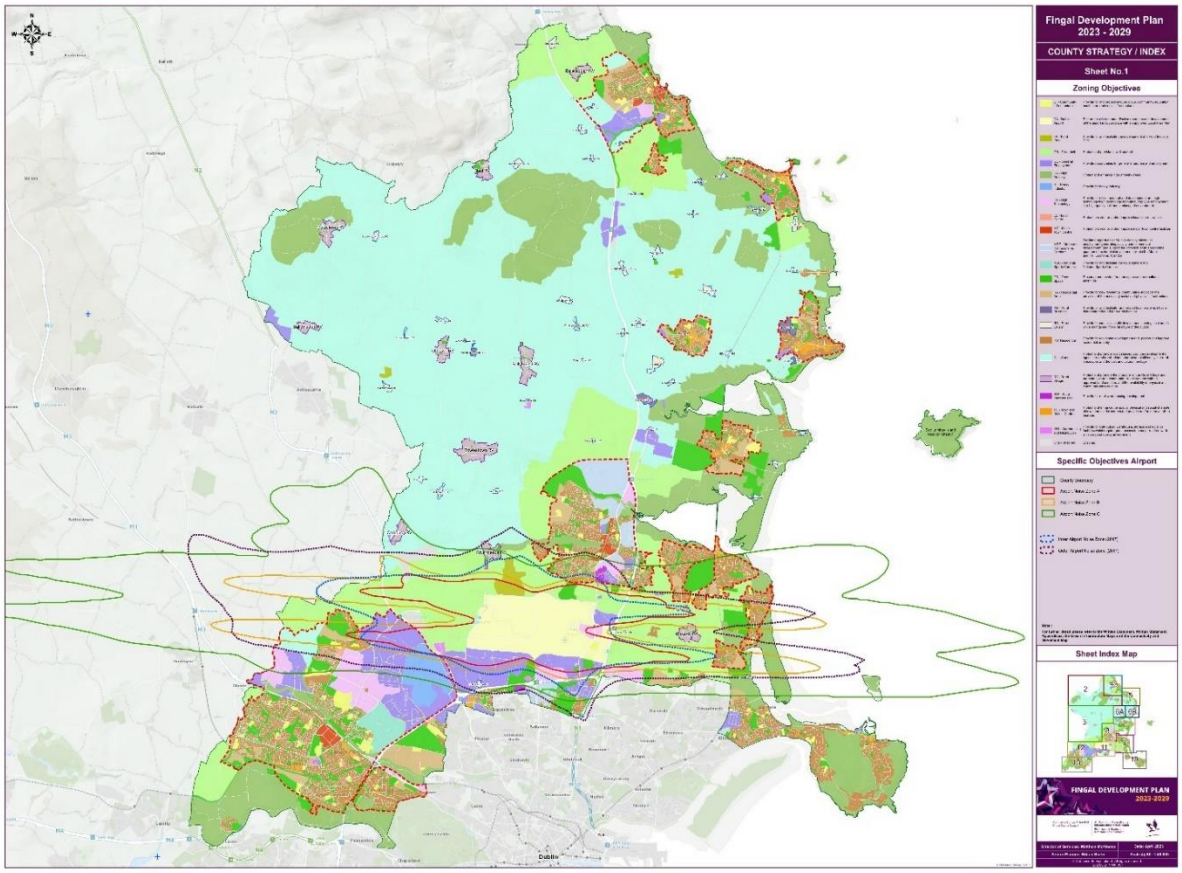


Table 5-4 – Aircraft noise zones and the associated objective of each zone along with an indication of the potential noise exposure from operations at Dublin Airport

Zone	Objective
D	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 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.
C	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.
B	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.
A	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.

Land Use Compatibility Management and Encroachment

In addition to the land use management schemes in place at Dublin Airport, aircraft noise management must consider the compatibility of land use zoning and development in the

communities around the airport to ensure that development is carried out in a sustainable way having regard to the current and forecasted noise climate.

Action 3 of The Dublin Airport Noise Action Plan 2019 – 2023 made provision to "Keep under review land-use policies in relation to aircraft noise through the review of existing land use planning frameworks in so far as they relate to Dublin Airport."

Action 4 of The Dublin Airport Noise Action Plan 2019 – 2023 requires that there is a means to "Monitor noise encroachment associated with Dublin Airport to ensure that airport noise policy is appropriately informed through land use planning frameworks in so far as they relate to Dublin Airport".

Under the ICAO Balanced Approach, land use planning and management is key measure in addressing airport noise problems. ICAO states that *"the number of people affected by aircraft noise is dependent on the way in which the use of land surrounding an airport is planned and managed, and in particularly the extent to which residential development and other noise-sensitive activities are controlled".*

Guidance provided by ICAO on the application of the ICAO Balanced Approach that minimising aircraft noise problems is possible through preventative measures including, but not limited to:

- Taking the appropriate measures so that land-use planning is taken fully into account at the initial stage of any new airport or of development of an existing airport;
- Defining and updating zones around airports associated with different noise levels taking into account population levels and growth as well as forecasts of traffic growth and establishing criteria for the appropriate use of such land, taking into account ICAO guidance;

The ICAO guidance promotes close cooperation between local and regional authorities typically responsible for land use planning and management functions and airport operators.

Having regard to ICAO guidance, any such review of land use management around Dublin Airport and how the measures incorporated within the land-use planning regime should be carried out as part of the ICAO Balanced Approach.

5.5 OR – Operating Restrictions

In 2021 there were no noise related operating restrictions in effect at Dublin Airport.

In August 2022, following the construction and commencement of North Runway operations at Dublin Airport, two noise related operating restrictions came into effect. These are set out in the NRPP.

PC-1 – Restriction on North Runway Use for Take-off or Landing between 23:00 and 07:00

Condition 3(d) of the NRPP requires that:

> On completion of construction of the runway hereby permitted, the runways at the airport shall be operated in accordance with the mode of operation – Option 7b – as detailed in the Environmental Impact Statement Addendum, Section 16 as received by the planning authority on the 9th day of August, 2005 and shall provide that –

> (d) Runway 10L-28R shall not be used for take-off or landing between 2300 hours and 0700 hours except in cases of safety, maintenance considerations, exceptional air traffic conditions, adverse weather, technical faults in air traffic control systems or declared emergencies at other airports.

As discussed in **Section 2.4.1**, the North Runway Relevant Action application seeks to amend Condition 3(d) to allow North Runway for two hours during the night, restricting its use between 00:00 and 06:00. ANCA's Regulatory Decision of June 2022 supported this proposal.

Data reported by the daa as summarised in **Table 5-2** and **Table 5-3** indicates that use of the North Runway at night has been exceptional. As highlighted in **Section 5.3** for Measure NA-8, daa have used two systems to report the times that aircraft use the airport's runways. Restrictions such as Condition 3(d) require such monitoring and reporting to be accurate.

PC-2 – Night-time Movement Restriction

Condition 5 of the NRPP restricts the number of night-time aircraft movements at Dublin Airport. Condition 5 states that:

> On completion of construction of the runway hereby permitted, the average number of night time aircraft movements at the airport shall not exceed 65/night (between 2300 hours and 0700 hours) when measured over the 92 day modelling period as set out in the reply to the further information request received by An Bord Pleanála on the 5th day of March, 2007.

As discussed in **Section 2.4.1**, the North Runway Relevant Action application sought to replace Condition 5 with a Noise Quota Scheme (NQS). As part of the Regulatory Decision of June 2022, ANCA prescribed an NQS which was subsequently incorporated as a condition of consent for the North Runway Relevant Action by FCC in August 2022. This decision was appealed to ABP.

Table 5-5 presents a comparison of annual average and summer night-time[15] movements at Dublin Airport as reported to ANCA in 2023.

Table 5-5 – Night-time Aircraft Movements at Dublin Airport in 2023

Period	2023
Annual Night – Total	33,507
Annual Night – Average	92
Summer Night – Total	10,069

[15] Summer night-time refers to a 92-day period spanning 16 June to 15 September inclusively, for aircraft operating in the 8-hours of night between 2300 and 0700.

Summer Night – Average	109

Table 5-5 shows that annual average and summer night-time movements in 2023 were significantly higher than 65 movements per night as required by PC-2.

In July 2023, the planning authority of FCC issued an enforcement notice related to Condition 5.

5.6 CE – Stakeholder and Community Engagement

CE-1 – Stakeholder Engagement

Stakeholder Engagement on noise and other environmental matters at Dublin Airport is carried out through the Dublin Airport Environmental Working Group (DAEWG). The DAEWG (formerly known as the Dublin Airport Stakeholder Forum) is independently chaired and was established in 2004.

This volunteer-based group comprises members from daa, FCC, AirNav Ireland and members of those local communities impacted by Dublin Airport operations, including Saint Margaret's, The Ward, Santry, Swords, Malahide, and Portmarnock.

The group meets on a quarterly basis to discuss environmental issues and is provided with updates on noise, air quality, water quality, and current/planned projects. When required or requested, experts attend the meetings to provide an opportunity for detailed discussion on any specific topic that is deemed to be of particular importance to the group.

Minutes of DAEWG and presentations to these community group meetings are made publicly available on the Dublin Airport website and are updated as meetings occur.

CE-2 – Community Engagement Programme

Dublin Airport operate a community engagement programme. This is delivered through the Community Liaison Group (CLG). The CLG is independently chaired and was established in 2016 through Condition 28 of the North Runway Planning Permission. The CLG includes representation from the Saint Margaret's Community, Fingal County Council, and daa.

The group meets bimonthly to discuss matters of interest to the local community, including current and future for the area, airport operations, and environmental issues. When required or requested, experts attend the meetings to provide an opportunity for detailed discussion on a topic that is deemed to be of particular importance to the group. The forum facilitates information exchange and provides a solid platform for all three bodies to communicate in an open and transparent manner.

Relevant meeting documentation is available on the Dublin Airport website and updates as meetings occur.

In addition to the CLG, daa maintains a free phoneline for enquiries relating to noise; and continues to update its websites in order to provide accurate, current information. The daa state that regular updates are provided to over 1,000 subscribers to the update service; issued relevant information via press releases and social media; and kept local elected representatives apprised of ongoing issues.

CE-3 – Noise and Flight Track Monitoring System

Condition 10 of the NRPP requires Dublin Airport to operate a noise and flight track monitoring system at all times.

Dublin Airport uses WebTrack which is a noise and flight tracking tool and is available on Dublin Airport website. WebTrak can be used to view all aircraft movements in the vicinity of the airport and gain further information about a specific flight, e.g., aircraft details, flight paths, altitudes as well as noise levels registered at Dublin Airport's noise monitoring terminals. It also provides a way for members of the public to monitor flights and submit noise complaints, if necessary.

The primary objective of the Noise and Flight Track Monitoring System is to gather information on aircraft approach and departure routes and resultant noise levels at several key locations. This information is used by daa to respond to any complaints relating to aircraft noise.

In addition to the aircraft tracking facility, the system is comprised of fixed Noise Monitoring Terminals (NMTs) that monitor arriving and departing aircraft. To enhance tracking of aircraft using Dublin Airport an expansion programme was completed in 2024 to implement 23 permanent measuring and two mobile units.

CE-4 – Noise Complaint Management

Dublin Airport operates a noise complaints management system. Noise complaints can be submitted through a variety of means including WebTrak, an online form, automated telephone line and by post.

FCC does not have a role in the management or oversight of aircraft noise complaints.

6 Summary of the Results of the Noise Mapping

6.1 Introduction

This section sets out the current noise situation in 2023 along with the results of the Round 4 (2021) strategic noise mapping for Dublin Airport. The noise situation and the results of the mapping are presented in line with the metrics required by the Regulations and the NAO i.e. L_{den} and L_{night}.

The information presented in this section has been provided by the daa as the noise mapping body under the Regulations.

Article 5 of the END states that:

"The action plans shall be reviewed, and revised if necessary, when a major development occurs affecting the existing noise situation, and at least every five years after the date of their approval"

The commencement of North Runway operations in 2022 alongside recovery following the pandemic means that for this Noise Action Plan, the noise situation in 2023 is considered representative of the current situation and has been used to inform this Noise Action Plan.

The results for 2023, and 2021, are presented along with comparisons to previous rounds. Whilst a comparison to previous rounds is not required under the END, it can be used to demonstrate trends which may provide context to the existing noise situation and similarly assist in the identification of problems and situations to be improved, from which actions can be determined.

A review of the noise situation in 2023 against the NAO is presented in **Section 6.5**.

6.2 2021 and 2023 Noise Mapping

The strategic noise maps and corresponding population exposure statistics have been produced by daa under their role as the noise mapping body.

All noise contours have been generated using the Federal Aviation Administration (FAA) Aviation Environmental Design Tool (AEDT) Version 3.0e software. The choice of the AEDT software has been approved by the EPA and their technical advisors.

Part 3 of the NAO requires that noise metrics be completed 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). This methodology is incorporated into the selected AEDT software.

Part 3 of the NAO also requires that the noise model be validated using local noise and track keeping performance data from Dublin Airport's systems.

The daa consultant report detailing the methodologies adopted for the 2021 strategic noise maps and 2023 noise contouring is included in **Appendix A3** for reference. This reports that a validation exercise for both the 2021 and 2023 results has been undertaken making use of data obtained from the Airport's Noise and Track Keeping (NTK) system.

The estimated area, total number of dwellings and people exposed above various noise levels in 2021 and 2023 are shown in **Table 6-1** and **Table 6-2** for the L_{den} and L_{night} metrics respectively. The noise exposure data presented in these tables is provided from 55 dB L_{den} and 50 dB L_{night} in 5 dB incremental

bands respectively.

Additionally, the estimated number of schools and hospital buildings within various noise bands have been reported for 2021 and shown in **Table 6-3** and **Table 6-4** for the L_{den} and L_{night} metrics respectively.

For context, the total number of aircraft movements and passengers for 2021 and 2023 are presented in **Table 6-1** and **Table 6-2**. Noise maps are provided in **Appendix A4**.

Table 6-1 – 2021 and 2023 Noise Exposure Data - L_{den}

Year	2021			2023		
Annual Movements	85,431			240,638		
Passengers	8.5m			33.5m		
Noise Band L_{den} dB(A)	Area (km^2)	Dwellings	Population	Area (km^2)	Dwellings	Population
55 – 59.9	26.1	4,333	12,591	65.2	9,233	28,228
60 – 64.9	8.9	190	701	26.8	2,874	8,904
65 – 69.9	2.6	16	65	8.9	106	301
70 – 74.9	0.7	0	0	2.6	8	22
>= 75	0.5	0	0	1.5	0	0

Table 6-2 – 2021 and 2023 Noise Exposure Data - L_{night}

Year	2021			2023		
Annual Night Movements	16,143			33,507		
Noise Band L_{night} dB(A)	Area (km^2)	Dwellings	Population	Area (km^2)	Dwellings	Population
50 – 54.9	16.3	1,855	3,267	37.0	5,843	18,272
55 – 59.9	5.2	74	289	12.6	1,276	4,297
60 – 64.9	1.5	4	16	4.1	60	160
65 – 69.9	0.4	0	0	1.2	3	8
>= 70	0.3	0	0	0.7	0	0

Table 6-3 – 2021 School and Hospital Buildings within Noise Contour Bands- L_{den}

Year	2021	
Annual Movements	85,431	
Noise Band L_{den} dB(A)	School Buildings	Hospitals Buildings
55 – 59.9	3	0
60 – 64.9	0	0
65 – 69.9	0	0
70 – 74.9	0	0
>= 75	0	0

Table 6-4 – 2021 School and Hospital Buildings within Noise Contour Bands- L_{night}

Year	2021	
Annual Night Movements	16,111	
Noise Band L_{night} dB(A)	School Buildings	Hospital Buildings
50 – 54.9	1	0
55 – 59.9	0	0
60 – 64.9	0	0
65 – 69.9	0	0
>= 70	0	0

6.3 Comparison to Previous Rounds

A comparison of the reported noise contour areas, number of dwellings and population exposed to aircraft noise from Dublin Airport over the period 2006 to 2023 is provided across **Table 6-5** to **Table 6-10** for the L_{den} and L_{night} metrics.

Such a comparison between each round of the strategic noise mapping can be used to identify trends in noise exposure over time. This is considered appropriate given the changing situation at Dublin Airport.

In line with the reporting requirements of the Regulations, exposure statistics are provided from 55 dB L_{den} and 50 dB L_{night}.

Table 6-5 – Contour Band Areas – L_{den}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{den})	Area km²				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Movements	192,605	160,664	213,974	85,431	240,638
55 – 59.9	35.5	29.9	39.7	26.1	65.2
60 – 64.9	13.0	10.7	16.9	8.9	26.8
65 – 69.9	5.4	4.6	6.5	2.6	8.9
70 – 74.9	2.1	1.7	2.3	0.7	2.6
>= 75	1.6	1.4	1.6	0.5	1.5

Table 6-6 – Dwellings exposed in Noise Contour Areas – L_{den}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{den})	Dwellings				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Movements	192,605	160,664	213,974	85,431	240,638
55 – 59.9	4,500	4,100	6,421	4,333	9,233
60 – 64.9	300	100	492	190	2,874
65 – 69.9	100	100	80	16	106
70 – 74.9	0	0	9	0	8
>= 75	0	0	2	0	0

Table 6-7 – Population exposed in Noise Contour Areas – L_{den}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{den})	Population				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Movements	192,605	160,664	213,974	85,431	240,638
55 – 59.9	13,000	11,900	18,505	12,591	28,228
60 – 64.9	1,200	300	1,483	701	8,904
65 – 69.9	200	200	268	65	301
70 – 74.9	0	0	25	0	22
>= 75	0	0	6	0	0

Table 6-8 – Contour Band Areas – L_{night}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{night})	Area km²				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Night Movements	-	16,682	24,753	16,111	33,507
50 – 54.9	17.0	14.6	24.1	16.3	37.0
55 – 59.9	6.6	5.9	9.1	5.2	12.6
60 – 64.9	2.8	2.3	3.3	1.5	4.1
65 – 69.9	1.0	0.8	1.3	0.4	1.2
>= 70	0.9	0.8	1.0	0.3	0.7

Table 6-9 – Dwellings exposed in Noise Contour Areas – L_{night}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{night})	Dwellings				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Night Movements	-	16,682	24,753	16,111	33,507
50 – 54.9	600	400	2,195	1,855	5,843
55 – 59.9	100	100	113	74	1,276
60 – 64.9	0	0	17	4	60
65 – 69.9	0	0	3	0	3
>= 70	0	0	0	0	0

Table 6-10 – Population exposed in Noise Contour Areas – L_{night}: 2006, 2011, 2016, 2021 and 2023

Contour Level (dB L_{night})	Population				
	2006 (R1)	2011 (R2)	2016 (R3)	2021 (R4)	2023
Annual Night Movements	-	16,682	24,753	16,111	33,507
50 – 54.9	1,800	1,200	6,211	3,267	18,272
55 – 59.9	200	200	375	289	4,297
60 – 64.9	0	0	46	16	160
65 – 69.9	0	0	10	0	8
>= 70	0	0	0	0	0

Table 6-5 to **Table 6-10 s**how a significant downward shift in noise exposure between 2016 (Round 3) and 2021 (Round 4) measurable across all exposure statistics. The decrease corresponds with the downturn in airport activity due to COVID-19 travel restrictions. The opposite trend is observed between 2023 and the previous rounds with an upward shift in the population exposed to levels of at least 55 dB L_{den} and 50 dB L_{night} and above.

The results of the mapping presented demonstrate that population exposure to aircraft noise in 2023 was higher than any other year reported under the Regulations with the areas exposed to noise, an indication of the total amount of noise produced by Dublin Airport, above these reporting requirements of the Regulations also increasing. Comparing the contour areas in km^2 between 2016 (Round 3) and 2021 (Round 4) and the Round 4 supplementary year of 2023, the L_{den} footprint above 55dB decreased in size by 42% and the L_{night} contour area above 50dB decreased 39% between Round 3 and Round 4 with an increase of 55% and 41% respectively between 2016 (Round 3) and 2023. Quiet Areas

Candidate Quite Areas for Fingal are addressed in Section 12 of the Noise Action Plan 2024-2028 – Dublin Agglomeration.

6.4 Financial Information

Financial information (if available) can include budgets, cost-effectiveness assessment, cost-benefit assessment. This financial information is not available.

6.5 Performance against Noise Abatement Objective (NAO)

The NAO for Dublin Airport sets measurable criteria compared to the situation in 2019 as shown below. The measurable criteria defined by the NAO seek to ensure that exposure to aircraft noise and its harmful effects on health and quality of life are limited and reduced over the short, medium to long term.

The number of people highly sleep disturbed and highly annoyed shall reduce compared to conditions in 2019:

- The number of people highly sleep disturbed and highly annoyed in 2030 shall reduce by 30% compared to 2019;
- The number of people highly sleep disturbed and highly annoyed in 2035 shall reduce by 40% compared to 2019;
- The number of people highly sleep disturbed and highly annoyed in 2040 shall reduce by 50% compared to 2019 and;
- The number of people exposed to aircraft noise above 55 dB L_{night} and 65 dB L_{den} shall be reduced compared to 2019.

Medium to Long Term NAO Outcomes

The measurable medium to long term objectives of the NAO are to reduce the number of people highly annoyed and highly sleep disturbed by set percentages against a reference year of 2019.

The number of people highly annoyed as reported by daa for 2023 compared to 2019 is presented in **Figure 17**, with the number of people highly sleep disturbed for these years presented in **Figure 18**. Based on the information reported by daa, compared to the situation in 2019, the number of people highly annoyed and highly sleep disturbed in 2023 is on track to achieve the 30% reduction described by the NAO for 2030 with a reduction of 38.3% in the number of people highly annoyed, and 31% in the number of people highly sleep disturbed.

Figure 17 – Number of People Highly Annoyed in 2019 and 2023

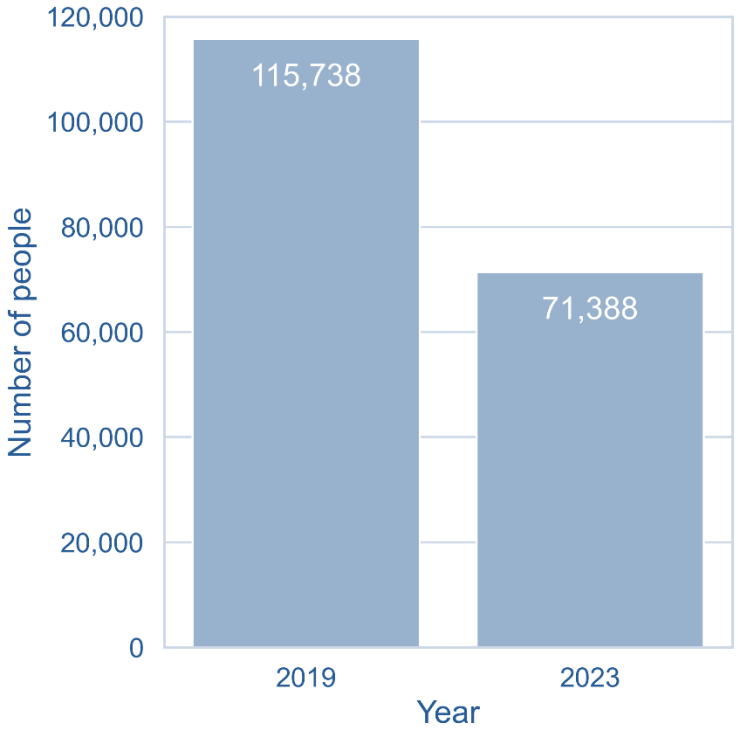
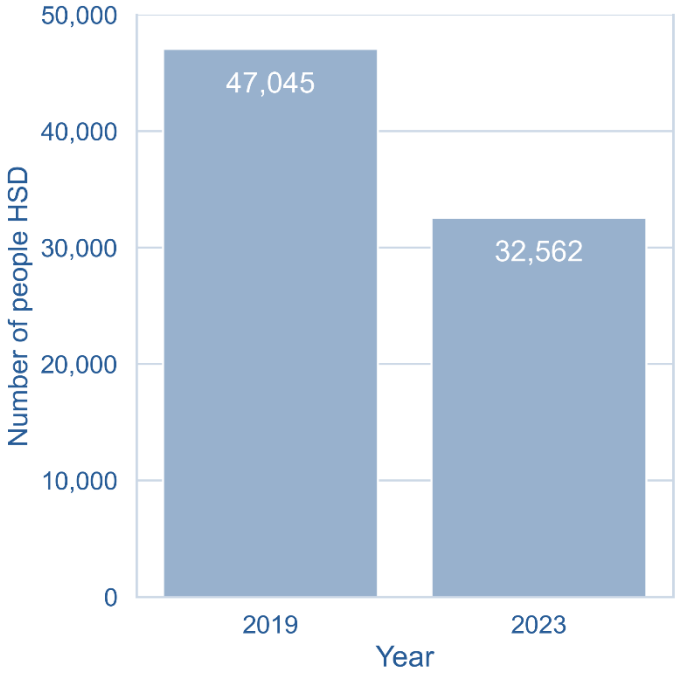


Figure 18 – Number of People Highly Sleep Disturbed in 2019 and 2023



NAO Priority Levels Outcomes

As well as reducing the harmful effects of aircraft noise over the medium to long-term, the NAO sets a priority of reducing the number of people exposed to 55 dB L_{night} and 65 dB L_{den} compared to its reference year of 2019.

Figure 19 presents the number of people exposed to aircraft noise above 65 dB L_{den} in 2023 and 2019. **Figure 19** shows that the number of people exposed to aircraft noise above 65 dB L_{den} in 2023 was higher than in 2019. **Figure 20** presents the number of people exposed to aircraft noise above 55 dB L_{night} in 2023 and 2019. This figure shows that the number of people exposure above 55 dB L_{night} in 2023 was considerably higher than in 2019.

Figure 19 – Number of People Exposed to Aircraft Noise above 65 dB L_{den}

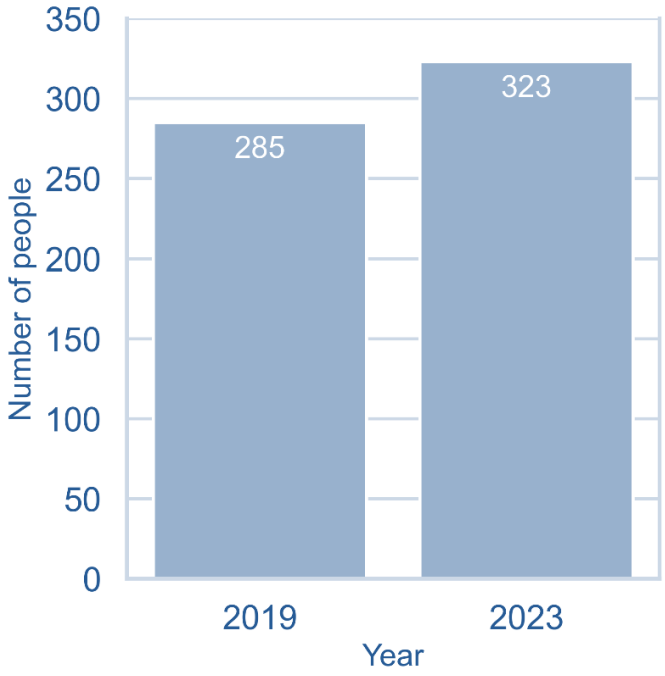
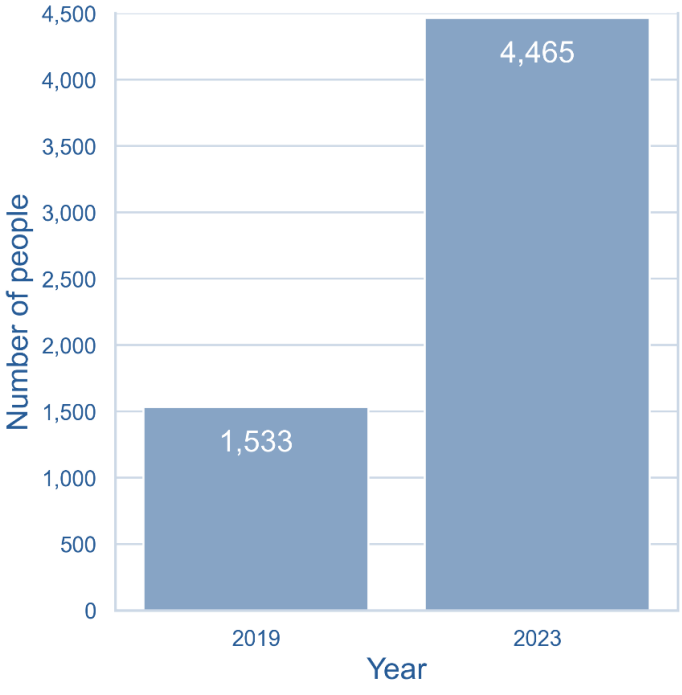


Figure 20 – Number of People Exposed to Aircraft Noise above 55 dB L_{night}



7 Possible future situations

7.1 Introduction

There are several potential situations which may affect the future noise situation at Dublin Airport. These situations are however subject to the determination of various planning applications and appeals.

The most recent forecasts of possible future noise situations at Dublin Airport were submitted to FCC by daa as part of its Infrastructure Application (F23A-0781) (IA) in December 2023.

The IA contains noise forecasts for 2027, 2031, 2034 and 2046 having regard for scenarios with and without changes to the Airport's passenger capacity providing consent for 40mppa, and with or without changes to its night-time operating restrictions (OR-1 and OR-2). For this Noise Action Plan, the forecasts for 2027 have been presented as these fall within the period of the plan.

The IA is currently under assessment and proposed changes to the Airport's night-time noise-related operating conditions as per the North Runway Relevant Action (NRRA) application are still to be determined by ABP.

The scenarios presented are summarised in **Table 7-1.**

Table 7-1 – Possible Future Scenarios in 2027 presented with the Infrastructure Application

Scenario, 2027	Description
Scenario D	Dublin Airport continues to operate with a 32 mppa passenger cap and without additional infrastructure, and there is no change to its night-time operating restrictions i.e. OR-1 and OR-2 remain in place.
Scenario B	Dublin Airport continues to operate with a 32 mppa passenger cap and without additional infrastructure, however relevant action is taken to amend and replace OR-1 and OR-2 respectively.
Scenario E	Dublin Airport is granted consent to increase its passenger capacity to 40 mppa however there are no changes to its night-time operating restrictions i.e. OR-1 and OR-2 remain in place.
Scenario C	Dublin Airport is granted consent to increase its passenger capacity to 40 mppa, and relevant action is taken to amend and replace OR-1 and OR-2 respectively.

As part of Scenarios D and E, the daa have stated that OR-2 would require the airport to operate within a nightly average of 65 aircraft movements.

Table 7-2 presents a summary of the potential outcomes of these future situations against the NAO with the percentage reduction in the population highly annoyed and highly sleep disturbed presented against 2019.

Table 7-3 to **Table 7-6** present potential changes to the population and areas exposed to aircraft noise from the reporting thresholds required under the Regulations. All population and dwelling statistics presented in **Table 7-2** are **exclusive** of forecast population growth.

Corresponding noise contours are the possible future situations summarised in **Table 7-1** can be found in **Appendix A5**.

Table 7-2 – Overview of Possible Future Situations against the NAO

Metric							
	Situation Year			Forecast Future Situation, 2027			
	2019	2021	2023	Scenario D	Scenario B	Scenario E	Scenario C
Passengers	32.9m	8.5m	33.5m	32.0m	32.0m	33.2m	35.6m
Annual 24-Hour ATMs	238,002	85,431	240,638	227,987	239,794	232,613	256,439
Annual Night-time ATMs	29,320	16,111	33,507	16,445	32,890	16,445	35,167
Population > 65 dB L_{den}	285	65	323	136	232	136	246
Population >55 dB L_{night}	1,533	305	4,465	279	2,762	279	2,937
Population Highly Annoyed - Census 2022	115,738	26,477	71,388	53,380 (-53.9%)	55,194 (-52.3%)	53,746 (-53.6%)	57,036 (-50.7%)
Population Highly Sleep Disturbed - Census 2022	47,045	13,203	32,563	19,513 (-58.2%)	23,357 (-50.4%)	19,513 (-58.5%)	24,160 (-48.6%)
Population Highly Annoyed – Future Consented	n/a	n/a	n/a	2,480	2,189	2,494	2,207
Population Highly Sleep Disturbed – Future Consented	n/a	n/a	n/a	978	1,222	978	1,316
Population Highly Annoyed – Future Zoned	n/a	n/a	n/a	3,270	3,378	3,270	3,407
Population Highly Sleep Disturbed – Future Zoned	n/a	n/a	n/a	1,987	2,166	1,987	2,176

Subject to population growth, **Table 7-2** indicates that in 2027 the daa forecast that the number of people highly annoyed and highly sleep disturbed will continue to reduce compared to 2019 and 2023. However, the degree to which this reduction occurs is dependent upon the wider consenting processes. In the case of the priority values of the NAO, without population growth but with changes to OR-1 and OR-2 there is a risk that the number of people exposed to 55 dB L_{night} would be higher than in 2019 but lower than in 2023. The number of people exposed to levels of 65 dB L_{den} is forecast to be lower than in 2019. NAO target outcomes are measured against the noise situation in 2019.

The overall reduction in harmful effects highlighted in **Table 7-2** can be explained by the forecast population exposure to L_{den} and L_{night} as presented in **Table 7-3** and **Table 7-5**.

Table 7-3 – Population, L_{den}

Metric, dB	Year and Situation						
	Situation			Forecast Future Situation, 2027			
	2019	2021	2023	Scenario D	Scenario B	Scenario E	Scenario C
55 – 59.9	27,818	12,591	28,228	22,896	21,850	22,952	22,968
60 – 64.9	5,994	701	8,904	3,882	5,654	3,985	6,032
65 – 69.9	254	65	301	128	214	128	228
70 – 74.9	25	0	22	8	18	8	18
>= 75	6	0	0	0	0	0	0

Table 7-4 – Area (km^2), L_{den}

Metric, dB	Year and Situation						
	Situation			Forecast Future Situation, 2027			
	2019	2021	2023	Scenario D	Scenario B	Scenario E	Scenario C
55 – 59.9	52.7	26.1	65.2	53.6	58.3	54.0	60.4
60 – 64.9	23.3	8.9	26.8	21.0	25.4	21.2	26.3
65 – 69.9	7.9	2.6	8.9	6.7	7.9	6.7	8.3
70 – 74.9	2.7	0.7	2.6	2.0	2.7	2.0	2.8
>= 75	1.7	0.5	1.5	1.3	1.6	1.3	1.6

Table 7-5 – Population, L_{night}

Metric, dB	Year and Situation						
	Situation			Forecast Future Scenario, 2027			
	2019	2021	2023	Scenario D	Scenario B	Scenario E	Scenario C
50 – 54.9	12,305	3,267	18,272	10,560	10,009	10,560	10,753
55 – 59.9	1,423	289	4,297	257	2,705	257	2,873
60 – 64.9	97	16	160	22	54	22	61
65 – 69.9	13	0	8	0	3	0	3
>= 70	0	0	0	0	0	0	0

Table 7-6 – Area (km^2), L_{night}

Metric, dB	Year and Situation						
	Situation			Forecast Future Scenario, 2027			
	2019	2021	2023	Scenario D	Scenario B	Scenario E	Scenario C
50 – 54.9	33.7	16.3	37.0	20.9	35.3	20.9	36.4
55 – 59.9	12.2	5.2	12.6	6.9	12.0	6.9	12.6
60 – 64.9	3.9	1.5	4.1	2.1	3.9	2.1	4.0
65 – 69.9	1.5	0.4	1.2	0.6	1.2	0.6	1.3
>= 70	1.0	0.3	0.7	0.5	0.9	0.5	0.9

Table 7-4 and **Table 7-6** present the areas exposed to aircraft noise above the reporting thresholds of the Regulations. These indicate that the area exposed for the L_{den} metric is forecast to reduce. For the L_{night} metric, subject to relevant action and changes to OR-1 and OR-2, the areas exposed to night-time noise could remain reasonably consistent with 2023.

8 Identification of Problems and Situations that need to be Improved

8.1 Overview of the Situation

The results of the noise mapping and the indicated performance against the NAO as described in **Section 6** against the assessment year of 2023 demonstrates that the management of the aircraft noise climate around Dublin Airport remains challenging.

Since 2006 and the first round of strategic noise mapping under the Regulations, the reported population, dwellings and areas exposed to aircraft noise has increased up to 2023 with respect to noise exposure above the reporting thresholds set by the Regulations for both the L_{den} and L_{night} metrics.

The latest exposure data prepared by daa for 2023 indicates that progress towards the medium to long-term reductions in harmful effects set out in Part 3 of the NAO for 2030 is on track. However, there are more people being exposed above the NAO priority values of 55 dB L_{night} and 65 dB L_{den} compared to the situation in 2019.

Section 7 identifies a number of possible future situations which may occur over the timeframe of this Noise Action Plan. Forecasts provided for 2027 as part of daa Infrastructure Application (F23A-0781) indicate that the medium to long-term outcomes of the NAO are forecast to achieve the objective, subject to population growth. However, the night-time priority of the NAO may not be achieved.

Night-time operations at Dublin Airport are the subject of ongoing legal and planning appeal proceedings.

The current and possible future situations described in this Noise Action Plan, amongst all other information prepared by daa, are being considered by ANCA and the planning authority as part of their functions under the Act of 2019 and the Act of 2000.

8.2 Areas of Improvement

The Noise Action Plan 2019-2023 identified a range of measures to ensure that the proposed noise management framework at the airport would be improved through actions to be delivered during the duration of the plan.

Some of this proposed management framework remains relevant for ongoing consideration:

1) Opportunities may exist to further develop the flight reporting software (Webtrak) as delivered during the 2019-2023 plan to provide additional community information such as flight tracks. It is important to ensure that there is community self-service access to good quality information relating to the noise climate around the airport and the factors that influence it.
2) Opportunities may exist to identify and implement improvements in noise abatement procedures in the AIP.
3) Reduction of noise at source is an important objective. The promotion of quieter aircraft through

incentives, particularly at night, such as FlyQuiet programmes or environmental charges schemes should continue to be progressed.

4) The noise complaints management system is a valuable tool for communities to report aircraft noise concerns. The process of accepting, responding to and using the information provided through the complaints system should remain under ongoing review to identify and implement process enhancements where possible.

5) The significantly increased number of noise monitoring terminals has been a valuable enhancement to the network of monitors. Further improvements may be obtained by reviewing the locations of monitors to ensure they are closely aligned with airspace operations.

8.3 Problems and Situations that need to be Improved

The data presented in this noise action plan indicates the existence of problems and/or situations that need to be improved at the airport having regard to the noise situation reported under the Regulations and for 2023 and when considered against the measurable outcomes of the NAO. Furthermore, **Section 8.2** identifies a series of improvements with respect to how noise is measured and communicated and in mitigation measures which seek to manage aircraft noise at Dublin Airport.

Section 9.2 presents the actions that should be implemented over the duration of the Noise Action Plan to address problems and/or situations that need to be improved at Dublin Airport.

9 Actions

9.1 Long-term Strategy

The long-term aircraft noise management strategy of FCC, including proposed policies and objectives, are set out in the Fingal Development Plan and the NAO.

The Development Plan seeks to safeguard the current and future operation of Dublin Airport, and its ongoing development.

With regards to noise from Dublin Airport, Objective DAO13 of the Development Plan states:

"Ensure that aircraft-related development and operation procedures proposed and existing at the Airport consider the requirements of the Aircraft Noise Regulations, the Noise Abatement Objective (NAO) for Dublin Airport, the Noise Action Plan, Health Issues and all measures necessary to mitigate against the potential negative impact of noise from aircraft operations (such as engine testing, taxiing, taking off and landing), on existing established residential communities, while not placing unreasonable, but allowing reasonable, restrictions on airport development to prevent detrimental effects on local communities, taking into account the EU Regulation 598/2014 (or any future superseding EU regulation applicable) having regard to the 'Balanced Approach' and the involvement of communities in ensuring a collaborative approach to mitigating against noise pollution."

The implementation and assessment of performance against the Development Plans objectives is primarily the responsibility of FCC.

The NAO for Dublin Airport, as described in **Section 4.7**, sets out the overarching noise policy objective as 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".

9.2 Review of Previous Actions

The Noise Action Plan for Dublin Airport for 2019 – 2023 contained 13 actions in support of the management of aircraft noise at Dublin Airport. **Table 9-1** presents a review of these actions.

Table 9-1 – Review of Actions from Noise Action Plan 2019 - 2023

Action	Description	Review
1	Encourage daa to work with airline partners to introduce quieter aircraft, particularly at night – including consideration of incentives	Based on the measures reported in **Section 5.2** of this Noise Action Plan, the daa has introduced incentives to promote the use of quieter aircraft through environmental charges. These charges were introduced during the period of the previous Noise Action Plan but there is no evidence regarding the effectiveness of these charges.
2	Encourage daa to promote quieter aircraft	The annual reviews did not report progress on this action.

	through incentives such as FlyQuiet programmes.	The progress of incentives such as FlyQuiet programmes is addressed in the annual compliance reports prepared by the daa, through section 19 of the Act of 2019 and published on the ANCA website. The report for 2022 highlights the matter as in-progress.
3	Keep under review land-use policies in relation to aircraft noise through the review of existing land use planning frameworks in so far as they relate to Dublin Airport.	Since the commencement of the previous noise action plan, noise zones have been established and are in place through the Fingal Development Plan 2023 – 2029. These are described in **Section 5.4** of this Noise Action Plan.
4	Monitor noise encroachment associated with Dublin Airport to ensure that airport noise policy is appropriately informed through land use planning frameworks in so far as they relate to Dublin Airport.	A study by FCC Planning Authority during the duration of the NAP 2019 -2023 supported the development of a new aviation noise land use zoning system around Dublin Airport that was subsequently incorporated into the county development plan. Noise contours have been prepared that extend outward from the airport that delineate areas affected by different ranges of noise exposure to ensure that development occurs in areas considered acceptable for that use.
5	Request daa to undertake a review of Departure Noise Abatement Procedures and to publish the findings	The annual reviews did not report progress on this action.
6	Request daa to monitor and publicly report key performance with respect to the Airport's existing Noise Abatement Procedures	daa is required under the Act of 2019 to report on the compliance of airport users with noise mitigation measures and operating restrictions. This reporting has been in place since 2019[16]. These measures include its noise abatement procedures.

[16] Annual reports on the compliance of airport users with noise mitigation measures and operating restrictions are available at: Airport Authority Compliance Reports | Fingal County Council

7	Request daa to produce annual noise contours and metrics and to share this information with interested parties	Annual noise contours were provided to FCC on an annual basis since 2019. These are published on the ANCA website.
8	Encourage daa to continue to operate noise complaint management systems and respond to all aviation related noise complaints in a timely manner	The daa operates a noise complaint management system. Complaints may be made through a webform, telephone, post and Webtrak. Complaint management is addressed in the annual compliance reports[17] prepared by the daa, through section 19 of the Act of 2019 and published on the ANCA website.
9	Promote the introduction of live (or near live) flight reporting software (such as Webtrak)	WebTrak now in place for Dublin Airport with a facility to examine flight tracks and the noise level of individual aircraft.
10	Promote the enhancement of the Noise Flight Track System to include where appropriate additional fixed and/or mobile noise monitoring terminals	An expansion programme of NMTs was completed during the duration of the Plan through a Direction by ANCA to provide 23 permanent measuring stations and 2 mobile units. These are available to view through WebTrak.
11	Engage proactively with communities through the Dublin Airport Environment Working Group (DAEWG) and the St. Margaret's Community Liaison Group	**Section 5.6** outlines the engagement with community groups.
12	Review any updates in advice from bodies such as the WHO and the European Environment	FCC has regard to best practice in relation to aircraft noise and its health and quality of life effects when making of statutory plans or decisions.

[17] Airport Authority Compliance Reports | Fingal County Council

	Agency in relation to aircraft noise and its health and quality of life effects	ANCA has incorporated the principles of the various WHO environmental noise guidelines for the European region into the NAO for Dublin Airport.
13	Request the submission of an annual report by daa outlining measures undertaken to achieve actions listed in this table	The Noise Action Plan annual progress report was submitted by FCC to the EPA each year, reporting on progress against the activities set out within the Noise Action Plan for the previous calendar year.

9.3 Actions to Take Place Over the Duration of the Noise Action Plan (2024-2028)

Table 9-2 presents a range of actions to be taken over the duration of this plan.

Table 9-2 – Noise Action Plan for 2024-2028

No	Action	Description	Implementation Authority
1	Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes.	The noise mitigation measures at Dublin Airport including those reported by the airport authority in **Table 5-1** and listed below, shall be implemented: 1) Promote quieter aircraft through incentives such as Fly Quiet programmes. 2) Work with airline partners to introduce quieter aircraft, particularly at night – including consideration of incentives 3) Preferential Runway Use 4) Noise Preferential Routes (NPRs) and Flight-Track Keeping 5) Noise Abatement Departure Procedures (NADPs) Climb Profile 6) Visual Approach Jet Aircraft (Category C/D) 7) Continuous Climb Operations / Continuous Decent Approach 8) Reverse Thrust 9) Engine Ground Running 10) Monitor and Report 11) Stakeholder Engagement 12) Community Engagement Programme 13) Noise & Flight Track Monitoring System 14) Noise Complaint Management Systems 15) Runway 10L-28R shall not be used for take-off or landing between 23:00 and 07:00 16) The average number of nighttime aircraft movements at the airport shall not exceed 65/night (between 23:00 and 07:00) when measured over the 92-day modelling period 17) Residential Noise Insulation Scheme (RNIS)	daa

No	Action	Description	Implementation Authority
		18) Voluntary Dwelling Purchase Scheme (VDPS) 19) Voluntary School Insulation Scheme (SIS) Further new noise mitigation measures shall be introduced as they are identified.	
2	Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Act of 2000 and/or the Aircraft Noise Regulation as appropriate.	This Noise Action Plan identifies problems and situations that need to be improved at Dublin Airport. The process of aircraft noise regulation as defined under Section 9 of the Act of 2019 will proceed to ensure that the noise situation at the airport is assessed in accordance with relevant legislation Following this, the measures available to reduce the problems and situations that need to be improved will be identified and the cost effectiveness of the measures determined. The measures will consider the four principal elements of the ICAO Balanced Approach, namely: • Reduction of noise at source; • Noise abatement operating procedures; • Land use planning and management; and • Operating restrictions; Consultation on any intended actions will be held with stakeholders, including residents and businesses, in a transparent way, in accordance with Section 9 of the Act of 2019.	FCC
3	Carry out a review of the Noise Abatement Objective for Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies.	The NAO for Dublin Airport will be, as appropriate, restated or amended, taking into account, as appropriate, Article 8 of, and Annex V to, the Environmental Noise Directive	FCC

No	Action	Description	Implementation Authority
4	Undertake an encroachment analysis to ensure that relevant plans and objectives remain effective to ensure that land use planning is an effective component of the ICAO balanced approach at Dublin Airport.	An encroachment analysis to be carried out. This will consider changes in population and land use alongside changes in aircraft noise exposure, including during the night.	FCC

10 Evaluating the implementation and the results of the noise action plan

10.1 Annual progress report

Under the Regulations, FCC is required to report annually to the EPA on all actions taken under each action plan or revised action plan in the previous year.

The annual Noise Action Plan progress report is to be submitted by FCC to the EPA each year, reporting actions undertaken, and progress against the activities set out within the Noise Action Plan during the previous calendar year.

From 2025, FCC will use these annual reports to present progress against the actions set out in **Section 9** of this Noise Action Plan.

10.2 Reporting

FCC shall ensure that this Noise Action Plan is submitted to the EPA using the templates from the EEA mandatory reporting mechanism, Reportnet 3, or other templates provided by the EPA, along with metadata, within one month of being made. Additional guidance on reporting the summary noise action plans in line with EEA Reportnet 3 to the EPA will be provided as necessary.

Reportnet 3 is an electronic reporting mechanism that combines the requirements of the END and INSPIRE. Fundamentally it is a data model documentation of a series of related datasets.

The Agency (EPA) is to report the results of the strategic noise maps to the Commission within 6 months of the dates set out in ENR (Regulation 12) using the mandatory EEA Reportnet 3 data repository. In the event that the Agency wants to update information available to the data repository, it shall describe the differences between the updated and original information and the reasons for the update when making the updated information available to the data repository.

Appendices

A1 Glossary

Term	Description
ABP	An Bord Pleanála
AEDT3e	Aviation Environmental Design Tool Version 3e
AIP	Aeronautical Information Publication
ANCA	The Aircraft Noise Competent Authority
ANOMS	Airport Noise Monitoring System
ANSP	Air Navigation Service Provider
AOA	American Overseas Airlines
APA	Action Planning Authority
ANR	Aircraft Noise Regulation
ATC	Air Traffic Control
APU	Auxiliary Power Unit. A power unit located on the aircraft.
ATM	Air Traffic Movement
CAP	Climate Action Plan
CCO	Continuous Climb Operations
CDA	Continuous Decent Approach
CLG	Community Liaison Group
daa	The airport authority for Dublin Airport
DACP	The Dublin Airport Central Masterplan
DAEWG	Dublin Airport Environment Working Group
dB (A)	A unit of sound pressure level, adjusted in accordance with the A weighting scale, which takes into account the increased sensitivity of the human ear at some frequencies.
DCC	Dublin City Council
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. Its logarithmic nature allows very large or very small ratios to be represented by a convenient number. Being a ratio, it is a dimensionless unit. Decibels are used for a wide variety of measurements including acoustics, and for audible sound A-weighted decibels (dB (A)) are commonly used.
DTTAS	Department of Transport, Tourism and Sport
EC	European Commission
ECAC	European Civil Aviation Conference
EEA	European Environment Agency
EMRA	Eastern & Midland Regional Assembly
END	Environmental Noise Directive
ENG18	Environmental Noise Guidelines for the European Region 2018
EPA	Environmental Protection Agency

ERF	Exposure Response Function
EU	European Union
FAA	Federal Aviation Administration
FCC	Fingal Country Council
FDP	Fingal Development Plan
GANP	Global Air Navigation Plan
HA	Highly Annoyed
HSD	Highly Sleep Disturbed
HSIP	Home Sound Insulation Programme
IA	Infrastructure Application
IAA	Irish Aviation Authority
ICAO	International Civil Aviation Organization
IHD	Ischaemic Heart Disease
ILS	Instrument Landing System
$L_{Aeq, 16h}$	The A-weighted average sound level over the 16 hour period of 07:00 – 23:00
$L_{Aeq, 8h}$	The A-weighted average sound level over the 16 hour period of 23:00 – 07:00
$L_{Aeq,T}$	The notional A-weighted equivalent continuous sound level which, if it occurred over the same time period, would give the same noise level as the actual varying sound level. The T denotes the time period over which the average is taken, for example $L_{Aeq,8h}$ is the equivalent continuous noise level over an 8 hour period.
L_{AMAX}	The maximum A-weighted sound level (in dBA) measured during an aircraft fly-by
LAP	Local Area Plan
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_{eq}	Equivalent sound level of aircraft noise in dB(A), often called equivalent continuous sound level. For conventional historical contours this is based on the daily average movements that take place in the 16 hour period (07:00 - 23:00 LT) during the 92 day period 16 June to 15 September inclusive.
$L_{evening}$	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
MCC	Meath County Council
MPPA	Million Passengers Per Annum
MTOW	Maximum Take-Off Weight
NADP	Noise Abatement Departure Procedures
NAO	Noise Abatement Objective
NAP	Noise Action Plan
NAPI	National Aviation Policy for Ireland
NDP	National Development Plan
NFTMR	Noise and Flight Track Monitoring Reports
NMB	Noise Mapping Body
NMT	Noise Monitoring Terminals

Noise Contour	Map contour line indicating noise exposure in dB for the area that it encloses
NPF	National Planning Framework
NPRs	Noise Preferential Routes
NRPP	North Runway Planning Permission
NQS	Noise Quota Scheme
NTK	Noise and Track Keeping monitoring system. The system associates radar data from air traffic control radar with related data from noise monitors at prescribed positions on the ground.
OR	Operating Restrictions
PCP	Pilot Common Project
PPA	Passengers Per Annum
RD	Regulatory Decision
RNIS	Residential Noise Insulation Scheme
RSES	The Regional Spatial and Economic Strategies
RSIGS	Residential Sound Insulation Grant Scheme
SEA	Strategic Environment Assessment
SEL	Sound Exposure Level
SES	Single European Sky programme
SID	Standard Instrument Departure
SSIS	Schools Sound Insulation Scheme
VDPS	Voluntary Dwelling Purchase Scheme
WHO	World Health Organization
ZPAP	Zero Pollution Action Plan

A2 Public Consultation and Stakeholder Engagement

The draft Dublin Airport Noise Action Plan was available for public consultation and accepted submissions for 6 weeks from 3rd September 2024 to 15 October 2024. The plan and associated environmental assessment documents could be viewed and downloaded from the Fingal County website. Interactive maps were also available. The interactive viewer facilitates the examination of the mapped aircraft noise exposure down to the level of individual homes and businesses for 2016, 2021, 2013 and the future forecast year of 2027.

The following Bodies/Agencies were circulated for comment on this draft document:

- Statutory Consultees:
    - Noise mapping body for Dublin Airport
    - Environmental Protection Agency

Other relevant consultees such as government departments, NGOs and citizen groups were consulted through the wider public consultation process and notified through the national press, public website and social media channels.

Other relevant consultees include:

- Department of the Environment, Climate and Communications
- Department of Transport
- Department of Housing, Local Government and Heritage
- Climate Change Advisory Council
- Action Planning Authorities for adjacent areas
- Local and regional authorities
- NGOs and professional bodies
- Local and national citizens groups.

A3 Strategic Noise Mapping Reports

Bickerdike
Allen
Partners
Architecture
Acoustics
Technology

DUBLIN AIRPORT

2023 NOISE CONTOURS

Prepared for:

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Dublin Airport
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Page No.

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1.0 INTRODUCTION

Bickerdike Allen Partners (BAP) have been retained by Dublin Airport Authority (daa) to produce noise contours for 2023. Noise contours have been produced based on the annual movements using the L_{den} and L_{night} metrics, and based on the summer movements (16th June to 15th September) using the $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metrics. Both sets of contours have been produced firstly based on the actual runway used by each aircraft, and secondly based on a long term modal split to assign the movements to specific runways.

This report presents the areas of the resulting noise contours, the population and dwelling counts within them, and a summary of the movements used to produce them. The noise contours are also presented in figures overlaid on Ordnance Survey Ireland base maps.

A glossary of acoustic terminology is given in Appendix 1.

2.0 NOISE MODELLING METHODOLOGY

Noise levels have been predicted using the Federal Aviation Authority prediction methodology, the Aviation Environmental Design Tool (AEDT) Version 3f. This computation method complies with the guidance given in ECAC Doc 29 4th Edition.

There are six basic datasets required for the aircraft noise modelling. These are the physical details of the airport, the topography of the surrounding area, the aircraft movements themselves, the aircraft flight profiles, the details of the routes flown by the aircraft movements and local noise measurement data. The following sections describe how each of these datasets have been used.

Noise contours and noise levels at dwelling locations have been generated in terms of the L_{den}, L_{night}, $L_{Aeq,16h}$ and $L_{Aeq,8h}$ noise metrics.

2.1 Physical details of airport

Dublin Airport data relevant to the AEDT study is taken from the latest version of the Irish Aviation Authority (IAA) Integrated Aeronautical Information Publication (AIP). This includes details of the location, length and orientation of the runways.

2.2 Topography of surrounding area

The AEDT model developed for Dublin Airport contains data for the terrain in the area surrounding the airport. The terrain data has been provided by eMapSite.

2.3 Aircraft movements

Details of all the aircraft movements at Dublin Airport during the 2023 calendar year were provided by daa. This actual aircraft movement data was processed by BAP as detailed below to enable input into the AEDT software.

2.3.1 Time period

The actual runway time of each movement in the log is given to the nearest minute, in local time. Using this, each movement has been categorised as occurring in the day (07:00-18:59), evening (19:00-22:59) or night (23:00-06:59) period as appropriate.

2.3.2 Aircraft type

The AEDT software includes noise information for many common aircraft types, but it does not include data for every aircraft type. Therefore, the aircraft operational codes used in the movement data need to be mapped to Aircraft Noise and Performance (ANP) aircraft types in the AEDT software. For some aircraft types, substitutions are proposed by the AEDT software where a similar alternative aircraft type is used to model the actual type. For larger aircraft types this generally does not involve a change but for the smaller aircraft, and in particular the general aviation aircraft, some substitutions occur. Where AEDT has no guidance, an aircraft type has been assigned based on the aircraft size and engine details. In a small number of cases, BAP's experience is that the type suggested by AEDT is not appropriate, and therefore in these cases a more representative type has been used.

It is relevant to separately consider Category A/B aircraft and Category C/D aircraft as they operate differently, in particular having different departure routes specified in the AIP. These categories are based on aircraft approach speeds. Propeller aircraft are typically in Category A/B, whereas jet aircraft are typically in Category C/D.

Table 1 below presents a summary of the 2023 movements by aircraft type and time period.

Aircraft Type	2023 Actual Movements				
	Annual			92-Day Summer	
	Day 07h-19h	Evening 19h-23h	Night 23h-07h	Day 07h-23h	Night 23h-07h
Airbus A220-100	356	178	10	148	3
Airbus A220-300	1,509	394	183	496	37
Airbus A306	55	1	52	13	13
Airbus A319	2,070	250	189	447	30
Airbus A320	34,819	7,732	6,839	11,827	2,511
Airbus A320neo	6,594	1,562	455	2,117	174
Airbus A321	1,795	584	944	622	252
Airbus A321neo	6,294	328	1,326	2,177	326
Airbus A330	7,567	40	1,346	2,216	394
Airbus A330neo	6	1	1	1	1
Airbus A350	624	1	382	236	109
ATR 42	163	2	1	60	0
ATR 72	17,398	2,938	1,106	5,915	192
Boeing 737-400	42	27	555	19	143
Boeing 737-700	253	71	35	26	1
Boeing 737-800	47,585	17,474	10,204	16,243	2,527
Boeing 737 MAX	15,402	5,129	4,889	6,945	1,770
Boeing 757	1,651	334	409	750	144
Boeing 767	2,775	518	845	863	209
Boeing 777	1,525	605	805	664	350
Boeing 787	3,958	1	1,365	1,427	392
Bombardier Dash 8	421	102	1	158	0
Embraer E190/195	5,277	1,570	601	1,924	220
Embraer E190-E2	562	265	119	198	36
Cessna 560XL	664	79	22	198	6
Embraer Phenom 300	471	42	14	159	2
Bombardier Global Express	382	63	49	160	11
Learjet 35/40/45	459	58	114	167	40
Other	5,094	1,011	646	1,819	176
Total	**165,771**	**41,360**	**33,507**	**57,995**	**10,069**

Table 1: 2023 Actual Movements

2.3.3 Operation

Each movement in the data is categorised as either an arrival or a departure and has been modelled as such.

2.3.4 Runway Use

The runway used was supplied for each movement in the 2023 data and has been modelled as such for the contours based on the actual modal split.

For the contours based on the long term modal split, there are two factors which determine which runway is used for an aircraft operation. The first is which direction or "mode" the airport is operating. This is primarily determined by the wind direction and is known as modal split. A summary of the overall actual modal split for 2023 is given in Table 2.

Runway	Runway End	Percentage of Flights
North Runway / South Runway	10L / 10R	27%
	28L / 28R	73%
Cross Runway	16	100%
	34	0%

Table 2: Summary of Actual 2023 Runway Modal Split

The long term average (2014-2023) modal split is given in Table 3. As the Cross Runway (16/34) was used for capacity reasons rather than due to wind direction for the majority of the years used in the average, a separate long term modal split has been applied to this runway.

Runway	Runway End	Percentage of Flights
North Runway / South Runway	10L / 10R	22%
	28L / 28R	78%
Cross Runway	16	75%
	34	25%

Table 3: Modelled Runway Modal Split (10-year Average)

The second factor is that at Dublin Airport there are differences in the use of the North Runway and the South Runway at different times of day and in different operating modes. Additionally, during 2023 there were a number of changes associated with the opening of the North Runway. This modelling has preserved the relative distribution of flights between the North Runway and the South Runway in 2023 presented in Table 4 and Table 5. This has been done separately for arrivals and departures, time periods, aircraft types and operating modes.

Arrivals Operating Mode	Runway End	Percentage of Flights		
		Day	Evening	Night
Easterly (10L/10R)	10L	82%	29%	4%
	10R	18%	71%	96%
Westerly (28L/28R)	28L	99.7%	98%	96%
	28R	0.3%	2%	4%

Table 4: 2023 Summary of Arrivals by Runway, Operating Mode and Period

Departures Operating Mode	Runway End	Percentage of Flights		
		Day	Evening	Night
Easterly (10L/10R)	10L	0.3%	0%	1%
	10R	99.7%	100%	99%
Westerly (28L/28R)	28L	15%	44%	99%
	28R	85%	56%	1%

Table 5: 2023 Summary of Departures by Runway, Operating Mode and Period

2.3.5 Stage length

For the departure movements, the AEDT software offers a number of flight profiles for most aircraft types, particularly the larger aircraft types. These relate to different departure weights, which are greatly affected by the length of the flight and consequently the fuel load. In the AEDT software this is referred to as the stage length. The stage length is defined in increments of 250 nmi from 500 nmi up to 1500 nmi and then in increments of 500 nmi. As the stage length increases, the aircraft has to depart with greater fuel and so its flight profile is slightly lower than when a shorter stage length is flown.

Destination airports were given with the aircraft movement data. Stage lengths have been calculated for each aircraft departure, where AEDT offers the option, based on the distance of these airports from Dublin Airport.

2.3.6 Aircraft route

There is a single modelled arrival route for each runway end.

Departure routes were assigned based on the radar tracks of each aircraft. Details of the modelled departure routes are given in Appendix 2.

2.4 Aircraft flight profiles

For each of the main noise-dominant aircraft types, the radar data for the calendar year of 2023 was reviewed and a custom profile created to match the actual flown profile as closely as possible. In particular it involved changes to the default initial departure thrust and the initial climb altitude for many aircraft types.

This was done separately for each runway end and for each stage length option available. Where limited data was available, assumptions were made based on other data for that aircraft type and runway end. Details of this process are given in Appendix 3.

For aircraft types other than the main noise-dominant types, the "STANDARD" or "MODIFIED_AW" profiles available in AEDT were used, depending on the stage length.

2.5 Aircraft routes

2.5.1 Arrivals

For arrival operations using the North Runway or the South Runway, aircraft are generally lined up with the extended centreline of the runway at least 17 km from the runway threshold. Consequently, the North Runway and South Runway arrival routes have been modelled as straight out to this point. Before this point arrivals are modelled using 7 routes at each end, which cover the broad swathe of directions that the arriving aircraft approach from. Flights have been equally distributed between the 7 routes.

These assumptions for the North and South Runways are based on an analysis of South Runway radar data in 2018. A review of recent radar data indicates that there have been no significant changes to arrival routes since 2018 and that the North Runway routes replicate those on the South Runway.

For arrival operations using Runway 16 or Runway 34, aircraft have been modelled as following the extended runway centreline within the area to be mapped as this is less than 17 km from the runway threshold.

2.5.2 Departures

For departures, as aircraft disperse about the routes they are assigned to, it is standard practice to represent this in the modelling software using a set of dispersed tracks, with a percentage of the departures assigned to each one. This has been done for each of the departure routes by analysing radar data to produce the set of dispersed tracks. Category A/B aircraft are defined as having different departure routes than category C/D aircraft in the AIP, and therefore have been considered separately for this exercise.

More details on the derivation of departure routes are given in Appendix 2.

2.6 Noise Monitoring Data

Results from the Dublin Airport Noise and Track Keeping (NTK) system have been used to validate the noise levels of the main noise-dominant aircraft types. Specifically, the results from NMTs 1, 2, 3, 4, 8, 20 and 204 in 2023 have been used.

There is limited measurement data available for Cross Runway operations in 2023 as they made up <1% of the total flights across the year. Therefore, only North Runway and South Runway measured data has been taken into account for these contours, although all movements have been modelled.

The noise levels from the monitors are automatically correlated with aircraft movements using the radar track keeping system and the average determined by aircraft type and operation. Several parameters are measured by the system, and for this validation the Sound Exposure Level (SEL) of the individual aircraft movements has been used.

To take into account the measured levels the AEDT software has been used to predict the level at the NMT locations. This has been compared to the measured averages for the aircraft types when separately arriving and departing. Where necessary, adjustments were made to the modelled noise levels of individual aircraft types to minimise the differences between the predicted and measured noise levels. More details of this process and the resulting adjustments are given in Appendix 4.

2.7 Noise metrics

The L_{den} unit is an L_{Aeq} for the whole 24 hour period but includes weightings depending on when during the 24 hour period the noise occurs.

If the noise is during the 12 hour day (07:00 – 18:59) there is no adjustment, if it is during the evening (19:00 – 22:59) a weighting of +5 dB(A) is added, and if it is at night (23:00 – 06:59) a weighting of +10 dB(A) is added. The unit is therefore biased to respond more to noise in the evening, and particularly at night than during the 12 hour day.

In movement terms the effect of the weightings is equivalent to more than trebling the number of movements during the evening and multiplying by ten the number of movements at night.

To compute the L_{den} noise metric, each period is considered separately and an L_{Aeq} determined for it. The weightings are then added to the evening L_{Aeq} and night L_{Aeq} with each L_{Aeq} then added together taking into account the period durations.

L_{night} , $L_{Aeq,8h}$ (both 23:00 – 06:59) and $L_{Aeq,16h}$ (07:00 – 22:59) metrics are a simple L_{Aeq} of the relevant periods with no weighting applied, being a duration of 8 or 16 hours.

The L_{den} and L_{night} metrics relate to the average annual day, whereas the $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metrics relate to the average summer (16 June – 15 September inclusive) day.

3.0 POPULATION AND DWELLING EXPOSURE ASSESSMENT METHODOLOGY

3.1 Exposure Assessment Metrics

The Noise Abatement Objective (NAO) for Dublin Airport requires the measurement of four metrics:

- The number of people Highly Annoyed (HA) by aircraft noise
- The number of people Highly Sleep Disturbed (HSD) by aircraft noise
- The number of people exposed to at least 65 dB L_{den}
- The number of people exposed to at least 55 dB L_{night}

The number of people Highly Annoyed (HA) and Highly Sleep Disturbed (HSD) is calculated in accordance with EU Directive 2020/367. This specifies the use of the following formulae:

$$\#\ People\ HA = \left(-0.509693 + 0.010168 \times L_{den} + 0.000072 \times {L_{den}}^2\right)$$

$$\#\ People\ HSD = \left(0.167885 - 0.009293 \times L_{night} + 0.000198 \times {L_{night}}^2\right)$$

Directive 2020/367 states that the total number of people HA or HSD should be calculated at the central value of each noise band, although there is no recommendation for the band width (examples of a 50-51 dB band and a 50-54 dB band are given). For this assessment, a band width of 1 dB has been used.

In the Aircraft Noise Competent Authority (ANCA) Noise Abatement Objective Report for Dublin Airport of 20th June 2022, it is stated that:

> *"The measures shall be calculated using population estimates representative of the current year or year of interest as well as against a baseline population representative of the year 2019"*

It is therefore necessary to carry our two separate assessments using different population datasets, one for 2023 and one for 2019.

3.2 Dwelling exposure assessment

To derive the dwelling exposure statistics a dataset of the locations of the properties has been used, specifically the GeoDirectory data developed by OSi and An Post. This provides a single location point for each building in Ireland. The GeoDirectory is updated quarterly. The datasets used for this assessment are 2023 Q3 and 2019 Q2.

As GeoDirectory provides a location point for all buildings and not just residential ones, it is necessary to undertake a filter procedure. This has been undertaken by utilising the additional information contained in the GeoDirectory data on each location. This allows the removal of the commercial properties, derelict buildings, and those under construction. The GeoDirectory also identifies multiple properties at the same location, such as a block of flats. The resultant dataset contains the location points for all residential buildings.

The noise model has been used to compute the noise level at the location of each of the residential buildings.

3.3 Population exposure assessment

Two population datasets have been used in this assessment. The 2023 Q3 dataset has been used to represent the population in 2023, and has been computed for all metrics. The 2019 Q2 dataset has been used to represent the population in 2019.

3.3.1 2023 Q3

Small Area Population Statistics (SAPS) are Census statistics covering the whole of Ireland. The 2022 Census results for Small Areas have been utilised for this assessment.

To create a dataset for the occupied residential buildings the vacant residential buildings have been identified and removed from the 2023 Q3 GeoDirectory data. The occupied residential buildings were then processed to determine into which of the Small Areas used in the reporting of census information they fall.

The population totals for each Small Area have been divided by the number of occupied residential buildings to derive an average number of people per occupied residential building.

The noise model has been used to compute the noise level at the location of each of the occupied residential buildings.

3.3.2 2019 Q2

Small Area Population Statistics (SAPS) are Census statistics covering the whole of Ireland. The 2016 Census results for Small Areas have been utilised for this assessment.

To create a dataset for the occupied residential buildings the vacant residential buildings have been identified and removed from the 2019 Q2 GeoDirectory data. The occupied residential buildings were then processed to determine into which of the Small Areas used in the reporting of census information they fall.

The population totals for each Small Area have been divided by the number of occupied residential buildings to derive an average number of people per occupied residential building.

The noise model has been used to compute the noise level at the location of each of the occupied residential buildings.

4.0 NOISE MODELLING RESULTS

4.1 Noise Contour Areas

The 2023 annual L_{den} contours are shown in Figures 01 and 05. The areas of the 2023 annual L_{den} contours are shown below in Table 6.

Metric Value, dB L_{den}	2023 Contour Area, km^2	
	Actual Modal Split	Long-Term Modal Split
≥ 45	630.2	637.4
≥ 50	250.4	252.1
≥ 55	105.0	104.6
≥ 60	39.8	39.8
≥ 65	13.0	13.1
≥ 70	4.1	4.2
≥ 75	1.5	1.5

Table 6: Contour Areas, L_{den} Metric

The 2023 annual L_{night} contours are shown in Figures 02 and 06. The areas of the 2023 annual L_{night} contours are shown below in Table 7.

Metric Value, dB L_{night}	2023 Contour Area, km^2	
	Actual Modal Split	Long-Term Modal Split
≥ 40	312.0	313.8
≥ 45	129.7	129.4
≥ 50	55.6	55.5
≥ 55	18.6	18.6
≥ 60	6.0	6.1
≥ 65	2.0	2.0
≥ 70	0.7	0.7

Table 7: Contour Areas, L_{night} Metric

The 2023 summer day contours are shown in Figures 03 and 07. The areas of the 2023 summer day contours are shown below in Table 8.

Metric Value, dB $L_{Aeq,16h}$	2023 Contour Area, km^2	
	Actual Modal Split	Long-Term Modal Split
≥ 51	130.3	130.5
≥ 54	74.2	74.2
≥ 57	42.8	42.8
≥ 60	22.8	22.8
≥ 63	11.9	11.9
≥ 66	6.6	6.6
≥ 69	3.6	3.5

Table 8: Contour Areas, $L_{Aeq,16h}$ Metric

The 2023 summer night contours are shown in Figures 04 and 08. The areas of the 2023 summer night contours are shown below in Table 9.

Metric Value, dB $L_{Aeq,8h}$	2023 Contour Area, km^2	
	Actual Modal Split	Long-Term Modal Split
≥ 45	138.3	139.8
≥ 48	89.5	90.8
≥ 51	51.3	51.9
≥ 54	26.9	27.0
≥ 57	13.5	13.5
≥ 60	7.0	6.9
≥ 63	3.6	3.6

Table 9: Contour Areas, $L_{Aeq,8h}$ Metric

4.2 Dwelling Totals

The number of dwellings contained within the 2023 annual L_{den} contours are shown below in Table 10 and Table 11, separately for each of the two dwelling datasets.

Metric Value, dB L_{den}	2023 Number of dwellings, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	143,954	147,221
≥ 50	45,268	45,176
≥ 55	12,221	11,535
≥ 60	2,988	2,925
≥ 65	114	114
≥ 70	8	8
≥ 75	0	0

Table 10: 2023 Q3 Dwelling Totals, L_{den} Metric

Metric Value, dB L_{den}	2023 Number of dwellings, 2019 Q2 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	134,863	137,938
≥ 50	40,261	40,166
≥ 55	9,183	8,524
≥ 60	1,774	1,741
≥ 65	110	110
≥ 70	7	7
≥ 75	0	0

Table 11: 2019 Q2 Dwelling Totals, L_{den} Metric

The number of dwellings contained within the 2023 annual L_{night} contours are shown below in Table 12 and Table 13, separately for each of the two dwelling datasets.

Metric Value, dB L_{night}	2023 Number of dwellings, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 40	74,729	74,937
≥ 45	22,276	21,909
≥ 50	7,182	7,125
≥ 55	1,339	1,337
≥ 60	63	63
≥ 65	3	3
≥ 70	0	0

Table 12: 2023 Q3 Dwelling Totals, L_{night} Metric

Metric Value, dB L_{night}	2023 Number of dwellings, 2019 Q2 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 40	68,326	68,491
≥ 45	17,793	17,439
≥ 50	5,070	5,015
≥ 55	698	689
≥ 60	60	60
≥ 65	2	2
≥ 70	0	0

Table 13: 2019 Q2 Dwelling Totals, L_{night} Metric

The number of dwellings contained within the 2023 summer day contours are shown below in Table 14.

Metric Value, dB $L_{Aeq,16h}$	2023 Number of dwellings, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 51	15,379	15,564
≥ 54	6,582	6,607
≥ 57	2,194	2,199
≥ 60	739	733
≥ 63	81	81
≥ 66	32	32
≥ 69	5	5

Table 14: 2023 Q3 Dwelling Totals, $L_{Aeq,16h}$ Metric

The number of dwellings contained within the 2023 summer night contours are shown below in Table 15.

Metric Value, dB $L_{Aeq,8h}$	2023 Number of dwellings, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	23,077	24,021
≥ 48	10,223	10,463
≥ 51	6,195	6,294
≥ 54	2,447	2,427
≥ 57	413	330
≥ 60	69	66
≥ 63	9	9

Table 15: 2023 Q3 Dwelling Totals, $L_{Aeq,8h}$ Metric

4.3 Population Totals

The number of people contained within the 2023 annual L_{den} contours are shown below in Table 16 and Table 17, separately for each of the two population datasets.

Metric Value, dB L_{den}	2023 Number of people, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	423,515	434,237
≥ 50	134,898	135,016
≥ 55	37,455	35,622
≥ 60	9,227	9,049
≥ 65	322	321
≥ 70	22	22
≥ 75	0	0

Table 16: 2023 Q3 Population Totals, L_{den} Metric

Metric Value, dB L_{den}	2023 Number of people, 2019 Q2 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	399,224	409,341
≥ 50	120,460	120,442
≥ 55	28,114	26,359
≥ 60	4,840	4,734
≥ 65	307	306
≥ 70	23	23
≥ 75	0	0

Table 17: 2019 Q2 Population Totals, L_{den} Metric

The number of people contained within the 2023 annual L_{night} contours are shown below in Table 18 and Table 19, separately for each of the two population datasets.

Metric Value, dB L_{night}	2023 Number of people, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 40	224,075	225,062
≥ 45	66,326	65,259
≥ 50	22,737	22,578
≥ 55	4,466	4,456
≥ 60	169	169
≥ 65	8	8
≥ 70	0	0

Table 18: 2023 Q3 Population Totals, L_{night} Metric

Metric Value, dB L_{night}	2023 Number of people, 2019 Q2 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 40	206,438	207,337
≥ 45	53,001	51,922
≥ 50	15,951	15,794
≥ 55	1,977	1,946
≥ 60	158	158
≥ 65	6	6
≥ 70	0	0

Table 19: 2019 Q2 Population Totals, L_{night} Metric

The number of people contained within the 2023 summer day contours are shown below in Table 20.

Metric Value, dB $L_{Aeq,16h}$	2023 Number of people, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 51	44,249	44,775
≥ 54	18,811	18,893
≥ 57	6,274	6,293
≥ 60	2,410	2,388
≥ 63	232	232
≥ 66	94	94
≥ 69	13	13

Table 20: 2023 Q3 Population Totals, $L_{Aeq,16h}$ Metric

The number of people contained within the 2023 summer night contours are shown below in Table 21.

Metric Value, dB $L_{Aeq,8h}$	2023 Number of people, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
≥ 45	68,619	71,534
≥ 48	31,815	32,546
≥ 51	19,602	19,766
≥ 54	7,718	7,672
≥ 57	1,360	1,064
≥ 60	186	178
≥ 63	25	25

Table 21: 2023 Q3 Population Totals, $L_{Aeq,8h}$ Metric

4.4 NAO Metrics

The results of the four metrics required to be measured as part of the NAO are presented in Table 22 and Table 23 below, separately for each of the two population datasets.

Metric	2023 Number of people, 2023 Q3 Dataset	
	Actual Modal Split	Long-Term Modal Split
# People HA	71,387	72,220
# People HSD	32,563	32,642
# People ≥ 65 dB L_{den}	322	321
# People ≥ 55 dB L_{night}	4,466	4,456

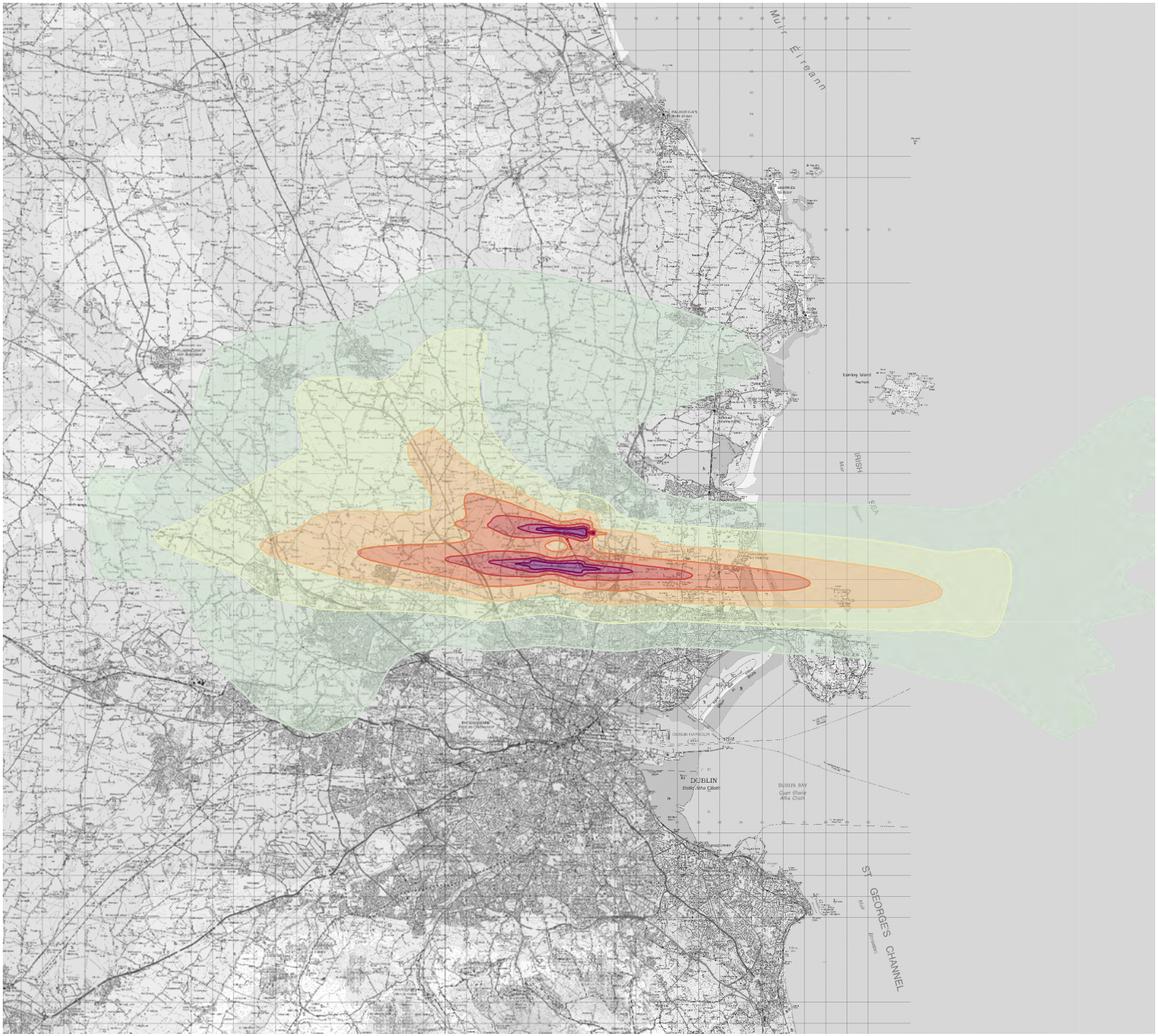
Table 22: 2023 Q3 NAO Results

Metric	2023 Number of people, 2019 Q2 Dataset	
	Actual Modal Split	Long-Term Modal Split
# People HA	65,656	66,440
# People HSD	29,293	29,364
# People ≥ 65 dB L_{den}	307	306
# People ≥ 55 dB L_{night}	1,977	1,946

Table 23: 2019 Q2 NAO Results

Nick Williams
for Bickerdike Allen Partners LLP

David Charles
Partner



LEGEND:

- 45 - 49 dB(A) L_{den}
- 50 - 54 dB(A) L_{den}
- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

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Dublin Airport
Annual Noise Contours

Figure 01
2023 Annual L_{den} Noise Contours
Actual Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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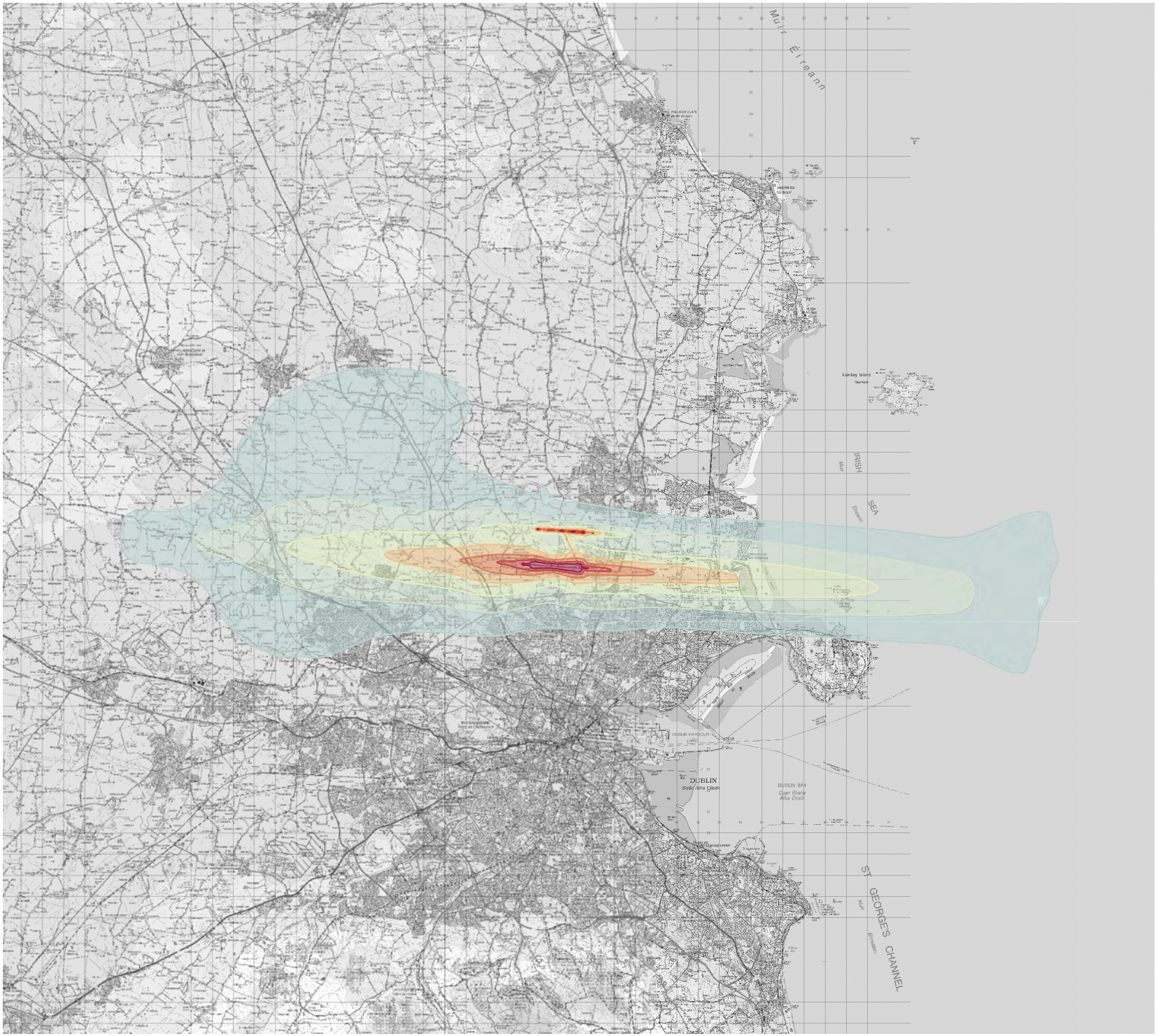

LEGEND:

- 40 - 44 dB(A) L_{night}
- 45 - 49 dB(A) L_{night}
- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

Rev	Date	Description	Initials

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Figure 02
2023 Annual L_{night} Noise Contours
Actual Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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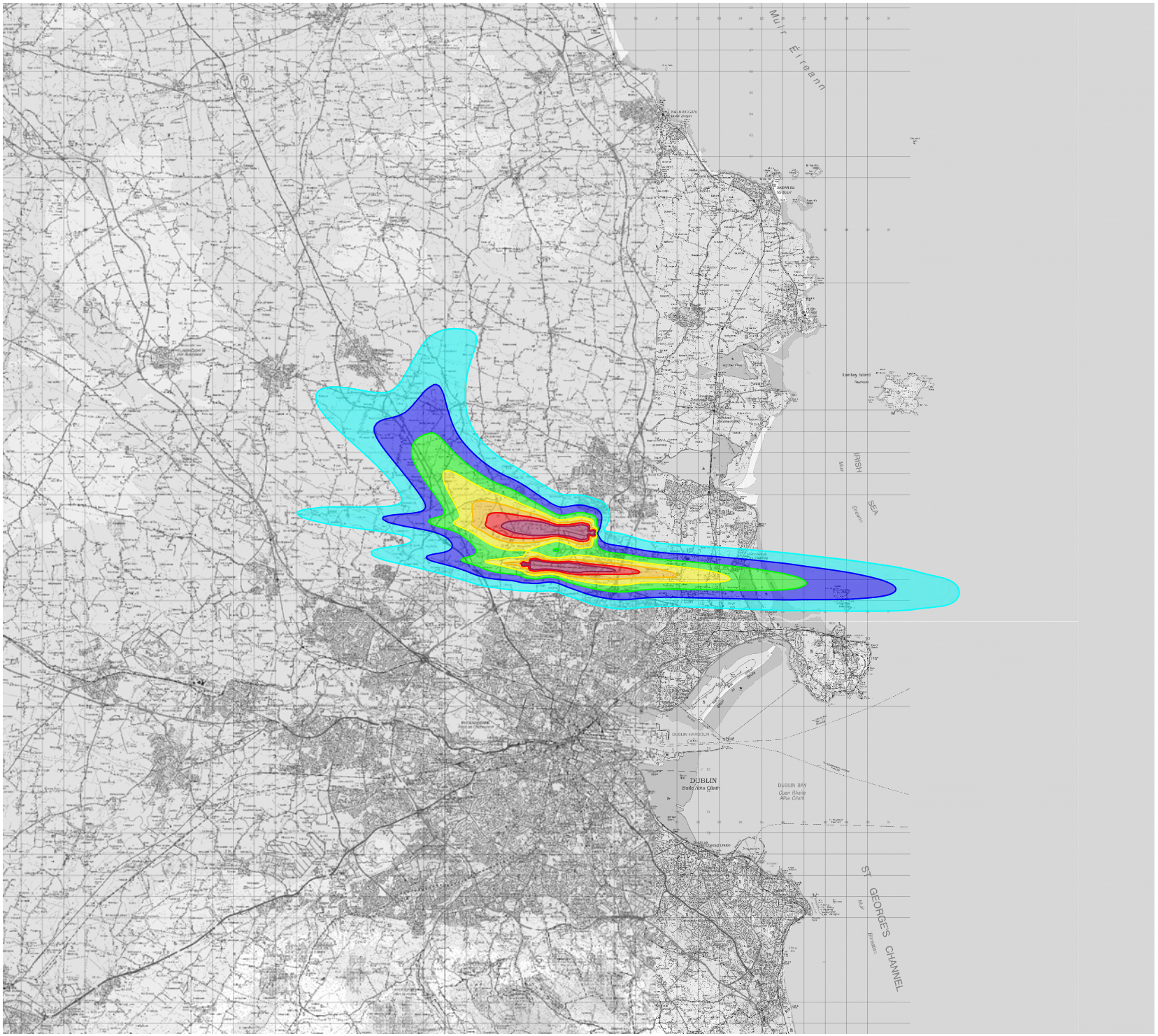

LEGEND:

- 51 - 53 dB(A) $L_{Aeq,16h}$
- 54 - 56 dB(A) $L_{Aeq,16h}$
- 57 - 59 dB(A) $L_{Aeq,16h}$
- 60 - 62 dB(A) $L_{Aeq,16h}$
- 63 - 65 dB(A) $L_{Aeq,16h}$
- 66 - 68 dB(A) $L_{Aeq,16h}$
- 69+ dB(A) $L_{Aeq,16h}$

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Figure 03
2023 Summer Day Noise Contours
Actual Modal Split

DRAWN: AM CHECKED: DC

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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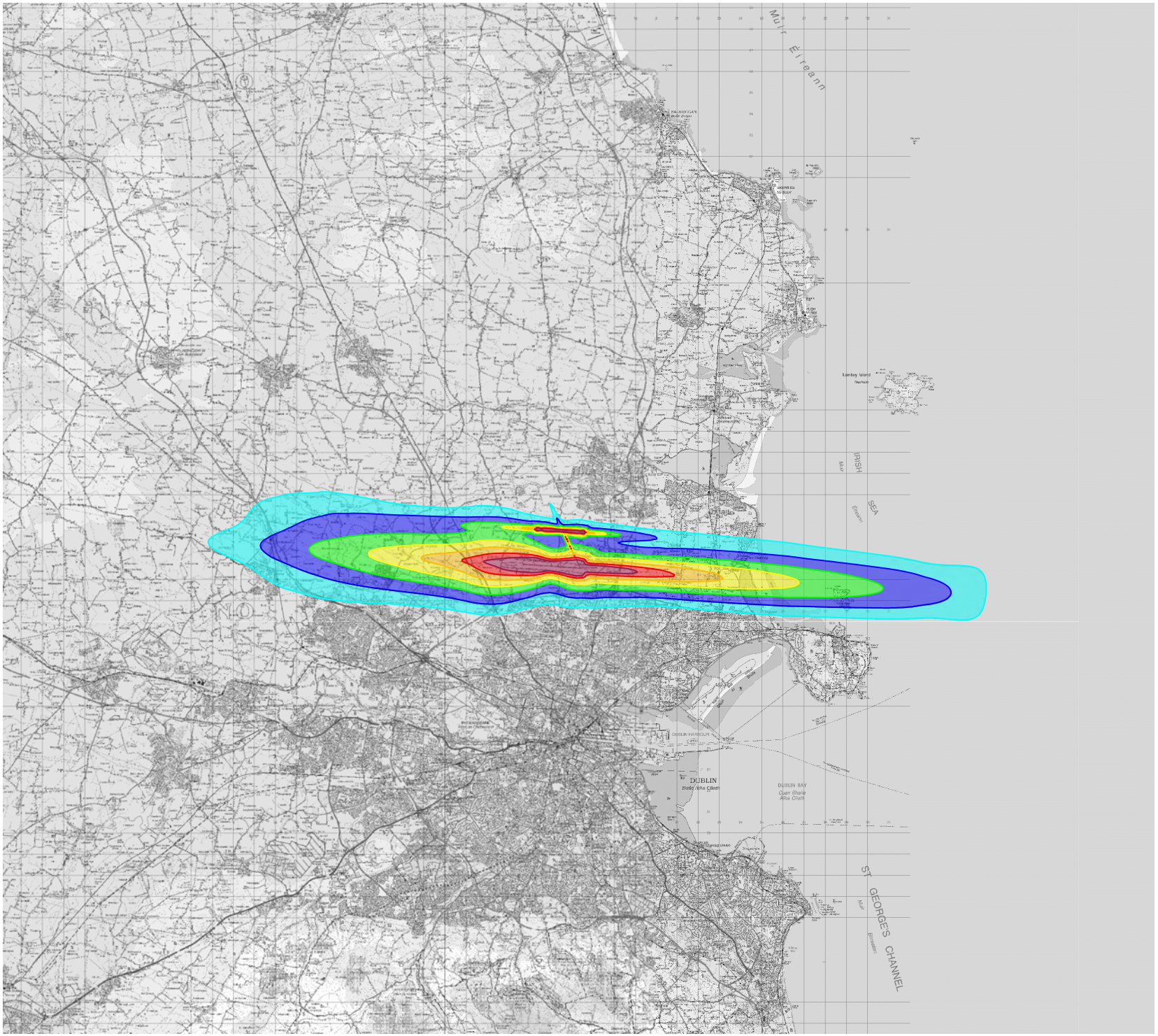

LEGEND:

- 45 - 47 dB(A) $L_{Aeq,8h}$
- 48 - 50 dB(A) $L_{Aeq,8h}$
- 51 - 53 dB(A) $L_{Aeq,8h}$
- 54 - 56 dB(A) $L_{Aeq,8h}$
- 57 - 59 dB(A) $L_{Aeq,8h}$
- 60 - 62 dB(A) $L_{Aeq,8h}$
- 63+ dB(A) $L_{Aeq,8h}$

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Figure 04
2023 Summer Night Noise Contours
Actual Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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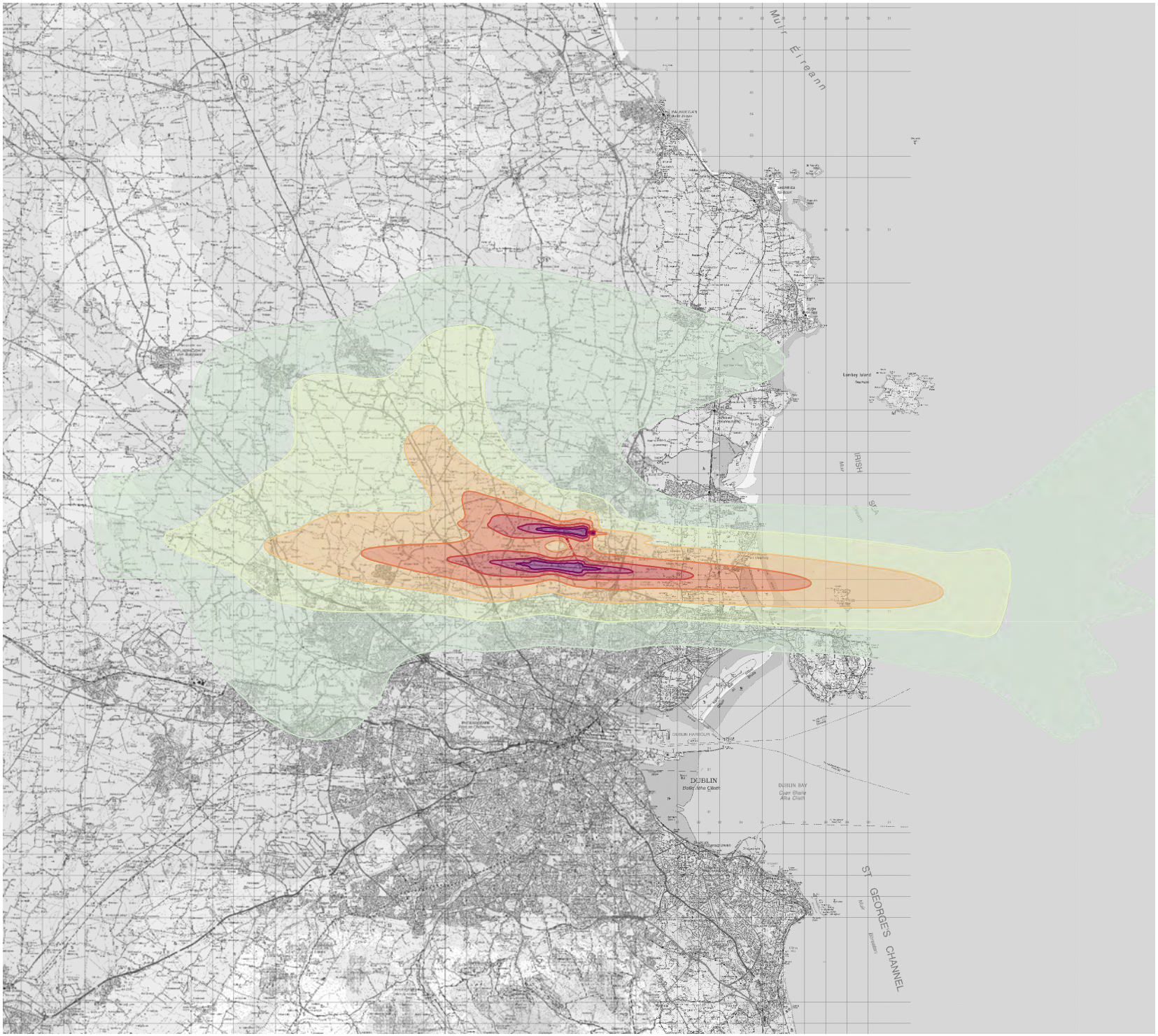

LEGEND:

- 45 - 49 dB(A) L_{den}
- 50 - 54 dB(A) L_{den}
- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

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Figure 05
2023 Annual L_{den} Noise Contours
Long-Term Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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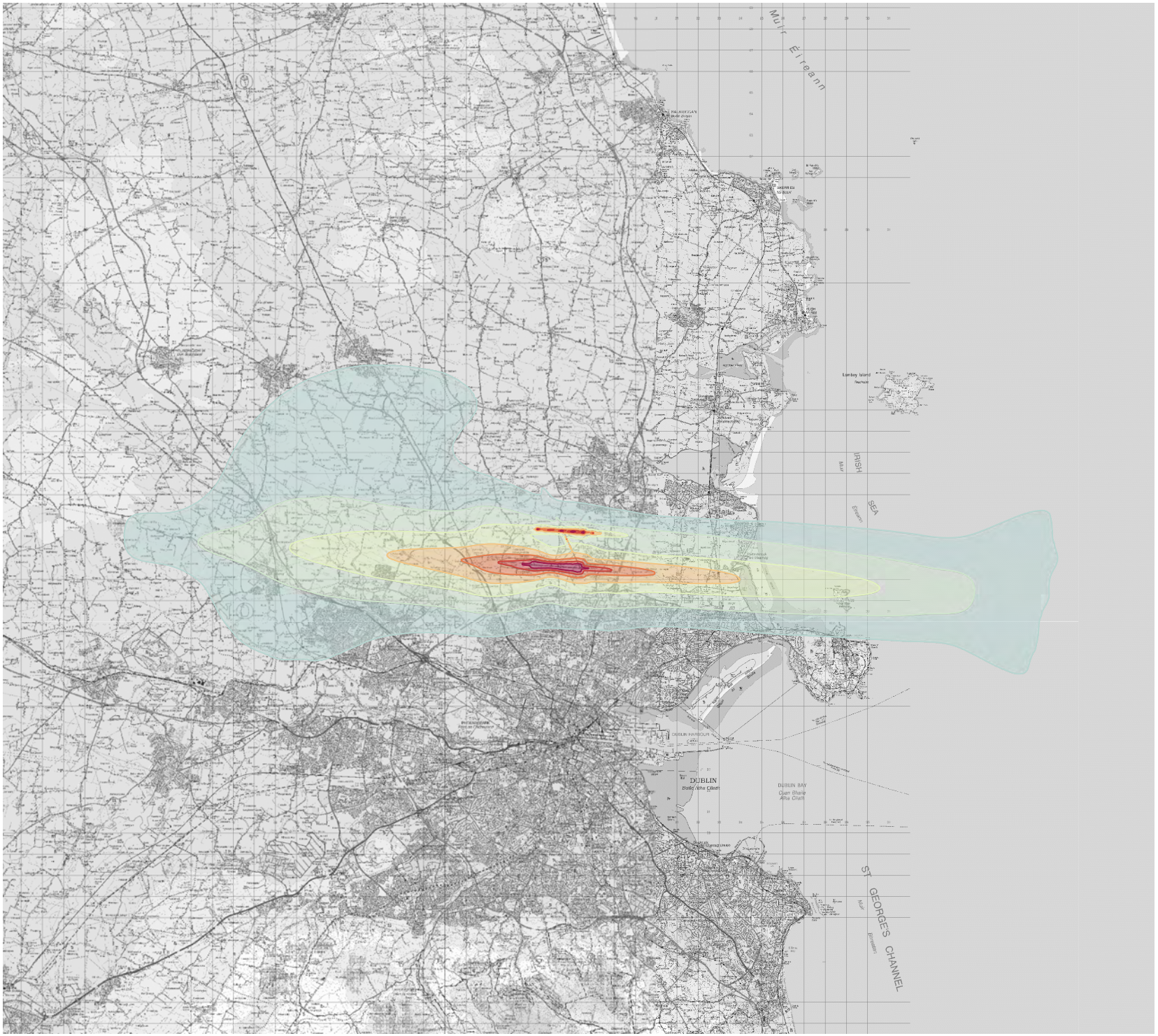

LEGEND:

- 40 - 44 dB(A) L_{night}
- 45 - 49 dB(A) L_{night}
- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

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Figure 06
2023 Annual L_{night} Noise Contours
Long-Term Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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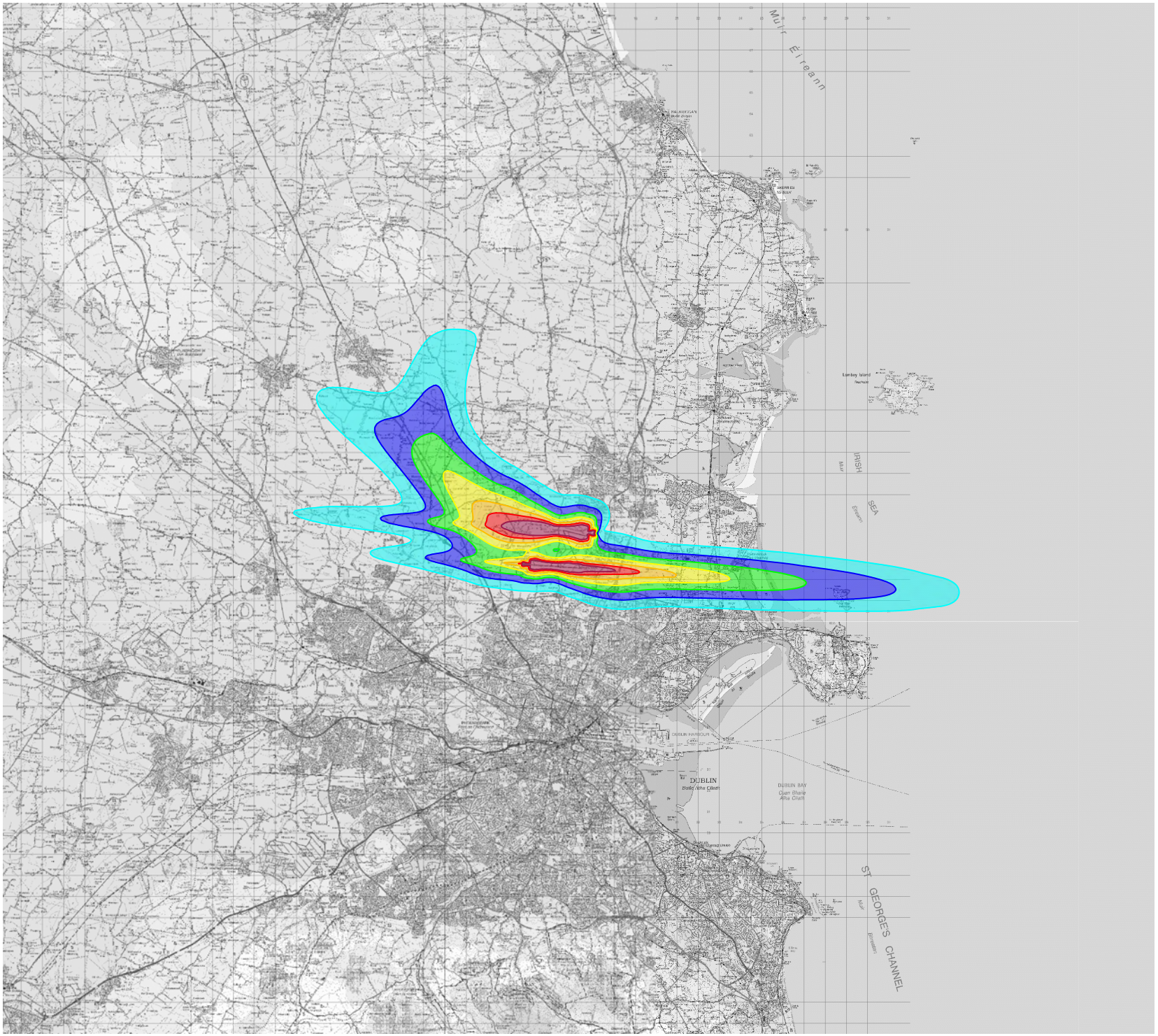

LEGEND:

- 51 - 53 dB(A) $L_{Aeq,16h}$
- 54 - 56 dB(A) $L_{Aeq,16h}$
- 57 - 59 dB(A) $L_{Aeq,16h}$
- 60 - 62 dB(A) $L_{Aeq,16h}$
- 63 - 65 dB(A) $L_{Aeq,16h}$
- 66 - 68 dB(A) $L_{Aeq,16h}$
- 69+ dB(A) $L_{Aeq,16h}$

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Figure 07
2023 Summer Day Noise Contours
Long-Term Modal Split

DRAWN: AM CHECKED: DC

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

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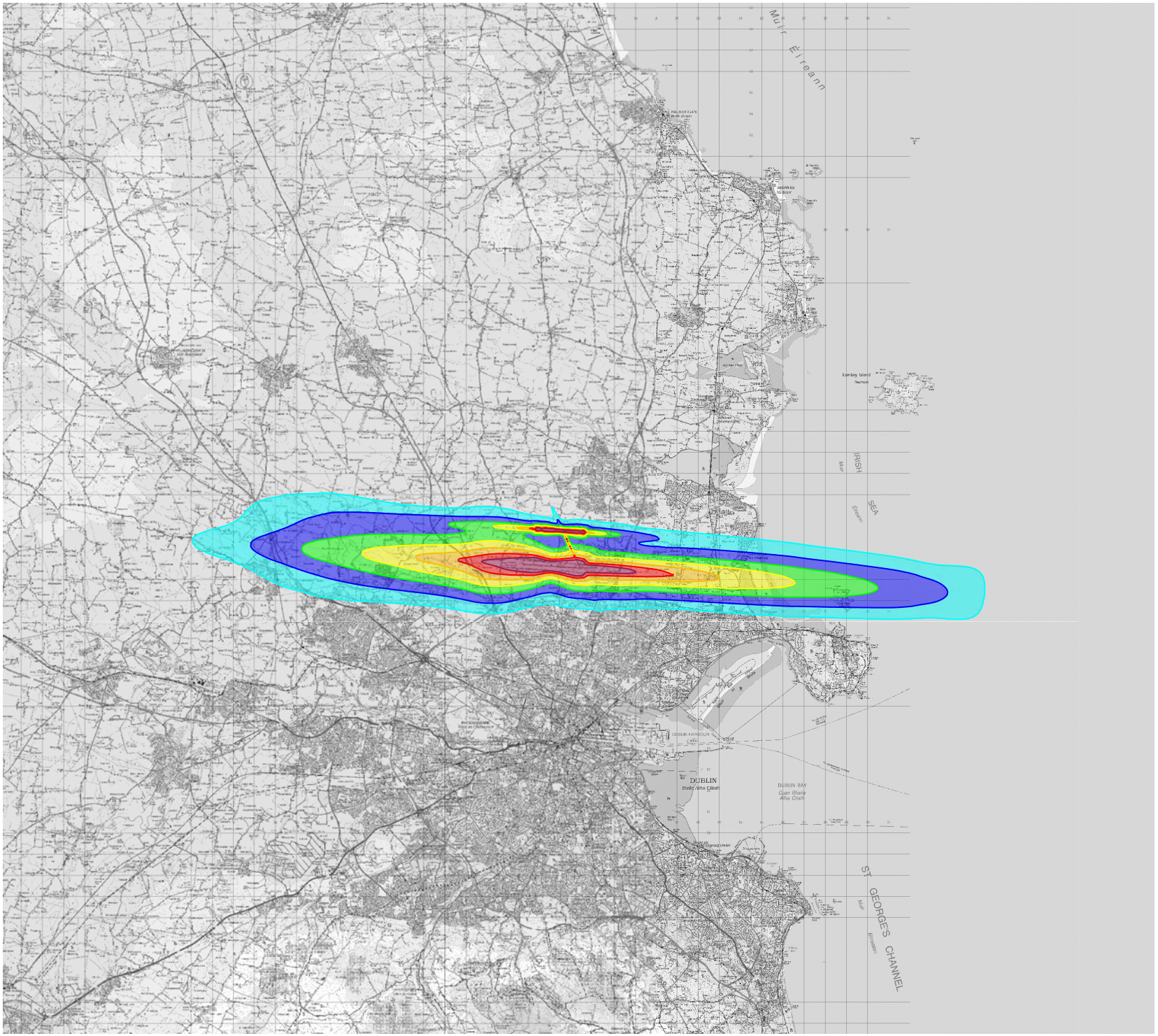

LEGEND:

- 45 - 47 dB(A) $L_{Aeq,8h}$
- 48 - 50 dB(A) $L_{Aeq,8h}$
- 51 - 53 dB(A) $L_{Aeq,8h}$
- 54 - 56 dB(A) $L_{Aeq,8h}$
- 57 - 59 dB(A) $L_{Aeq,8h}$
- 60 - 62 dB(A) $L_{Aeq,8h}$
- 63+ dB(A) $L_{Aeq,8h}$

Rev	Date	Description	Initials

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Figure 08
2023 Summer Night Noise Contours
Long-Term Modal Split

DRAWN: AM CHECKED: NW

DATE: May 2024 SCALE: 1:250000@A4

Drawing No:

A11429_01_DR0033_1.0

APPENDIX 1
GLOSSARY OF ACOUSTIC TERMINOLOGY

The Decibel, dB

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

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

Frequency, Hz

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

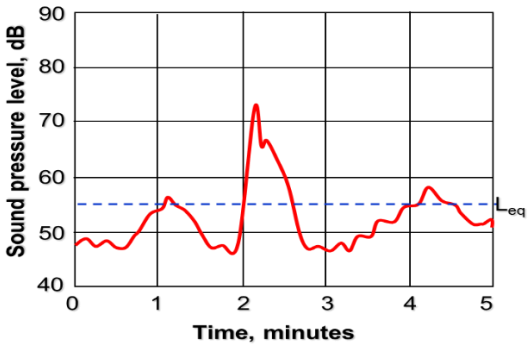
A-weighting

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

Environmental Noise Descriptors

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

Statistical Term	Description
$L_{Aeq,T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound. This is shown in the graph below:



L_{den}	The day-evening-night noise indicator in decibels (dB) defined by the following formula:

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

in which:

L_{day} is the A-weighted long-term average sound level for the daytime period (07:00-19:00)
$L_{evening}$ is the A-weighted long-term average sound for the evening period (19:00-23:00)
L_{night} is the A-weighted long-term average sound level for the night time period (23:00-07:00)

APPENDIX 2
DERIVATION OF AIRCRAFT ROUTES

This appendix describes the process followed to convert the radar data into a set of aircraft routes.

Commercial fixed-wing aircraft fall into one of four categories based on their approach speed. These are denoted A, B, C and D, with A being the slowest and D being the fastest. Dublin Airport operates two sets of departure routes, one for category A and B aircraft and another for category C and D aircraft. In general, categories A and B contain general aviation and propeller aircraft, with jet aircraft falling into categories C or D.

This appendix describes the process followed to convert the radar data into a set of average departure tracks. This process was done separately for each combination of runway end, aircraft category (i.e. A/B or C/D) and route.

An example of a resulting set of dispersed modelled flight tracks overlaid on the actual radar tracks is given in Figure A2.1, which shows a sample of 500 tracks which followed the Runway 28R LIFFY route (post 23 Feb 2023) for Category C/D aircraft. The seven dispersed modelled flight tracks are shown in black, with the actual radar tracks shown in green.

The steps followed to produce these are outlined below.

1. Assign each radar track to a route group. The route groups combine some of the initially similar SIDs in use at the airport. In some cases, it was necessary to subdivide route groups to account for the range of locations where aircraft turn. For runway 28R departures by category C/D aircraft, separate route groups were used for different time periods, as some routes changed on 23 February 2023. The route groups are given in Table A2.1 below.

Route Group (Track Name)	Description
DEXEN	Initial turn south, heading east
INKUR	Heading west
LIFFY	Initial turn north, heading east
NEPOD	Heading south
OLONO	Heading south-south-west
PELIG	Heading southwest
ROTEV	Heading north
SUROX	Heading northwest

Table A2.1: Route Groups

2. For each route group determine a proxy mean flight track from the radar data.

3. For each route group, create a series of “gates” along the proxy mean flight track.

4. For each gate, calculate the point at which each track (in the same route group) goes through the gate.
5. For each route group, create a mean track and a number of sub-tracks. The route for each sub-track has been based on the average of the tracks within the relevant percentiles at each gate. The number of sub-tracks and percentiles used has been based on the values given in ECAC Doc 29 4th Edition Volume 2, Appendix C.

The ECAC document recommends that normally 7 discrete sub-tracks (including the mean track) will be adequate. This has been followed except where a limited number of actual tracks are available to base them on, and in these cases a lower number of sub-tracks have been used.

The percentages in the ECAC document are based on a normal distribution and mean that the area within the outermost sub tracks will contain the large majority of the radar tracks, but not every single one.

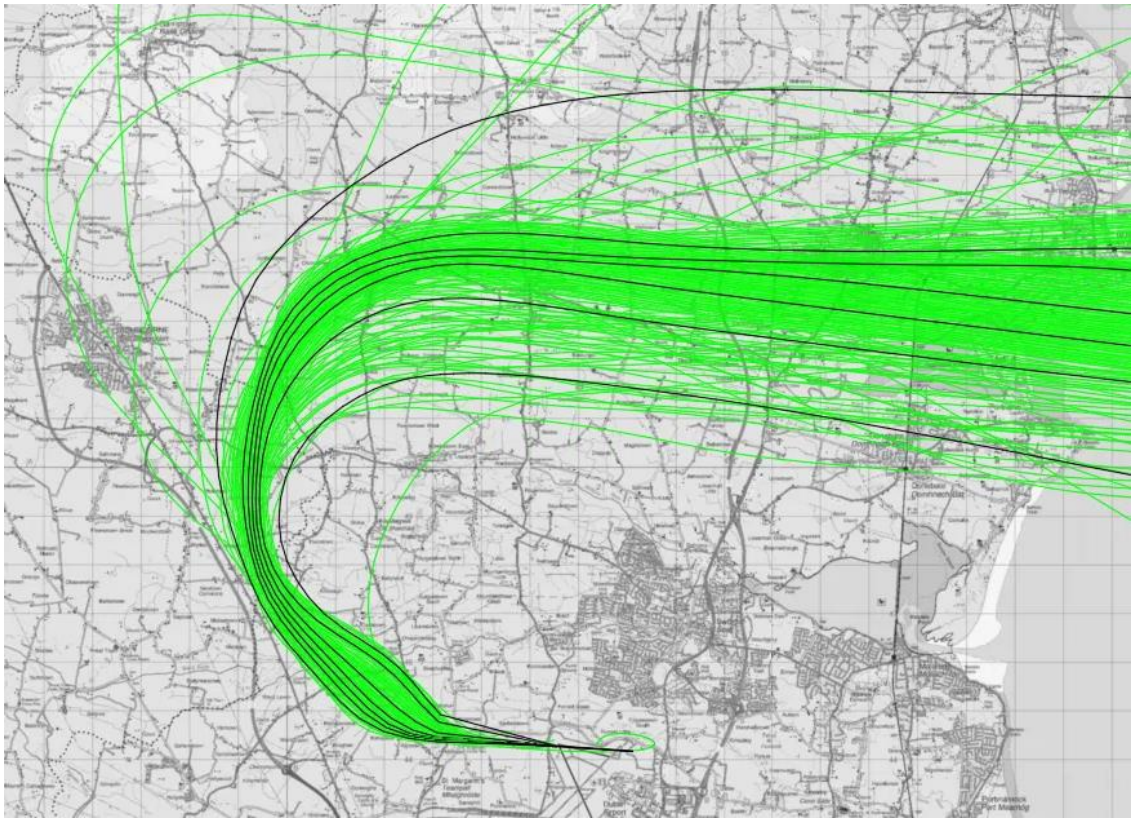


Figure A2.1: Example of Modelled and Actual Flight Tracks

APPENDIX 3
DERIVATION OF AIRCRAFT PROFILES

This appendix describes the process followed to convert the radar data into a set of aircraft profiles.

For the most common aircraft, the Airbus A320 and the Boeing 737-800, airlines were consulted to check that the resulting assumptions used were in line with what occurs in practice. As specific departure procedures are commercially sensitive information, this is not repeated here, but they were broadly in line with the assumptions.

Based on the airline responses, intersection departures are rarely used for Runway 28L, but are commonly used for Runway 10R. Based on this advice and analysis of the radar data, the following assumptions have been made in relation to intersection departures:

- All aircraft departing from Runway 10R used the intersection with Taxiway S6, with the exception of the following operations:
    - Airbus A321 departures to destinations further than 2,500 nautical miles
    - Boeing 777-200 departures to destinations further than 3,000 nautical miles
- All aircraft departing from Runway 10L used the intersection with Taxiway N6
- All aircraft departing from Runway 28L used the full runway length
- All aircraft departing from Runway 28R used the intersection with Taxiway N2, with the exception of the following operations:
    - Airbus A321 departures to destinations further than 2,500 nautical miles
    - Airbus A350-900 departures to destinations further than 3,000 nautical miles, and
    - Boeing 777-200 departures to destinations further than 3,000 nautical miles.

The aircraft profiles for all the aircraft types reviewed at Dublin Airport can be broadly described by the following phases:

1. Takeoff

    This starts with the aircraft stationary on the ground, it will then use takeoff thrust (which can be maximum thrust or a percentage of it) to accelerate on the runway and get off the ground. This phase ends when the aircraft reaches the desired speed for the initial climb phase, which should be shortly after leaving the ground.

2. Initial climb

    Still using takeoff thrust, the aircraft continues to climb, with a constant speed.

3. Flap retraction

   The aircraft will now switch to climb thrust and will gain both altitude and speed. Within the model this is represented by a certain percentage of the available thrust being used for acceleration, with the remainder being used for climbing. Flaps are retracted at certain speeds, often in stages.

4. Ongoing flight

   With flaps fully retracted, the aircraft continues to gain both altitude and speed using climb thrust. The percentage of thrust being used for acceleration is typically reduced from the previous phase. This phase continues until the aircraft is outside the modelled area.

An example profile showing these phases is presented in Figure A3.1, which shows the modelled profile of an Airbus A320 Stage 1 departure using Runway 28R.

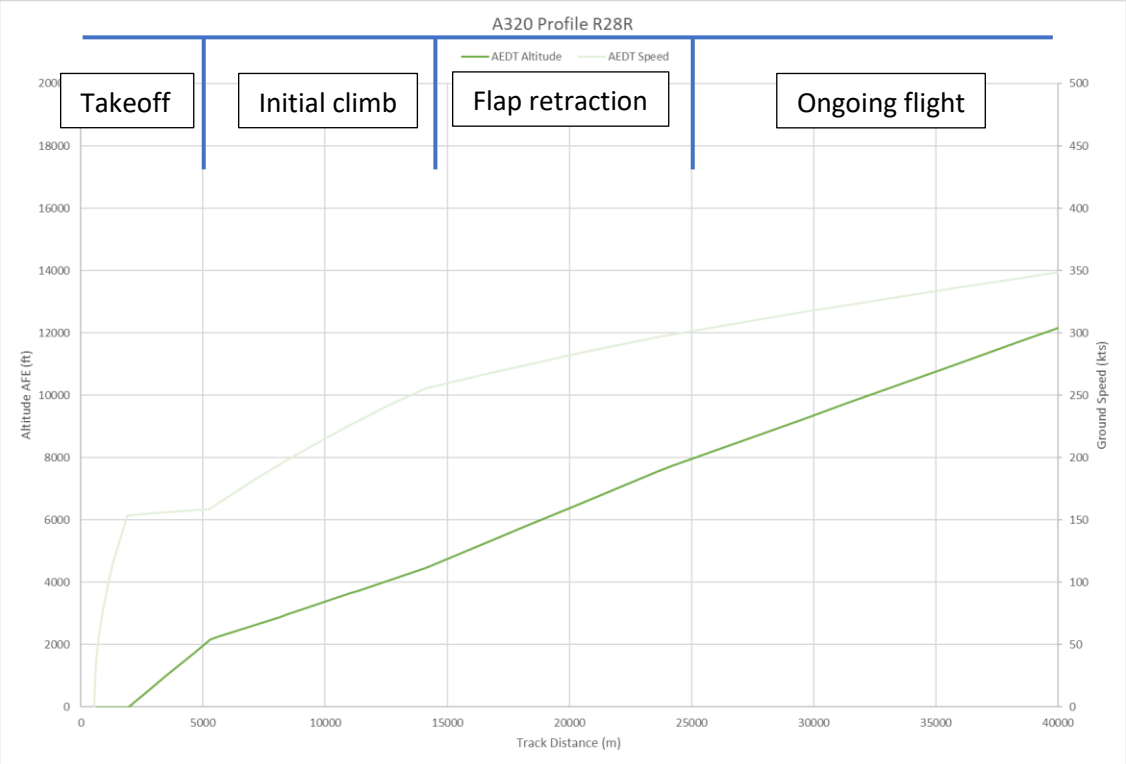


Figure A3.1: Phases of Flight Profile

The general steps followed to produce the modelled profiles are outlined below. In some cases, other adjustments were required. A profile was created separately for each combination of runway end, aircraft type, and stage length, where sufficient data was available.

- Identify the base AEDT type for each actual aircraft type.
- Compare the average radar profile (altitude and ground speed) with the model output from AEDT.
- If necessary, reduce takeoff thrust from maximum to better match the climb gradient in the initial climb phase. The takeoff thrust was never reduced lower than 75% of the AEDT default value, based on the guidance in ECAC Doc 29 that this is often stipulated as a lower limit by airworthiness authorities. For many aircraft types, in particular larger aircraft such as the Boeing 767, a higher value of minimum thrust was used.
- If necessary, adjust the initial climb altitude to better match the radar data.
- Leaving the flap retraction speeds as per the default profiles, set the percentage of thrust used for accelerating in the flap retraction phase to match the altitude and speed from the radar data as closely as possible. If necessary, adjust the default climb thrust.
- Set the percentage of thrust used for accelerating in the continued flight phase to match the altitude and speed from the radar data as closely as possible.

For stage lengths with insufficient data, the same approach was adopted, with the takeoff thrust extrapolated based on the relative modelled departure weights from the modelled profiles of stage lengths which had sufficient data for the same runway end and aircraft type.

In cases where there was insufficient data for a runway end, the North and South Runway profiles were assumed to be the same as for Runway 28L, and the Cross Runway profiles were assumed the be the same as Runway 28L, but with no reduction in thrust. This is because the Cross Runway is significantly shorter, and the available data suggests that most aircraft use the maximum thrust available, or close to it.

The base AEDT types for each actual aircraft type considered are given in Table A3.1 below.

Aircraft Type Description	Base AEDT Type
Airbus A320neo	A320-270N
Airbus A321neo	A320-270N
Airbus A319	A319-131
Airbus A320	A320-211
Airbus A321	A321-232
Airbus A330-200	A330-301
Airbus A330-300	A330-301
Airbus A350-900	A350-941

Aircraft Type Description	Base AEDT Type
ATR 72	ATR72
Boeing 737 MAX 8	7378MAX
Boeing 737-400	737400
Boeing 737-800	737800
Boeing 757-200	757RR
Boeing 767-300	767300
Boeing 767-400	767400
Boeing 777-200	777200
Boeing 777-300	777300
Boeing 787	7878R
Embraer E190	EMB190

Table A3.1: Operational Aircraft Types and Base AEDT Types

An example of a resulting modelled aircraft profile compared with actual radar profiles is given in Figure A3.2 for altitude and Figure A3.3 for ground speed, which show the modelled profile by an Airbus A320 Runway 28R Stage 1 departure, alongside the average and percentiles containing 95% of the flights.

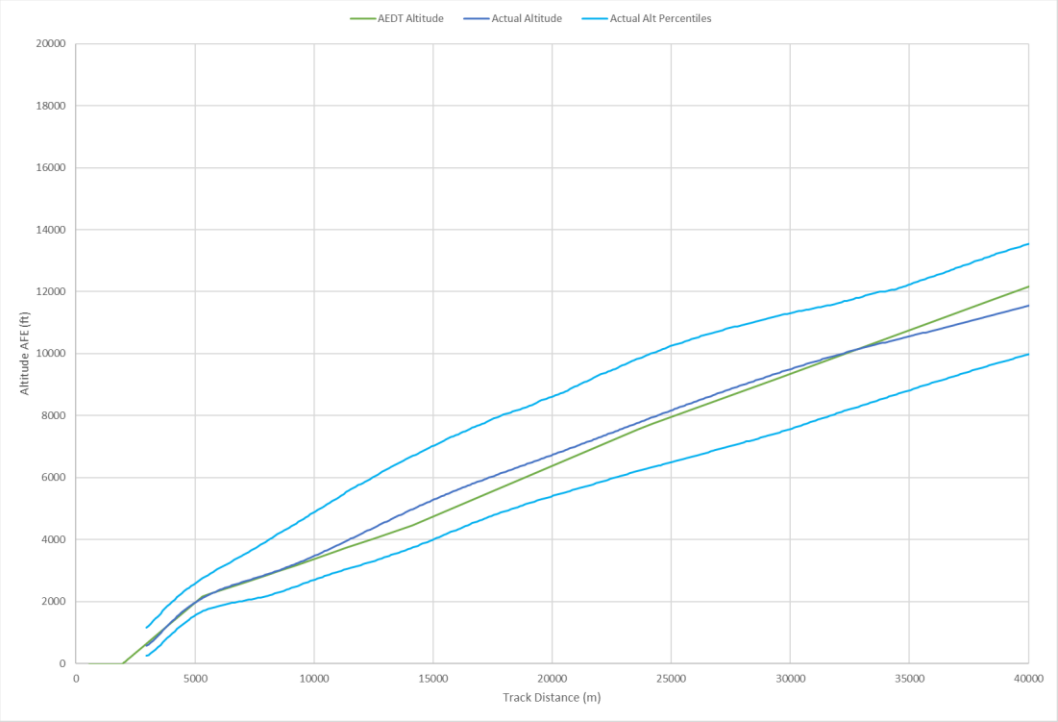


Figure A3.2: Example of Modelled and Actual Flight Profiles – Altitude

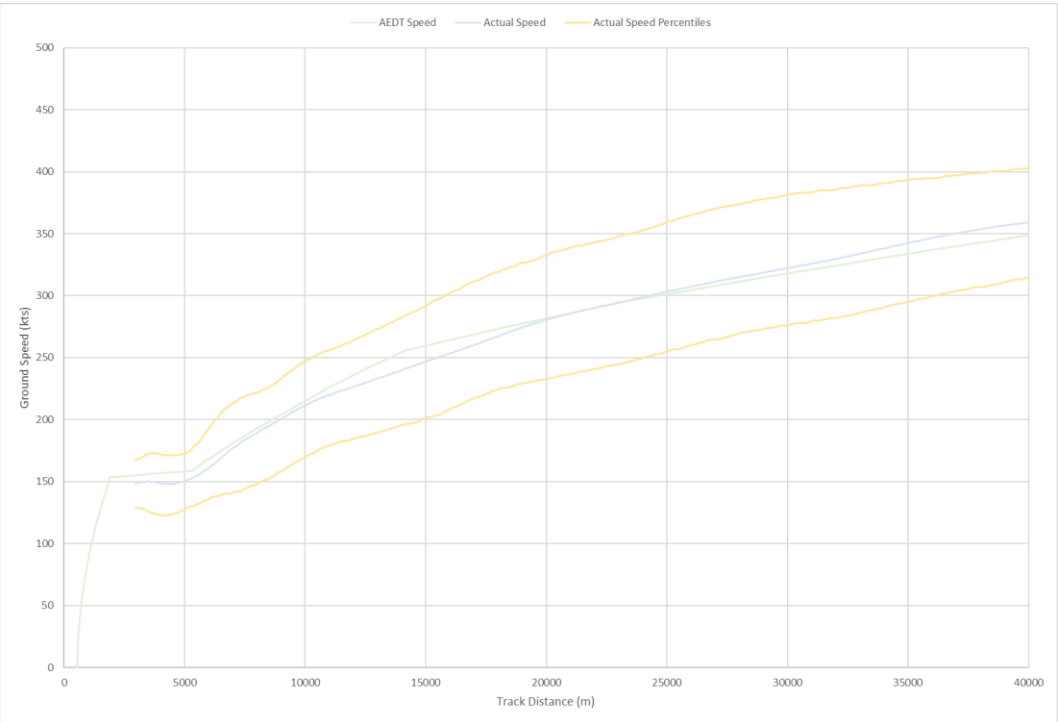


Figure A3.3: Example of Modelled and Actual Flight Profiles – Ground Speed

APPENDIX 4
VALIDATION OF AIRCRAFT NOISE LEVELS

This appendix describes the process followed to account for the Noise Monitoring Terminal (NMT) results and the adjustments made to the model.

Measured noise levels taken by the Dublin Airport Noise and Track Keeping (NTK) system have been used to carry out a noise validation exercise. A number of additional Noise Monitoring Terminals (NMTs) have been added to the NTK system in recent years. The NMTs used in this assessment are listed in Table A4.1.

NMT ID	Location Name	Latitude	Longitude
1	Bay Lane	53.42508	-6.34636
2	St. Doolaghs	53.41436	-6.18694
3	Bishopswood	53.43862	-6.33274
4	Feltrim	53.4318	-6.17777
8	Malahide	53.443341	-6.16172
10	St. Margarets	53.430295	-6.300554
20	OP	53.41404	-6.13817
26	Kilcoskan National School	53.463556	-6.344889
28	Newpark	53.446937	-6.329015
204	Milhead	53.435598	-6.295823

Table A4.1: Operational Aircraft Types and Base AEDT Types

Results from 1 January 2023 to 31 December 2023 were used with the following exceptions:

- NMT26 excluded results between 12:00 and 14:00 as it was noted that there were a number of noisy events during this period which could be related to the school's lunch break.
- NMT28 was available from 11 August 2023 onwards
- NMT204 was available from 26 September 2023 onwards

The noise levels from the monitors are automatically correlated with aircraft movements using the radar track keeping system and the average determined by aircraft type and operation. Several parameters are measured by the system, and for this validation the Sound Exposure Level (SEL) of the individual aircraft movements has been used.

To take into account the measured levels, first the logarithmic average has been computed for each aircraft type and operation, at each NMT. Next the AEDT software has been used to predict the logarithmic average level at the NMT locations using the base AEDT aircraft type with the same distribution of stage lengths as the measurements.

These two levels have been compared for each aircraft type when separately arriving and departing. Adjustments were then made to the modelled aircraft noise levels to minimise differences between the measured and predicted results. This was done by adjusting the AEDT NPD data for the modelled aircraft types so that the movement-weighted average modelled noise levels at the NMTs matched that measured.

Nineteen aircraft have had modifications made to their arrival and departure noise assumptions. The modifications are detailed in Table A4.2 below.

Aircraft Type Description	Base AEDT Type	Arrival Adjustment (dB)	Departure Adjustment (dB)
Airbus A320neo	A320-270N	0	-0.6
Airbus A321neo	A320-270N	0.2	2.8
Airbus A319	A319-131	-0.6	0.2
Airbus A320	A320-211	-0.5	1.1
Airbus A321	A321-232	-0.2	-0.8
Airbus A330-200	A330-301	-0.6	-0.2
Airbus A330-300	A330-301	-0.5	0.5
Airbus A350-900	A350-941	-0.5	1.4
ATR 72	ATR72	3.2	-1
Boeing 737 MAX 8	7378MAX	-0.3	1.1
Boeing 737-400	737400	0.7	0.5
Boeing 737-800	737800	-0.8	0.2
Boeing 757-200	757RR	0.6	0.7
Boeing 767-300	767300	-1.8	-2.5
Boeing 767-400	767400	0.9	2.6
Boeing 777-200	777200	0.5	3.4
Boeing 777-300	777300	-0.1	-1.5
Boeing 787	7878R	0.3	2.7
Embraer E190	EMB190	-0.8	0.7

Table A4.2: Noise Level Adjustments

Project: **A11469 DUBLIN AIRPORT END R4**

File Ref: A11469_02_MO001_2.0

Date: 20 June 2023

Subject: **Harmful Effects Assessment - Noise**

1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have prepared noise information for the Strategic Noise Mapping process based on activity at Dublin Airport in 2021. BAP have been retained by daa to use this noise information to produce an assessment of the harmful effects, utilising the methodology specified by the Environmental Protection Agency (EPA). This memo contains the results of this assessment.

2.0 METHODOLOGY

For airports, the EPA requirement is to assess the number of people highly annoyed (HA) and highly sleep disturbed (HSD). These are to be based on the L_{den} and L_{night} metrics which are calculated as part of the Strategic Noise Mapping process.

2.1 People Highly Annoyed (HA)

Using the methodology specified the expected percentage of people highly annoyed by aircraft noise ($AR_{HA,air}$) is given by the following formula:

$$AR_{HA,air} = \frac{\left(-50.9693 + 1.0168 \times L_{den} + 0.0072 \times {L_{den}}^2\right)}{100}$$

2.2 People Highly Sleep Disturbed (HSD)

Using the methodology specified the expected percentage of people highly sleep disturbed by aircraft noise ($AR_{HSD,air}$) is given by the following formula:

$$AR_{HSD,air} = \frac{\left(16.7885 - 0.9293 \times L_{night} + 0.0198 \times {L_{night}}^2\right)}{100}$$

2.3 Assessment of Population

The assessment of HA has included all people with an L_{den} noise level of 45 dB L_{den} or above, and the assessment of HSD has included all people with an L_{night} noise level of 40 dB L_{night} or above.

For both assessments, the exposed population was split into bands with a width of 1 dB, as specified by the EPA. The midpoint of each band was then used in the formula given in 2.1 and 2.2 to determine the associated percentages, which were then multiplied by the number of people in that band. The resulting total number of people HA or HSD for each band was then added together to give the overall total.

3.0 RESULTS

The results are presented in Table 1 and Table 2. The values in each band are rounded to the nearest whole number. The totals use the unrounded numbers by band and therefore may not exactly match the sum of the values in the tables.

Band, dB L_{den}	Population	HA	Band, dB L_{den}	Population	HA
$45 \leq L_{den} < 46$	36,373	3,710	$61 \leq L_{den} < 62$	80	31
$46 \leq L_{den} < 47$	35,353	4,200	$62 \leq L_{den} < 63$	68	28
$47 \leq L_{den} < 48$	34,248	4,649	$63 \leq L_{den} < 64$	64	27
$48 \leq L_{den} < 49$	25,974	3,969	$64 \leq L_{den} < 65$	129	58
$49 \leq L_{den} < 50$	13,313	2,264	$65 \leq L_{den} < 66$	42	20
$50 \leq L_{den} < 51$	4,500	843	$66 \leq L_{den} < 67$	7	3
$51 \leq L_{den} < 52$	2,439	500	$67 \leq L_{den} < 68$	5	2
$52 \leq L_{den} < 53$	2,254	502	$68 \leq L_{den} < 69$	3	2
$53 \leq L_{den} < 54$	2,811	676	$69 \leq L_{den} < 70$	8	4
$54 \leq L_{den} < 55$	4,304	1,112	$70 \leq L_{den} < 71$	0	0
$55 \leq L_{den} < 56$	4,789	1,324	$71 \leq L_{den} < 72$	0	0
$56 \leq L_{den} < 57$	4,579	1,349	$72 \leq L_{den} < 73$	0	0
$57 \leq L_{den} < 58$	1,155	362	$73 \leq L_{den} < 74$	0	0
$58 \leq L_{den} < 59$	738	245	$74 \leq L_{den} < 75$	0	0
$59 \leq L_{den} < 60$	1,330	466	$75 \leq L_{den}$	0	0
$60 \leq L_{den} < 61$	359	133	**Total**	**174,926**	**26,477**

Table 1: Estimated Population Highly Annoyed

Band, dB L_{night}	Population	HSD	Band, dB L_{night}	Population	HSD
$40 \leq L_{night} < 41$	33,299	3,872	$56 \leq L_{night} < 57$	102	28
$41 \leq L_{night} < 42$	25,927	3,195	$57 \leq L_{night} < 58$	89	26
$42 \leq L_{night} < 43$	9,791	1,278	$58 \leq L_{night} < 59$	29	9
$43 \leq L_{night} < 44$	3,782	523	$59 \leq L_{night} < 60$	7	2
$44 \leq L_{night} < 45$	2,520	369	$60 \leq L_{night} < 61$	5	2
$45 \leq L_{night} < 46$	2,019	313	$61 \leq L_{night} < 62$	11	4
$46 \leq L_{night} < 47$	2,719	446	$62 \leq L_{night} < 63$	0	0
$47 \leq L_{night} < 48$	4,993	865	$63 \leq L_{night} < 64$	0	0
$48 \leq L_{night} < 49$	4,930	902	$64 \leq L_{night} < 65$	0	0
$49 \leq L_{night} < 50$	3,330	643	$65 \leq L_{night} < 66$	0	0
$50 \leq L_{night} < 51$	931	190	$66 \leq L_{night} < 67$	0	0
$51 \leq L_{night} < 52$	832	179	$67 \leq L_{night} < 68$	0	0
$52 \leq L_{night} < 53$	1,258	284	$68 \leq L_{night} < 69$	0	0
$53 \leq L_{night} < 54$	166	39	$69 \leq L_{night} < 70$	0	0
$54 \leq L_{night} < 55$	79	20	$70 \leq L_{night}$	0	0
$55 \leq L_{night} < 56$	62	16	**Total**	**96,882**	**13,203**

Table 2: Estimated Population Highly Sleep Disturbed

Nick Williams
for Bickerdike Allen Partners LLP

David Charles
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Bickerdike Allen Partners
Architecture Acoustics Technology

STRATEGIC NOISE MAPPING REPORT FOR SUBMISSION TO THE EPA UNDER THE EUROPEAN COMMUNITIES (ENVIRONMENTAL NOISE) REGULATIONS 2018

DUBLIN AIRPORT 2021

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On Behalf Of daa

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A11469_02_RP003_1.0
6 March 2023

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

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

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

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

EXECUTIVE SUMMARY

Bickerdike Allen Partners LLP (BAP) have been retained by daa to carry out the Strategic Noise Mapping for Dublin Airport as outlined in Statutory Instrument No. 549 of 2018, the European Communities (Environmental Noise) Regulations 2018, as amended by Statutory Instrument No. 663 of 2021, the European Communities (Environmental Noise) (Amendment) Regulations 2021.

Noise levels have been predicted for 2021 using the actual aircraft movements over the entire year and the Federal Aviation Authority prediction methodology, the Aviation Environmental Design Tool (AEDT) Version 3e.

Noise level bands are presented for five noise indices; L_{den}, L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$. Detailed editable numerical results for a 10 m x 10 m grid have also been produced for each of the noise indices. Information on the areas, dwelling numbers and populations within relevant noise bands has also been provided.

Contents

Page No.

1.0 INTRODUCTION

1.1 Background

Bickerdike Allen Partners LLP (BAP) have been retained by daa to carry out the Strategic Noise Mapping for Dublin Airport as outlined in Statutory Instrument No. 549 of 2018, the European Communities (Environmental Noise) Regulations 2018, as amended by Statutory Instrument No. 663 of 2021, the European Communities (Environmental Noise) (Amendment) Regulations 2021.

Noise levels have been predicted for 2021 using the actual aircraft movements over the entire year and the Federal Aviation Authority prediction methodology, the Aviation Environmental Design Tool (AEDT) Version 3e.

This report sets out the assumptions used in the computation of the noise levels and includes the resulting noise bands in graphical format for five parameters, namely L_{den}, L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$. The L_{night} results are presented in 5 dB(A) wide bands starting at 40 dB(A) and finishing with an inner area for greater than or equal to 70 dB(A). The results for all of the other indices are presented in 5 dB(A) wide bands starting at 45 dB(A) and finishing with an inner area for greater than or equal to 75 dB(A).

Detailed editable numerical results for a 10 m by 10 m grid, for each of the measurement parameters are provided separate to this report electronically.

Appendix 1 contains a glossary of acoustic and technical terms. Appendix 2 contains the bibliography and references.

1.2 Purpose and Scope of the Directive

Directive 2002/49/EC of the European Parliament and of the Council ("the Directive") relates to the assessment and management of environmental noise, and is commonly referred to as the Environmental Noise Directive or END[1].

The aim of the Directive is:

"to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise".

[1] Official Journal of the European Union, L 189, 12-25, 18 July 2002.
Available from: http://eur-lex.europa.eu/JOIndex.do?ihmlang=en [accessed July 2017]

Three stages are set out, the first of which is to undertake strategic noise mapping to determine exposure to environmental noise from the main sources, i.e. major roads, major railways, major airports and across agglomerations with a population of more than 100,000 persons in the relevant year. The Directive required the first round of mapping to be conducted in 2007, based on what occurred in 2006, and for the exercise to be repeated every 5 years leading to the fourth round being conducted now, based on the activity in 2021.

The second stage requires information on environmental noise and its effects to be made available to the public. The third stage requires the adoption of action plans, based upon the results of noise mapping, with a view to preventing and reducing environmental noise where necessary and particularly where exposure levels can induce harmful effects on human health and to preserving environmental noise quality where it is good.

1.3 Purpose and Scope of the Regulations

In Ireland, the Directive is transposed by the European Communities (Environmental Noise) Regulations 2018, S.I. No. 549 of 2018 ("the Regulations"), as amended by the European Communities (Environmental Noise) (Amendment) Regulations 2021, S.I. No. 663 of 2021 ("the Amendment Regulations"). The strategic mapping duties of the relevant designated Noise Mapping Bodies (NMBs) is given under Article 11 of the Regulations which is repeated below.

Strategic Noise Maps

11 (1) The noise-mapping body or bodies concerned shall, no later than 30 June 2022, make or review the strategic noise map, or revised strategic noise map, as appropriate, for each of the following areas, in respect of the calendar year 2021:-

(a) (i) the agglomeration of Cork;

(ii) the agglomeration of Dublin;

(iii) the agglomeration of Limerick;

(b) a major road;

(c) a major railway; and

(d) a major airport.

(2) Strategic noise maps shall satisfy the minimum requirements set out in the Third Schedule.

(3) Noise-mapping bodies shall co-operate, as appropriate, with their counterparts in neighbouring Member States of the European Union with regard to the strategic noise mapping of border areas.

(4) A noise map shall be reviewed by the noise-mapping body and, if necessary, revised not later than five years after the date on which it was made.

(5) Noise-mapping bodies shall provide the Agency with information required for the purposes of Regulation 5(5) no later than one month after the date on which a map or revised map is made.

1.4 Roles and Responsibilities of designated bodies

As Dublin Airport had over 50,000 movements in 2021, excluding those purely for training purposes on light aircraft, it is classed as a 'major airport' by the definitions given in the Directive and the Regulations and so strategic noise mapping must be undertaken for it. The relevant Noise Mapping Body (NMB) is the airport operator, daa, who has retained Bickerdike Allen Partners LLP (BAP) to carry out the strategic noise mapping.

1.5 Key Phases

Compliance with the Regulations can be simplified into the five key phases detailed below. The current exercise reported here is concerned principally with the first and second phases.

- Identification of areas required to be mapped
- Preparation of strategic noise maps
- Publication of extent of noise impact
- Development of the noise action plans
- Implementation of the plans (5 year time scale)

2.0 OVERVIEW OF STRATEGIC NOISE MAPPING PROCESS

2.1 Project review

Bickerdike Allen Partners LLP (BAP) have been retained by daa to carry out the Strategic Noise Mapping for Dublin Airport. BAP have therefore been responsible for the mapping, utilising information provided by daa.

2.2 Process Overview

The aircraft noise modelling process followed for the noise mapping at Dublin Airport can be summarised by the following steps:

- Obtain input data

- Analyse input data to determine flight path geometry

- Compare measured with predicted noise levels for key aircraft types and adjust model to minimise differences

- Calculate noise levels for contour grids and receptor locations

- Post-processing of results

Detailed draft guidance on the modelling process was provided by the Environmental Protection Agency (EPA).

3.0 REVIEW OF THIRD ROUND MAPS

3.1 Developments since the 3rd round

Between 2016 and 2021 there were not any significant changes in the way that aircraft operate at Dublin Airport. A new North Runway (designated 10L-28R) subsequently opened in 2022 but this was not operational in 2021.

daa statistics[2] show that in 2021 Dublin Airport had 92,119 aircraft movements, of which 85,431 were commercial air transport movements. By comparison the aircraft movements in 2016 were 215,078, of which 207,517 were commercial air transport movements. Therefore total movements have decreased by 57% since the last noise maps were produced.

3.2 Review and Revision of strategic noise maps prepared during Round 3

The EPA guidance is that Noise Mapping Bodies who previously undertook strategic noise mapping should consider revising them if it is known, or thought likely, that greater than 10% of the exposed population within the area of an action plan have experienced a change in the prevailing noise situation of greater than 1 dB(A) L_{den} or L_{night}. As the total aircraft movements have decreased by 57% between 2016 and 2021, it is considered likely that the thresholds indicated in the EPA Guidance were exceeded and therefore it was determined to undertake mapping for the 2021 calendar year, rather than re-issuing the 2016 maps.

[2] daa Annual Report 2021
https://www.daa.ie/media-centre/annual-reports/annual-report-2021/

4.0 DEFINE AREAS TO BE MAPPED

4.1 Requirements of the Directive

The requirements of the Directive for strategic noise mapping relevant to this project are to determine the estimated number of dwellings as well as the number of people (in hundreds) living in dwellings that are exposed to noise in 5 dB bands from values of 55 dB to greater than 75 dB L_{den} and from 50 dB to greater than 70 dB L_{night}.

The requirements are for noise levels to be produced at a height of 4 metres above the ground and on the most exposed facade.

The populations associated with the above noise bands are to be determined separately for those exposed to such noise within an agglomeration and those exposed outside any agglomeration.

Therefore, the area to be mapped must include all dwellings exposed to noise levels above either 55 dB L_{den} or 50 dB L_{night}.

4.2 Requirements of the Regulations

The requirements of the Regulations are as the Directive detailed in Section 4.1.

4.3 Approach to Definition of Mapping Extents

The AEDT software was used to produce the noise contours for the lowest value of each noise index, specifically the 45 dB(A) L_{den} and 40 dB(A) L_{night} contours. An area enclosing these contours was taken to be the area to be mapped. It was also checked that the 45 dB(A) contours for the $L_{Aeq,16h}$, L_{day} and $L_{evening}$ indices were contained within this area, as would normally be expected for an airport with the operational profiles of Dublin Airport.

4.4 Maps and Statistics Describing Area to be Mapped

The mapping extents shown in blue on Figure 1 were informed by the 45 dB(A) L_{den} and 40 dB(A) L_{night} contours which are shown in red and green respectively. The bounding coordinates for the mapping extents in the Irish Transverse Mercator coordinate system (ITM) are:

- North 752100
- South 735230
- West 693190
- East 738730

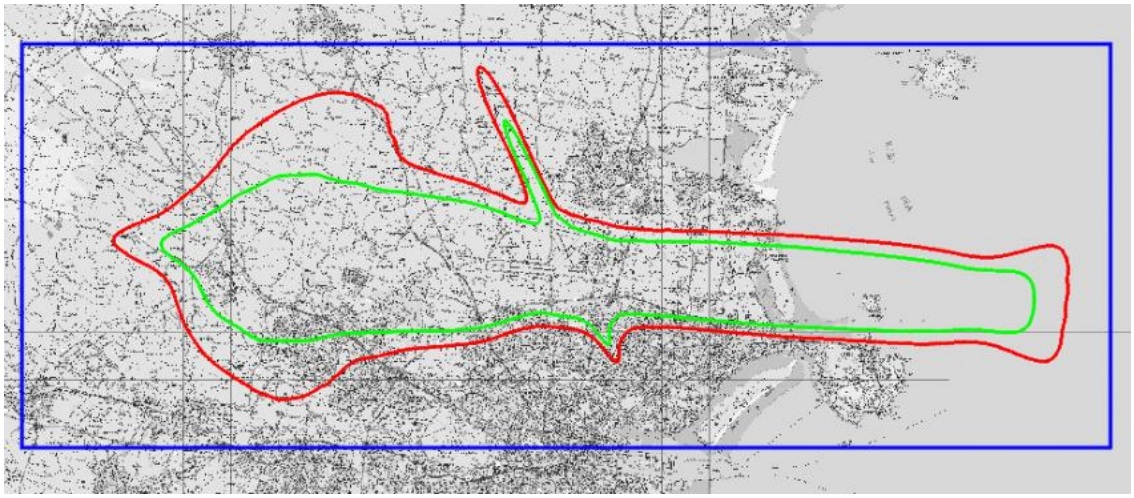


Figure 1: Areas to be Mapped and Modelled

4.5 Approach to Definition of Model Extents including buffer

As detailed in Section 4.3, when setting up an area to be mapped contours were produced setting out the area required to contain the noise contours of 45 dB(A) L_{den} and 40 dB(A) L_{night}. As a result, when these contours are converted to an area to be modelled, no buffer is required. A set of grids with points at 10 m spacing was defined which covered the outermost of the two contours, 45 dB(A) L_{den}.

4.6 Maps and Statistics Describing Area to be Modelled

The area to be modelled is the same as the area to be mapped described in Section 4.4.

5.0 DEFINE NOISE CALCULATION METHOD

5.1 Requirements of the Directive

The Directive has been amended a number of times for the purposes of adapting to scientific and technical progress, in accordance with Article 12. The most significant of these was to replace Annex II of the Directive by removing the recommended interim methods and establishing common noise assessment methods. References below to "the Directive" refer to the consolidated version of 29 July 2021[3].

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02002L0049-20210729

Annex II of the Directive sets out the computation methods which may be used for the assessment of noise. For aircraft noise, the method of assessment is described in Section 2.6 of Annex II of the Directive.

The assessment method described is extensive and is not repeated here.

5.2 Requirements of the Regulations

The Amendment Regulations refer to the Annex to the EU Commission Directive 2015/996, rather than to Annex II of the Directive. This is not functionally different to the requirements of the Directive.

5.3 Factors influencing selection of assessment method

In the EPA Guidance[4] the calculation methods for aircraft noise are discussed in Section 8. Recommendations are made to follow the guidance given in ECAC Doc 29 4th Edition, and to meet the requirements of Noise Modelling Category C as described in the Civil Aviation Authority (CAA) document CAP 2091 *CAA Policy on Minimum Standards for Noise Modelling*, including the use of radar data for flight tracks, and noise measurement data for validation.

5.4 Confirmation of method of assessment along with any required adaptations

The requirements of CAP 2091 Noise Modelling Category B have been followed. These are more involved than those of Category C and include the use of local noise monitoring data for noise levels and local track-keeping data for flight profiles and tracks, all for the main noise dominant aircraft types. The requirement is that these aircraft types cover more than 75% of the total noise energy produced by aircraft at the airport. The types selected as noise dominant for this noise mapping covered more than 90% of the total noise energy produced by aircraft at each noise monitor.

This assessment method complies with the guidance given in ECAC Doc 29 4th Edition, and the requirements of both the Directive and the Regulations.

[4] DRAFT Guidance Noise for Strategic Noise Mapping, Part 2: Calculation Methodology & Noise Modelling for the Environmental Noise Regulations 2018 (amended), DRAFT Version 3 July 2022

6.0 DEVELOP DATASET SPECIFICATION

6.1 Input Data Requirements of Calculation Method – Conceptual Model

The input data required for the aircraft noise strategic mapping are the physical details of the airport, the topography of the surrounding area, the aircraft movements themselves, details of the aircraft flight profiles and details of the routes flown by the aircraft movements. Where possible this information should be validated against measured information.

6.2 Data specification requirements of noise mapping software – Logical model

To utilise the AEDT software the data requirements are for the aircraft movements to be attributed to aircraft types within the AEDT database and then assigned to the runways, profiles and routes which also require definition.

6.3 Data specification requirements of GIS – Physical model

The physical model comprises the location and dimensions of the runways, and the routes. The physical model data specification includes details of the topography around the airport on a 90 m grid.

6.4 Data specification for noise mapping – Database design

The database specifications were designed to obtain the information required as outlined in Sections 6.2 and 6.3.

7.0 PRODUCE DATASETS

7.1 Identify data sources

There are six basic datasets required for the aircraft noise strategic mapping. These are the physical details of the airport, the topography of the surrounding area, the aircraft movements themselves, the aircraft flight profiles, the details of the routes flown by the aircraft movements and local noise measurement data.

Dublin Airport data relevant to the AEDT study is taken from the October 2022 edition of the Irish Aviation Authority (IAA) Integrated Aeronautical Information Publication (AIP). This includes details of the location, length and orientation of the runways as well as information relating to departure routes. Although included in the entry, no aircraft operations have been assigned to the North Runway (designated 10L-28R).

The AEDT model developed for Dublin Airport does contains data for the terrain in the area surrounding the airport. The terrain data has been provided by eMapSite.

Details of all the aircraft movements during the 2021 calendar year were provided for Dublin Airport by daa. This information included for each movement the date and local time, the aircraft type (aircraft operational code), whether the movement was an arrival or a departure, and the origin or destination. This actual aircraft movement data was processed to enable input into the AEDT software.

Aircraft profiles for the main noise-dominant aircraft types have been derived from radar data for the calendar year of 2021, which has been provided by daa. For other aircraft types the ”STANDARD” aircraft profiles given in the AEDT software have been used.

Aircraft routes were derived from radar data for the calendar year of 2021, which has been provided by daa.

The measurements taken by the airport's Noise Monitoring Terminals (NMTs) for the calendar year of 2021 was provided by daa.

7.2 Identify gaps, anomalies and uncertainties

Radar data was provided for the large majority of flights, but not for every single flight. For flights without associated radar data, they were distributed between the different routes based on the overall distribution of the flights with radar data.

7.3 Field survey work to reduce data gaps

No field survey work was considered to be required to reduce data gaps.

8.0 DEVELOP NOISE MODEL DATASETS

8.1 Develop input datasets to meet specification

The actual aircraft movement data supplied by daa has been processed to enable input into the AEDT software. This section of the report describes this processing in detail and considers the following:

- Aircraft type (Aircraft Operational Code)
- Time period
- Runway
- Operation

- Stage Length
- Aircraft Profile
- Aircraft Route
- Noise Monitoring Data

There were a total of 92,046 aircraft movements in the data supplied by daa. Of these, 999 were by helicopters, approximately 1% of the total. Helicopter movements at this level are unlikely to have a significant effect on the overall noise contours. This is due to the lower noise contribution of the helicopter movements compared with the greater number of large turbofan aircraft movements. Therefore, the helicopter movements have been excluded from the modelling. This approach is taken at most airports.

A breakdown of the aircraft movement data by aircraft operational code, time period and operation is given in Appendix 3.

8.1.1 Aircraft type

The AEDT software includes noise information for many common aircraft types, but it does not include data for every aircraft type. Therefore, the aircraft operational codes used in the movement data need to be mapped to Aircraft Noise and Performance (ANP) aircraft types in the AEDT software. For some aircraft types, substitutions are proposed by the AEDT software where a similar alternative aircraft type is used to model the actual type. For larger aircraft types this generally does not involve a change but for the smaller aircraft, and in particular the general aviation aircraft, some substitutions occur. Where AEDT has no guidance, an aircraft type has been assigned based on the aircraft size and engine details. In a small number of cases, BAP's experience is that the type suggested by AEDT is not appropriate, and therefore in these cases a more representative type has been used.

It is relevant to separately consider Category A/B aircraft and Category C/D aircraft as they operate differently, in particular having different departure routes specified in the AIP. These categories are based on aircraft approach speeds. Category A/B aircraft are typically propeller aircraft, whereas Category C/D aircraft are typically the larger jet aircraft.

A list of each aircraft operational code mapped to its ANP aircraft type (AEDT aircraft code) and Category (A/B or C/D) is given in Appendix 4.

8.1.2 Time period

The actual time of each movement in the log is given to the nearest minute, in local time. Using this, each movement has been categorised as occurring in the day (07:00-19:00), evening

(19:00-23:00) or night (23:00-07:00) as appropriate. Movements occurring on a boundary between periods have been counted as being in the later period, e.g. a movement occurring at 07:00 would be counted as being in the day period.

8.1.3 Runway

The actual runway used by each aircraft is given in the movement log, and this has been used in the modelling. The overall distribution in the year by aircraft category and time period for each runway is given in Table 1.

Aircraft Category	Time Period	Split of Aircraft Movements by Runway			
		10	28	16	34
A/B	Day	18%	81%	1%	0%
	Evening	23%	77%	1%	0%
	Night	7%	87%	3%	2%
C/D	Day	13%	86%	1%	0%
	Evening	13%	86%	0%	0%
	Night	9%	89%	1%	0%

Note – Percentages rounded to nearest whole number

Table 1: 2021 Distribution of Movements by Runway

8.1.4 Operation

Each movement in the data is categorised as either an arrival or a departure and has been modelled as such.

8.1.5 Stage Length

For the departure movements, the AEDT software offers a number of flight profiles for most aircraft types, particularly the larger aircraft types. These relate to different departure weights, which are greatly affected by the length of the flight and consequently the fuel load. In the AEDT software this is referred to as the stage length. The stage length is defined in increments of 250 nmi from 500 nmi up to 1500 nmi and then in increments of 500 nmi. As the stage length increases, the aircraft has to depart with greater fuel and so its flight profile is slightly lower than when a shorter stage length is flown.

For the contours in this report, destination airports were given with the aircraft movement data. Stage lengths have been calculated for each aircraft departure, where AEDT offers the option, based on the distance of these airports from Dublin Airport.

8.1.6 Aircraft Profile

For each of the main noise-dominant aircraft types, the radar data was reviewed and a custom profile created to match the actual flown profile as closely as possible. This was done separately for Runway 10 and Runway 28, and for each stage length option available. It involved changes to the initial departure thrust and the initial climb altitude for many aircraft types. Details of this process are given in Appendix 5.

Due to the limited number of flights on Runway 16 and Runway 34, the profiles for Runway 28 were used for these runways also.

For other aircraft types the "STANDARD" or "MODIFIED_AW" profiles available in AEDT were used, depending on the stage length.

8.1.7 Aircraft Route

For arrival operations using Runway 10 or Runway 28, aircraft are generally lined up with the extended centreline of the runway at least 17 km from the runway threshold. Consequently, the main runway arrival routes have been modelled as straight out to this point. Before this point arrivals are modelled using 7 routes which cover the broad swathe of directions that the arriving aircraft approach from. Flights have been equally distributed between the 7 routes. These assumptions are based on an analysis of radar data in 2018. It is understood that there were no significant changes to arrival routes between 2018 and 2021.

For arrivals operations using Runway 16 or Runway 34, aircraft have been modelled as following the extended runway centreline within the area to be mapped as this is less than 17 km from the runway threshold.

For departures, as aircraft do not follow precisely the routes they are assigned to, it is standard practice to represent this in the modelling software using a set of dispersed tracks, with a percentage of the departures assigned to each one. This has been done for each of the departure routes by analysing the radar data to produce the set of dispersed tracks. Category A/B aircraft are defined as having different departure routes than category C/D aircraft in the AIP, and therefore have been considered separately for this exercise.

More details on the derivation of departure routes, including figures showing the modelled arrival and departure routes, are given in Appendix 6.

For the majority of departures, which have associated radar data, their radar data was used to assign them to a departure route. Departures without associated radar data were distributed between the different routes based on the overall distribution of the flights with radar data, for the same aircraft category and runway end. The overall distribution is given in Table 2 below.

Aircraft Category	Departure Route	Split of Aircraft Movements by Runway			
		10	28	16	34
A/B	DEXEN	26%	-	-	9%
	INKUR	-	-	8%	4%
	LIFFY	8%	46%	55%	76%
	NEPOD	8%	16%	17%	7%
	OLONO	-	-	-	-
	PELIG	22%	-	5%	4%
	ROTEV	35%	22%	13%	-
	SUROX	-	3%	2%	-
C/D	DEXEN	11%	11%	-	9%
	INKUR	6%	6%	8%	4%
	LIFFY	45%	43%	55%	76%
	NEPOD	26%	23%	17%	7%
	OLONO	-	3%	-	-
	PELIG	2%	4%	5%	4%
	ROTEV	8%	8%	13%	-
	SUROX	3%	2%	2%	-

Note – Percentages rounded to nearest whole number

Table 2: 2021 Distribution of Movements by Route

8.1.8 Noise Monitoring Data

Results from the Dublin Airport Noise and Track Keeping (NTK) system have been used to validate the noise levels of the main noise dominant aircraft types. Specifically, the results from NMTs 1, 2 and 20 in 2021 have been used. NMT 1 is located approximately 6 km from the departure point of Runway 28 and NMTs 2 and 20 are located approximately 7 and 10 km respectively from the departure point of Runway 10 and so all are well located for recording noise from arrivals and departures as the NMTs are close to the extended centreline of the runways.

The noise levels from the monitors are automatically correlated with aircraft movements using the radar track keeping system and the average determined by aircraft type and operation.

Several parameters are measured by the system, for this validation the Sound Exposure Level (SEL) of the individual aircraft movements has been used.

To take into account the measured levels the AEDT software has been used to predict the level at the NMT locations. This has been compared to the measured averages for the aircraft types when separately arriving and departing. Where necessary, adjustments were made to the modelled noise levels of individual aircraft types to minimise the differences between the predicted and measured noise levels. More details of this process and the resulting adjustments are given in Appendix 7.

8.3 Document use of WG-AEN GPG v2 Toolkits and assumptions to fill data gaps

The WG-AEN GPG v2 toolkits have not been utilised as any initial gaps in the data had already been resolved.

8.4 Document data checks and QA

As a check on the data provided by Dublin Airport, comparisons have been made with publicly available data. This found a difference of 73 flights (0.08%) between the reported annual total and the log supplied. This is not considered to have any noticeable effect on the results. The processing of the data includes regular checks, for example that movement numbers remain consistent, and has been audited in-house.

9.0 NOISE LEVEL CALCULATIONS

9.1 Documentation of noise mapping software system

The noise mapping has been undertaken using the Federal Aviation Authority (FAA) prediction methodology, the Aviation Environmental Design Tool (AEDT) Version 3e.

For the noise mapping the AEDT default meteorological and lateral attenuation settings were assumed (SAE-ARP-5534). The software predicts the noise level near the ground which is considered equivalent to the 4 metres referred to in the Regulations. No efficiency settings were utilised.

9.2 Approach to calculations

The AEDT model was set up as described in the above sections. The calculation procedure in the AEDT software is compliant with the methodology in ECAC Doc 29 4th Edition, and therefore meets the requirements of the Directive and the Regulations. The size of the model was also sufficiently small as to allow it to be run without the need for multiple client, or tiling or splitting of the model.

9.3 Results of noise calculations

Noise bands have been produced for each of the five noise indices; L_{den}, L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$, and are shown on Figures DR011 to DR015 in Appendix 8. For the two main indices, L_{den} and L_{night}, a series of figures are also included at a scale of 1:20000 showing the extent of the 55 dB L_{den} and 50 dB L_{night} contours.

A 50 m by 50 m grid was set up within the AEDT model to calculate the numerical noise levels for both of the required noise indices. This has then been interpolated to a 10 m by 10 m grid orthogonal to the Irish Transverse Mercator (ITM) coordinate system. The grid was large enough to encompass the 45 dB(A) and 40 dB(A) contours for L_{den} and L_{night} respectively.

Detailed editable numerical results for a 10 m by 10 m grid, for each of the noise indices are provided separate to this report electronically.

10.0 POST PROCESSING AND ANALYSIS

10.1 Post processing of noise level results

The interpolation method used was inverse distance weighting with a power of 2. For each point in the 10 m by 10 m grids, the following procedure was followed to calculate the noise level:

1. Determine the nearest point on the 50 m by 50 m grid for which a noise level has been predicted, in each of 4 directions (NE, NW, SE, SW).
2. For each of the 4 points, calculate the distance to the point in the 10 m by 10 m grid.
3. Use the following calculation to estimate the noise level at the point in the 10 m by 10 m grid:

$$Noise\ Level = \frac{\left(\frac{NE\_Noise}{(NE\_Dist^2)} + \frac{NW\_Noise}{(NW\_Dist^2)} + \frac{SE\_Noise}{(SE\_Dist^2)} + \frac{SW\_Noise}{(SW\_Dist^2)}\right)}{\left(\frac{1}{(NE\_Dist^2)} + \frac{1}{(NW\_Dist^2)} + \frac{1}{(SE\_Dist^2)} + \frac{1}{(SW\_Dist^2)}\right)}$$

Where, for example NE_Noise is the noise level at the nearest point to the North-East, and NE_Dist is the distance between the point on the 10 m by 10 m grid and the nearest point to the North-East.

Due to the nature of aircraft noise from airborne aircraft, no allowance has been made for the screening and reflections from surrounding buildings.

Noise contours have been generated using the L_{den}, L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$ noise indices. The L_{den} unit is an L_{Aeq} for the whole 24 hour period but includes weightings depending on when during the 24 hour period the noise occurs.

If the noise is during the 12 hour day (07:00h – 19:00h) there is no adjustment, if it is during the evening (19:00h - 23:00h) a weighting of +5 dB(A) is added, and if it is at night (23:00h – 07:00h) a weighting of +10 dB(A) is added. The unit is therefore biased to respond more to noise in the evening, and particularly at night than during the 12 hour day.

In movement terms the effect of the weightings is equivalent to more than trebling the number of movements during the evening and multiplying by ten the number of movements at night.

To compute the L_{den} noise index, each period is considered separately and an L_{Aeq} determined for it. The weightings are then added to the evening L_{Aeq} and night L_{Aeq} with each L_{Aeq} then added together taking into account the period durations.

The L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$ indices are a simple L_{Aeq} of the relevant periods with no weighting applied, being a duration of 8, 16, 12 and 4 hours respectively.

The AEDT software has been used to generate 5 dB(A) noise level contour bands based on a 50 m by 50 m grid.

10.2 Area exposure assessment

In addition to determining noise level contours, the AEDT software can also determine the contour areas and export them in a shapefile format so they can be used with a variety of software packages. In this case AutoCAD Map 2020 has been used to compare the noise level contours with the boundary of the Dublin agglomeration so as to determine the contour band areas both inside the agglomeration and outside. The resulting noise level band areas for each of the five indices are given in Table 3 to Table 7.

Contour Level Band, dB(A) L_{den}	Area of L_{den} Air Noise Contour Band (km^2)		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	841.1	n/a	n/a
45-49.9	54.8	85.6	140.4
50-54.9	29.6	28.5	58.1
55-59.9	21.9	4.1	26.1
60-64.9	8.9	0.0	8.9
65-69.9	2.6	0.0	2.6
70-74.9	0.7	0.0	0.7
≥75	0.5	0.0	0.5

Note – Areas rounded to 1 decimal place. Total column is the sum of unrounded values.

Table 3: 2021 L_{den} Noise Contour Band Areas

Contour Level Band, dB(A) L_{night}	Area of L_{night} Air Noise Contour Band (km^2)		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<40	873.6	n/a	n/a
40-44.9	37.0	47.7	84.7
45-49.9	26.6	14.9	41.5
50-54.9	15.6	0.7	16.3
55-59.9	5.2	0.0	5.2
60-64.9	1.5	0.0	1.5
65-69.9	0.4	0.0	0.4
≥70	0.3	0.0	0.3

Note – Areas rounded to 1 decimal place. Total column is the sum of unrounded values.

Table 4: 2021 L_{night} Noise Contour Band Areas

Contour Level Band, dB(A) $L_{Aeq,16h}$	Area of $L_{Aeq,16h}$ Air Noise Contour Band (km^2)		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	888.6	n/a	n/a
45-49.9	30.5	38.2	68.7
50-54.9	24.8	7.0	31.8
55-59.9	11.3	0.0	11.3
60-64.9	3.5	0.0	3.5
65-69.9	0.9	0.0	0.9
70-74.9	0.3	0.0	0.3
≥75	0.3	0.0	0.3

Note – Areas rounded to 1 decimal place. Total column is the sum of unrounded values.

Table 5: 2021 $L_{Aeq,16h}$ Noise Contour Band Areas

Contour Level Band, dB(A) L_{day}	Area of L_{day} Air Noise Contour Band (km^2)		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	886.5	n/a	n/a
45-49.9	30.9	41.5	72.4
50-54.9	25.3	8.0	33.3
55-59.9	12.1	0.0	12.1
60-64.9	3.8	0.0	3.8
65-69.9	1.0	0.0	1.0
70-74.9	0.4	0.0	0.4
≥75	0.3	0.0	0.3

Note – Areas rounded to 1 decimal place. Total column is the sum of unrounded values.

Table 6: 2021 L_{day} Noise Contour Band Areas

Contour Level Band, dB(A) $L_{evening}$	Area of $L_{evening}$ Air Noise Contour Band (km^2)		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	895.8	n/a	n/a
45-49.9	30.2	28.0	58.2
50-54.9	21.6	5.1	26.7
55-59.9	9.0	0.0	9.0
60-64.9	2.5	0.0	2.5
65-69.9	0.7	0.0	0.7
70-74.9	0.3	0.0	0.3
≥75	0.2	0.0	0.2

Note – Areas rounded to 1 decimal place. Total column is the sum of unrounded values.

Table 7: 2021 $L_{evening}$ Noise Contour Band Areas

10.3 Dwelling exposure assessment

To derive the dwelling exposure statistics a dataset of the locations of the properties has been used, specifically the GeoDirectory data developed by OSi and An Post. This provides a single point location object for each building in Ireland. As the GeoDirectory is updated quarterly there are four versions for 2021. The EPA have recommended that the Q4 2021 dataset should be used. BAP have been supplied with the Q1 2022 dataset. This is expected to result in a small but not material increase in the number of dwellings assessed as being within the contours, compared to using the Q4 2021 dataset.

As GeoDirectory provides a location point for each building and not just residential ones, it is necessary to undertake a filter procedure. This has been undertaken by utilising the additional information contained in the GeoDirectory on each location. This allows the removal of the commercial properties, derelict buildings, and those under construction. The GeoDirectory also identifies multiple properties at the same location, such as a block of flats. The resultant dataset contains the location points for all residential buildings.

The noise model has been used to compute the noise level at each of the locations for the residential buildings to determine which of the noise level bands they fall into. The results of this analysis for each of the five indices are given in Table 8 to Table 12.

Contour Level Band, dB(A) L_{den}	Number of Dwellings within L_{den} Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	477082	n/a	n/a
45-49.9	45188	3930	49118
50-54.9	6165	202	6367
55-59.9	4333	0	4333
60-64.9	190	0	190
65-69.9	16	0	16
70-74.9	0	0	0
≥75	0	0	0

Table 8: 2021 L_{den} Dwellings within Noise Contour Bands

Contour Level Band, dB(A) L_{night}	Number of Dwellings within L_{night} Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<40	503095	n/a	n/a
40-44.9	22428	3409	25837
45-49.9	5518	44	5562
50-54.9	1855	0	1855
55-59.9	74	0	74
60-64.9	4	0	4
65-69.9	0	0	0
≥70	0	0	0

Table 9: 2021 L_{night} Dwellings within Noise Contour Bands

Contour Level Band, dB(A) $L_{Aeq,16h}$	Number of Dwellings within $L_{Aeq,16h}$ Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	517743	n/a	n/a
45-49.9	9702	888	10590
50-54.9	4650	17	4667
55-59.9	821	0	821
60-64.9	57	0	57
65-69.9	1	0	1
70-74.9	0	0	0
≥75	0	0	0

Table 10: 2021 $L_{Aeq,16h}$ Dwellings within Noise Contour Bands

Contour Level Band, dB(A) L_{day}	Number of Dwellings within L_{day} Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	516306	n/a	n/a
45-49.9	10914	1465	12379
50-54.9	4716	35	4751
55-59.9	974	0	974
60-64.9	62	0	62
65-69.9	2	0	2
70-74.9	0	0	0
≥75	0	0	0

Table 11: 2021 L_{day} Dwellings within Noise Contour Bands

Contour Level Band, dB(A) $L_{evening}$	Number of Dwellings within $L_{evening}$ Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	521594	n/a	n/a
45-49.9	7147	172	7319
50-54.9	3848	0	3848
55-59.9	370	0	370
60-64.9	15	0	15
65-69.9	0	0	0
70-74.9	0	0	0
≥75	0	0	0

Table 12: 2021 $L_{evening}$ Dwellings within Noise Contour Bands

10.4 Population exposure assessment

In order to create a dataset for the occupied residential buildings the vacant residential buildings have been identified and removed. The occupied residential buildings are then processed to determine into which of the Small Areas used in the reporting of census information they fall. The average occupancy per dwelling for the Small Area the occupied dwellings are located in, defined as the total population living in dwellings divided by the number of dwellings, is then applied to them.

Small Area Population Statistics (SAPS) are Census 2016 statistics produced for a range of geographical levels from state to Small Areas. This contains 18,641 Small Areas, covering the whole of Ireland.

The 2022 Census results for Small Areas are not available at the time of writing, although results for the larger Electoral Division are. The 2022 Small Area (SA) population totals have been estimated by first determining which Electoral Division (ED) each Small Area is within, and then using the following formula:

$$2022\ SA\ Population = \frac{2016\ SA\ Population\ \times 2022\ ED\ Population}{2016\ ED\ Population}$$

The noise model has been used to compute the noise level at each of the locations for the occupied residential buildings to determine which of the noise level bands their associated

populations fall into. The results of this analysis for each of the five indices are given in Table 13 to Table 17.

Contour Level Band, dB(A) L_{den}	Population within L_{den} Air Noise Contour Bands[1]		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	1145154	n/a	n/a
45-49.9	134383	10879	145261
50-54.9	15735	573	16308
55-59.9	12591	0	12591
60-64.9	701	0	701
65-69.9	65	0	65
70-74.9	0	0	0
≥75	0	0	0

Note – Population totals rounded to the nearest whole number. Total column is the sum of unrounded values.

Table 13: 2021 L_{den} Population within Noise Contour Bands

Contour Level Band, dB(A) L_{night}	Population within L_{night} Air Noise Contour Bands		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<40	1221307	n/a	n/a
40-44.9	65874	9445	75319
45-49.9	17875	116	17991
50-54.9	3267	0	3267
55-59.9	289	0	289
60-64.9	16	0	16
65-69.9	0	0	0
≥70	0	0	0

Note – Population totals rounded to the nearest whole number. Total column is the sum of unrounded values.

Table 14: 2021 L_{night} Population within Noise Contour Bands

Contour Level Band, dB(A) $L_{Aeq,16h}$	Population within $L_{Aeq,16h}$ Air Noise Contour Bands[1]		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	1267309	n/a	n/a
45-49.9	23994	2682	26676
50-54.9	15259	45	15304
55-59.9	1837	0	1837
60-64.9	227	0	227
65-69.9	3	0	3
70-74.9	0	0	0
≥75	0	0	0

Note – Population totals rounded to the nearest whole number. Total column is the sum of unrounded values.

Table 15: 2021 $L_{Aeq,16h}$ Population within Noise Contour Bands

Contour Level Band, dB(A) L_{day}	Population within L_{day} Air Noise Contour Bands[1]		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	1263339	n/a	n/a
45-49.9	27385	4326	31711
50-54.9	15682	92	15774
55-59.9	1974	0	1974
60-64.9	242	0	242
65-69.9	7	0	7
70-74.9	0	0	0
≥75	0	0	0

Note – Population totals rounded to the nearest whole number. Total column is the sum of unrounded values.

Table 16: 2021 L_{day} Population within Noise Contour Bands

Contour Level Band, dB(A) $L_{evening}$	Population within $L_{evening}$ Air Noise Contour Bands[1]		
	Within Dublin Agglomeration	Outside Dublin Agglomeration	Total
<45	1277920	n/a	n/a
45-49.9	18766	487	19253
50-54.9	10553	0	10553
55-59.9	1328	0	1328
60-64.9	62	0	62
65-69.9	0	0	0
70-74.9	0	0	0
≥75	0	0	0

Note – Population totals rounded to the nearest whole number. Total column is the sum of unrounded values.

Table 17: 2021 $L_{evening}$ Population within Noise Contour Bands

10.5 Schools and hospitals exposure assessment

To derive the school and hospital exposure statistics, the same GeoDirectory data was utilised as for the dwelling assessment. Schools and hospitals were identified by searching the "NAME" field in the GeoDirectory data for the terms:

Term	Category
CBS	School (manual review)
C.B.S	School (manual review)
College	School (manual review)
Choláiste	School (manual review)
Coláiste	School (manual review)
Educate Together	School
School	School
Scoil	School
Further Education	School
N.S	School (manual review)
NS	School (manual review)
Hospital	Hospital (manual review)

Table 18: GeoDirectory search terms for schools and hospitals

The noise model has been used to compute the noise level at each of the locations for the schools and hospitals identified to determine which of the noise level bands they fall into. The results of this analysis for each of the five indices are given in Table 19 to Table 23.

Contour Level Band, dB(A) L_{den}	Number of Schools within L_{den} Air Noise Contour Bands	Number of Hospitals within L_{den} Air Noise Contour Bands
45-49.9	58	0
50-54.9	5	0
55-59.9	3	0
60-64.9	0	0
65-69.9	0	0
70-74.9	0	0
≥75	0	0

Table 19: 2021 L_{den} Schools and Hospitals within Noise Contour Bands

Contour Level Band, dB(A) L_{night}	Number of Schools within L_{night} Air Noise Contour Bands	Number of Hospitals within L_{night} Air Noise Contour Bands
40-44.9	20	0
45-49.9	5	0
50-54.9	1	0
55-59.9	0	0
60-64.9	0	0
65-69.9	0	0
≥70	0	0

Table 20: 2021 L_{night} Schools and Hospitals within Noise Contour Bands

Contour Level Band, dB(A) $L_{Aeq,16h}$	Number of Schools within $L_{Aeq,16h}$ Air Noise Contour Bands	Number of Hospitals within $L_{Aeq,16h}$ Air Noise Contour Bands
45-49.9	7	0
50-54.9	3	0
55-59.9	0	0
60-64.9	0	0
65-69.9	0	0
70-74.9	0	0
≥75	0	0

Table 21: 2021 $L_{Aeq,16h}$ Schools and Hospitals within Noise Contour Bands

Contour Level Band, dB(A) L_{day}	Number of Schools within L_{day} Air Noise Contour Bands	Number of Hospitals within L_{day} Air Noise Contour Bands
45-49.9	11	0
50-54.9	3	0
55-59.9	0	0
60-64.9	0	0
65-69.9	0	0
70-74.9	0	0
≥75	0	0

Table 22: 2021 L_{day} Schools and Hospitals within Noise Contour Bands

Contour Level Band, dB(A) $L_{evening}$	Number of Schools within $L_{evening}$ Air Noise Contour Bands	Number of Hospitals within $L_{evening}$ Air Noise Contour Bands
45-49.9	6	0
50-54.9	3	0
55-59.9	0	0
60-64.9	0	0
65-69.9	0	0
70-74.9	0	0
≥75	0	0

Table 23: 2021 $L_{evening}$ Schools and Hospitals within Noise Contour Bands

11.0 SUMMARY AND CONCLUSIONS

Noise contours have been produced based on the actual aircraft movements at Dublin Airport for 2021. The assumptions used in the computation of the contours have been described and the resulting contours presented for both the required noise indices, L_{den} and L_{night}.

Detailed editable numerical results for a 10 m by 10 m grid have been produced separately for the required noise indices. Information on the areas, dwelling numbers, and populations within the relevant noise level bands have also been provided.

Nick Williams
for Bickerdike Allen Partners LLP

David Charles
Partner

APPENDIX 1
GLOSSARY OF ACOUSTIC AND TECHNICAL TERMS

The Decibel, dB

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

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

Frequency, Hz

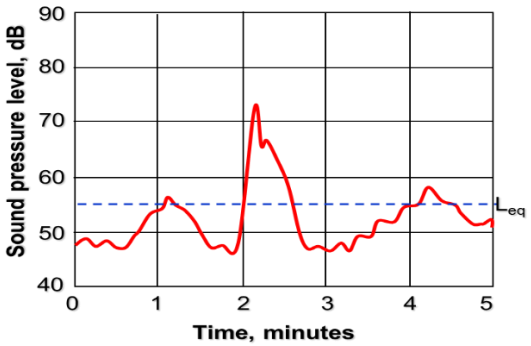
Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes,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

A-weighting

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

Environmental Noise Descriptors

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

Statistical Term	Description
$L_{Aeq,T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound. This is shown in the graph below: 
L_{den}	The day-evening-night noise indicator in decibels (dB) defined by the following formula: $$L_{den} = 10 \times \log\left(\frac{12 \times 10^{\frac{L_{day}}{10}} + 4 \times 10^{\frac{L_{evening}+5}{10}} + 8 \times 10^{\frac{L_{night}+10}{10}}}{24}\right)$$ in which: L_{day} is the A-weighted long-term average sound level for the daytime period (07:00-19:00) $L_{evening}$ is the A-weighted long-term average sound for the evening period (19:00-23:00) L_{night} is the A-weighted long-term average sound level for the night time period (23:00-07:00)

APPENDIX 2
BIBLIOGRAPHY AND REFERENCES

- European Communities (Environmental Noise) Regulations 2018, (S.I. No. 549 of 2018).
- European Communities (Environmental Noise) (Amendment) Regulations 2021, (S.I. No. 663 of 2021).
- Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Amended by:
    - Regulation (EC) No 1137/2008 of the European Parliament and of the Council of 22 October 2008
    - Commission Directive (EU) 2015/996 of 19 May 2015
    - Regulation (EU) 2019/1010 of the European Parliament and of the Council of 5 June 2019
    - Regulation (EU) 2019/1243 of the European Parliament and of the Council of 20 June 2019
    - Commission Directive (EU) 2020/367 of 4 March 2020
    - Commission Delegated Directive (EU) 2021/1226 of 21 December 2020
- ECAC.CEAC Doc. 29 4th Edition 'Report on Standard Method of Computing Noise Contours around Civil Airports', 2016
- CAP 2091 'CAA Policy on Minimum Standards for Noise Modelling', 2021

APPENDIX 3
AIRCRAFT MOVEMENT DATA

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
100	1	1	2
14Z	1	2	3
221	2	2	4
223	148	146	294
295	27	27	54
318	48	40	88
319	644	633	1277
320	4761	5406	10167
321	82	92	174
32A	387	340	727
32B	42	33	75
32N	531	530	1061
32Q	1098	1423	2521
332	44	44	88
333	534	1657	2191
339	4	4	8
33X	3	5	8
33Y	1	0	1
343	5	5	10
351	45	40	85
359	1	1	2
734	8	7	15
735	1	0	1
738	6	6	12
73C	3	3	6
73H	12006	13122	25128
73J	59	59	118
73K	0	1	1
73P	48	46	94
73W	160	147	307
73Y	0	1	1
744	0	1	1
74Y	1	1	2
752	1	1	2
75F	4	5	9

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
75T	3	3	6
75V	0	1	1
75W	31	32	63
75X	1	0	1
762	2	2	4
764	111	166	277
76F	1	176	177
76W	75	92	167
76Y	0	50	50
772	19	33	52
773	1	3	4
777	4	2	6
77L	3	8	11
77W	325	329	654
77X	51	50	101
781	5	5	10
788	571	679	1250
789	387	427	814
78J	7	29	36
7M8	306	226	532
7M9	18	18	36
7S8	13	19	32
A26	0	1	1
ABY	16	74	90
ACP	1	1	2
ANF	1	1	2
AR1	1	1	2
AR8	1	1	2
AT6	286	280	566
AT7	645	624	1269
ATR	0	1	1
BBJ	2	1	3
BE2	24	25	49
BE4	47	49	96
BEH	3	3	6

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
BHL	2	2	4
C2F	0	1	1
CC8	20	22	42
CCJ	54	68	122
CCX	24	30	54
CJ1	14	12	26
CJ2	39	41	80
CJ3	26	29	55
CJ4	12	12	24
CJ6	7	9	16
CJ7	2	2	4
CJ8	35	35	70
CJM	11	12	23
CL3	4	3	7
CL5	12	11	23
CL6	27	33	60
CN2	4	4	8
CN7	1	1	2
CNJ	3	5	8
CR1	1	1	2
CR2	12	12	24
CR9	289	307	596
CRK	4	2	6
CS1	70	60	130
CS3	144	132	276
CS5	10	6	16
D20	56	56	112
D28	1	1	2
D2L	3	3	6
D38	1	1	2
D62	6	9	15
DA5	1	1	2
DA9	5	7	12
DF1	1	1	2
DF3	1	0	1

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
DF7	13	14	27
DF8	4	5	9
DF9	5	7	12
DH2	1	1	2
DH3	0	1	1
DH4	68	49	117
E3L	68	63	131
E70	73	70	143
E75	96	96	192
E90	1052	1039	2091
E95	190	159	349
EM1	2	3	5
EM4	4	3	7
EM5	17	23	40
EP1	5	6	11
EP3	43	50	93
ER3	28	29	57
ER4	64	63	127
ERJ	2	2	4
F50	300	300	600
GJ3	1	1	2
GJ4	9	14	23
GJ5	12	13	25
GJ6	43	58	101
GS3	1	1	2
GS4	9	17	26
GS5	13	16	29
GS6	7	8	15
H25	18	20	38
H28	3	3	6
H29	4	5	9
H40	0	1	1
IL7	1	1	2
L35	21	19	40
L45	140	135	275

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
L55	1	1	2
L60	4	3	7
L75	3	3	6
LJ3	1	1	2
LJ4	4	4	8
LJ7	6	6	12
LOS	1	1	2
P18	3	3	6
P46	2	2	4
PC9	1	1	2
PL2	54	53	107
PL4	13	13	26
PN6	1	1	2
Q00	121	133	254
Q08	3	5	8
Q12	18	17	35
Q22	5	5	10
Q34	62	61	123
Q36	0	1	1
Q76	1	1	2
Q82	20	25	45
Q83	131	134	265
Q84	31	38	69
S92	363	422	785
SF3	36	30	66
SWM	12	8	20
X01	1	1	2
X11	17	24	41
X13	38	39	77
X70	4	4	8
X94	1	2	3
Y08	140	3	143
Y59	21	21	42
Y67	2	1	3
Y68	2	2	4

Aircraft Operational Code	Number of Annual Day (07:00-19:00) Aircraft Movements		
	Arrivals	Departures	Total
Y72	1	1	2
Y73	7	8	15
Y77	2	2	4
Y78	1	1	2
Y80	3	3	6
Y83	1	1	2
Y84	1	1	2
Y89	2	2	4
Y93	19	19	38
Y98	38	42	80
Y99	1	1	2
Z01	8	8	16
Z02	1	1	2
Z03	78	80	158
Z06	75	106	181
Z08	2	2	4
Z12	120	127	247
Z13	58	59	117
Z14	7	7	14
Z15	57	64	121
Z16	15	14	29
Z17	6	7	13
Z18	1	3	4
Z22	89	92	181
Z24	4	3	7
Z25	3	4	7
Z26	1	1	2
Z30	19	23	42
Z31	1	1	2
Z32	1	1	2
Z33	1	1	2
Z34	2	5	7
Total	**28634**	**32228**	**60862**

Table A3.1: 2021 Day Movements by Aircraft Operational Code and Operation

Aircraft Operational Code	Number of Annual Evening (19:00-23:00) Aircraft Movements		
	Arrivals	Departures	Total
14Z	1	0	1
223	1	3	4
318	13	2	15
319	222	43	265
320	1694	255	1949
321	50	4	54
32A	116	74	190
32B	0	9	9
32N	108	46	154
32Q	135	9	144
332	0	1	1
333	269	23	292
33X	2	0	2
343	1	1	2
351	2	8	10
359	1	0	1
734	0	2	2
735	0	1	1
73H	4906	3160	8066
73J	13	0	13
73K	1	0	1
73P	279	421	700
73W	142	18	160
74Y	1	0	1
752	1	1	2
75F	1	11	12
762	2	0	2
76F	1	22	23
76W	2	1	3
76X	4	56	60
76Y	246	261	507
777	0	1	1
77W	2	10	12
77X	2	2	4
788	1	1	2

Aircraft Operational Code	Number of Annual Evening (19:00-23:00) Aircraft Movements		
	Arrivals	Departures	Total
789	4	22	26
7M8	51	124	175
7S8	4	0	4
A26	1	0	1
ABY	173	455	628
AT6	0	6	6
AT7	15	20	35
ATF	0	1	1
BBJ	0	1	1
BE2	5	1	6
BE4	5	2	7
CC8	4	2	6
CCJ	20	7	27
CCX	14	7	21
CJ1	1	3	4
CJ2	3	1	4
CJ3	7	1	8
CJ4	1	1	2
CJ6	2	0	2
CJ8	4	4	8
CJM	1	0	1
CL5	0	1	1
CL6	5	3	8
CR2	1	0	1
CR9	51	19	70
CRK	0	1	1
CS1	2	12	14
CS3	16	24	40
D20	1	1	2
D62	4	2	6
DA9	2	0	2
DF3	0	1	1
DF7	0	1	1
DF8	1	0	1
DF9	3	1	4

Aircraft Operational Code	Number of Annual Evening (19:00-23:00) Aircraft Movements		
	Arrivals	Departures	Total
DH4	1	20	21
E3L	3	4	7
E70	15	0	15
E75	2	0	2
E90	243	138	381
E95	13	37	50
EM4	0	1	1
EM5	7	1	8
EP1	1	0	1
EP3	9	2	11
ER3	2	1	3
ER4	1	1	2
F50	1	1	2
GJ4	2	0	2
GJ5	8	6	14
GJ6	12	3	15
GR2	1	1	2
GS4	7	2	9
GS5	1	3	4
GS6	2	1	3
H25	1	0	1
H40	1	0	1
L35	5	4	9
L45	16	10	26
L60	2	2	4
PL2	5	3	8
PL4	4	3	7
Q00	21	4	25
Q08	3	2	5
Q12	0	1	1
Q34	6	5	11
Q36	2	1	3
Q82	8	3	11
Q83	12	5	17
Q84	12	7	19

Aircraft Operational Code	Number of Annual Evening (19:00-23:00) Aircraft Movements		
	Arrivals	Departures	Total
S92	96	51	147
SF3	12	18	30
SWM	2	3	5
X11	3	0	3
X13	4	3	7
X70	2	0	2
Y08	42	175	217
Y59	2	1	3
Y73	1	0	1
Y98	8	3	11
Z01	1	1	2
Z03	13	7	20
Z06	26	12	38
Z12	10	5	15
Z13	4	4	8
Z15	9	2	11
Z16	1	1	2
Z17	1	0	1
Z22	13	4	17
Z24	0	1	1
Z30	6	1	7
Z34	2	0	2
Total	**9307**	**5734**	**15041**

Table A3.2: 2021 Evening Movements by Aircraft Operational Code and Operation

Aircraft Operational Code	Number of Annual Night (23:00-07:00) Aircraft Movements		
	Arrivals	Departures	Total
318	0	19	19
319	21	210	231
320	467	1261	1728
321	17	54	71
32A	35	124	159
32D	0	1	1
32N	28	91	119
32Q	376	179	555
332	1	0	1
333	873	0	873
33Y	0	1	1
343	1	1	2
351	1	0	1
359	12	13	25
734	4	3	7
735	1	1	2
73C	1	2	3
73G	1	1	2
73H	2548	3181	5729
73J	0	13	13
73K	8	8	16
73P	581	441	1022
73W	0	135	135
73Y	6	5	11
744	1	0	1
74Y	0	1	1
75F	15	5	20
75W	2	1	3
762	0	2	2
764	55	0	55
76F	197	1	198
76W	17	1	18
76X	54	2	56
76Y	313	248	561
772	14	0	14

Aircraft Operational Code	Number of Annual Night (23:00-07:00) Aircraft Movements		
	Arrivals	Departures	Total
773	2	0	2
77L	251	246	497
77W	102	91	193
77X	3	4	7
788	299	191	490
789	317	259	576
78J	22	0	22
7M8	11	20	31
7S8	5	2	7
ABY	491	151	642
AT3	145	145	290
AT6	0	1	1
AT7	255	275	530
ATF	1	0	1
BBJ	1	2	3
BE2	1	4	5
BE4	0	1	1
C2F	1	0	1
CCJ	6	5	11
CCX	6	7	13
CJ2	1	1	2
CJ3	0	4	4
CL3	0	1	1
CL6	6	2	8
CNJ	2	0	2
CR2	0	1	1
CR9	16	39	55
CRK	0	1	1
CS3	0	4	4
CS5	0	4	4
D20	3	2	5
D42	1	1	2
D62	2	1	3
DF7	4	2	6
DF9	2	2	4

Aircraft Operational Code	Number of Annual Night (23:00-07:00) Aircraft Movements		
	Arrivals	Departures	Total
E3L	2	6	8
E70	1	19	20
E75	0	2	2
E90	32	149	181
E95	14	21	35
E9L	1	1	2
EM2	1	1	2
ER3	1	1	2
ER4	0	1	1
GJ4	1	1	2
GJ5	5	6	11
GJ6	9	3	12
GS3	1	1	2
GS4	5	2	7
GS5	5	0	5
GS6	1	1	2
H25	6	5	11
L35	1	4	5
L45	17	26	43
L60	0	1	1
PL2	0	3	3
PL4	1	1	2
Q00	0	5	5
Q08	1	0	1
Q34	5	5	10
Q83	2	6	8
Q84	2	0	2
S92	23	8	31
SF3	142	143	285
SWM	102	105	207
X11	8	7	15
X13	3	3	6
X70	0	2	2
Y08	21	25	46
Y59	0	1	1

Aircraft Operational Code	Number of Annual Night (23:00-07:00) Aircraft Movements		
	Arrivals	Departures	Total
Y83	1	1	2
Y98	1	1	2
Y99	2	2	4
Z03	0	4	4
Z06	31	14	45
Z12	4	2	6
Z13	1	0	1
Z15	2	2	4
Z16	0	1	1
Z17	2	2	4
Z18	1	0	1
Z22	0	6	6
Z25	1	0	1
Z30	1	2	3
Z34	1	0	1
Total	**8067**	**8076**	**16143**

Table A3.3: 2021 Night Movements by Aircraft Operational Code and Operation

APPENDIX 4

AIRCRAFT OPERATIONAL CODES AND MODELLED ANP AIRCRAFT TYPES

Key

Aircraft Operational Code:	Aircraft Type Code supplied by Dublin Airport
AEDT Aircraft code:	AEDT code of aircraft used in modelling. Those marked "Validated" have custom types created with aircraft profiles based on radar data and noise levels based on measured results at Dublin Airport

N.B. Aircraft Operational Codes do not necessarily reflect ICAO/IATA Codes.

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
100	F10065	C/D
221	737700	C/D
223	737700	C/D
295	DHC8	A/B
318	A319-131	C/D
319	Validated	C/D
320	Validated	C/D
321	Validated	C/D
332	A330-301	C/D
333	Validated	C/D
339	A330-343	C/D
343	A340-211	C/D
351	A350-941	C/D
359	A350-941	C/D
734	Validated	C/D
735	737500	C/D
738	Validated	C/D
744	747400	C/D
752	757RR	C/D
762	767CF6	C/D
764	Validated	C/D
772	Validated	C/D
773	Validated	C/D
777	Validated	C/D
781	Validated	C/D
788	Validated	C/D
789	Validated	C/D
14Z	BAE300	C/D
32A	Validated	C/D
32B	Validated	C/D
32D	Validated	C/D
32N	Validated	C/D
32Q	Validated	C/D
33X	A330-301	C/D
33Y	Validated	C/D
73C	737300	C/D

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
73G	Validated	C/D
73H	Validated	C/D
73J	737800	C/D
73K	Validated	C/D
73P	Validated	C/D
73W	Validated	C/D
73Y	737300	C/D
74Y	747400	C/D
75F	757RR	C/D
75T	757300	C/D
75V	757RR	C/D
75W	757RR	C/D
75X	757RR	C/D
76F	Validated	C/D
76W	Validated	C/D
76X	767CF6	C/D
76Y	Validated	C/D
77L	Validated	C/D
77W	Validated	C/D
77X	Validated	C/D
78J	Validated	C/D
7M8	Validated	C/D
7M9	7378MAX	C/D
7S8	Validated	C/D
A26	DHC8	A/B
ABY	Validated	C/D
ACP	DHC6	A/B
ANF	C130	A/B
AR1	BAE146	C/D
AR8	BAE146	C/D
AT3	DHC8	A/B
AT6	DHC8	A/B
AT7	Validated	A/B
ATF	Validated	A/B
ATR	Validated	A/B
BBJ	Validated	C/D

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
BE2	DHC6	A/B
BE4	MU3001	C/D
BEH	1900D	A/B
BHL	HELO	Helicopter
C2F	CNA208	A/B
CC8	CL600	C/D
CCJ	CL600	C/D
CCX	BD-700-1A10	C/D
CJ1	CNA525C	C/D
CJ2	CNA525C	C/D
CJ3	CNA525C	C/D
CJ4	CNA525C	C/D
CJ6	CIT3	C/D
CJ7	CIT3	C/D
CJ8	CNA680	C/D
CJM	CNA525C	C/D
CL3	CL600	C/D
CL5	CL600	C/D
CL6	CL600	C/D
CN2	CNA525C	C/D
CN7	CNA750	C/D
CNJ	CNA560E	C/D
CR1	CL600	C/D
CR2	CL600	C/D
CR9	CRJ9-ER	C/D
CRK	CRJ9-ER	C/D
CS1	737700	C/D
CS3	737700	C/D
CS5	SF340	A/B
D20	CNA750	C/D
D28	DO228	A/B
D2L	CNA750	C/D
D38	DO328	A/B
D42	PA30	A/B
D62	PA30	A/B
DA5	FAL900EX	C/D

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
DA9	FAL900EX	C/D
DF1	LEAR35	C/D
DF3	FAL900EX	C/D
DF7	GIV	C/D
DF8	GIV	C/D
DF9	FAL900EX	C/D
DH2	DHC830	A/B
DH3	DHC830	A/B
DH4	DHC830	A/B
E3L	EMB145	C/D
E70	EMB170	C/D
E75	EMB175	C/D
E90	Validated	C/D
E95	EMB195	C/D
E9L	EMB190	C/D
EM1	DHC6	A/B
EM2	EMB120	A/B
EM4	EMB145	C/D
EM5	CNA55B	C/D
EP1	CNA510	C/D
EP3	CNA510	C/D
ER3	EMB145	C/D
ER4	EMB145	C/D
ERJ	EMB145	C/D
F50	HS748A	A/B
GJ3	GIIB	C/D
GJ4	GIV	C/D
GJ5	GV	C/D
GJ6	GV	C/D
GR2	IA1125	C/D
GS3	GIIB	C/D
GS4	GIV	C/D
GS5	LEAR35	C/D
GS6	G650ER	C/D
H25	LEAR35	C/D
H28	LEAR35	C/D

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
H29	LEAR35	C/D
H40	LEAR35	C/D
IL7	A340-211	C/D
L35	LEAR35	C/D
L45	LEAR35	C/D
L55	LEAR35	C/D
L60	LEAR35	C/D
L75	LEAR35	C/D
LJ3	LEAR35	C/D
LJ4	LEAR35	C/D
LJ7	LEAR35	C/D
LOS	C130	A/B
P18	DHC6	A/B
P46	PA31	A/B
PC9	GASEPF	A/B
PL2	CNA208	A/B
PL4	CNA55B	C/D
PN6	BEC58P	A/B
Q00	CNA510	C/D
Q08	HELO	Helicopter
Q12	CNA510	C/D
Q22	DHC6	A/B
Q34	DHC6	A/B
Q36	DHC6	A/B
Q76	BEC58P	A/B
Q82	CIT3	C/D
Q83	CNA560XL	C/D
Q84	CNA500	C/D
S92	HELO	Helicopter
SF3	SF340	A/B
SWM	DHC6	A/B
UNK	GASEPF	A/B
X01	GIV	C/D
X11	BD-700-1A11	C/D
X13	GIV	C/D
X58	BEC58P	A/B

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
X70	DHC6	A/B
X94	CNA441	A/B
Y08	DHC6	A/B
Y59	CNA680	C/D
Y67	FAL900EX	C/D
Y68	HELO	Helicopter
Y72	LEAR35	C/D
Y73	MU3001	C/D
Y77	GASEPV	A/B
Y78	HELO	Helicopter
Y80	HELO	Helicopter
Y83	IA1125	C/D
Y84	HS748A	A/B
Y89	CNA750	C/D
Y93	CNA55B	C/D
Y98	CL600	C/D
Y99	PA30	A/B
Z01	ECLIPSE500	C/D
Z02	HELO	Helicopter
Z03	CNA510	C/D
Z06	BD-700-1A10	C/D
Z08	HELO	Helicopter
Z12	CL600	C/D
Z13	CNA55B	C/D
Z14	CNA510	C/D
Z15	CNA560XL	C/D
Z16	MU3001	C/D
Z17	GIV	C/D
Z18	FAL900EX	C/D
Z22	CNA680	C/D
Z24	BD-700-1A10	C/D
Z25	GV	C/D
Z26	MU3001	C/D
Z30	CL601	C/D
Z31	GASEPV	A/B
Z32	ECLIPSE500	C/D

Aircraft Operational Code	AEDT Aircraft Code	Aircraft Category
Z33	CL600	C/D
Z34	GV	C/D

Table A4.1: Aircraft Operation Codes Mapping to AEDT Aircraft Codes, and Aircraft Category

APPENDIX 5
DERIVATION OF AIRCRAFT PROFILES

This appendix describes the process followed to convert the radar data into a set of aircraft profiles.

For the most common aircraft, the Airbus A320 and the Boeing 737-800, airlines were consulted to check that the resulting assumptions used were in line with what occurs in practice. As specific departure procedures are commercially sensitive information, this is not repeated here, but they were broadly in line with the assumptions.

Based on the airline responses, intersection departures are rarely used other than for Runway 10. BAP were advised that these are typically used for the Boeing 737-800, but not for the Airbus A320 which typically uses the full runway length. Based on this advice and analysis of the radar data, it has been assumed the following aircraft use intersection departures from Runway 10:

- Airbus A319
- Airbus A321neo
- Boeing 737-400
- Boeing 737-700
- Boeing 737-800
- Boeing 767-300
- Boeing 767-400
- Boeing 777-200
- Boeing 777-300
- Boeing 787
- Embraer E190

All other aircraft were assumed to use the full runway length when departing from Runway 10.

The aircraft profiles for all the aircraft types reviewed at Dublin Airport can be broadly described by the following phases:

1. Takeoff

   This starts with the aircraft stationary on the ground, it will then use takeoff thrust (which can be maximum thrust or a percentage of it) to accelerate on the runway and get off the ground. This phase ends when the aircraft reaches the desired speed for the initial climb phase, which should be shortly after leaving the ground.

2. Initial climb

Still using takeoff thrust, the aircraft continues to climb, with a constant speed.

3. Flap retraction

   The aircraft will now switch to climb thrust and will gain both altitude and speed. Within the model this is represented by a certain percentage of the available thrust being used for acceleration, with the remainder being used for climbing. Flaps are retracted at certain speeds, often in stages.

4. Ongoing flight

   With flaps fully retracted, the aircraft continues to gain both altitude and speed using climb thrust. The percentage of thrust being used for acceleration is typically reduced from the previous phase. This phase continues until the aircraft is outside the modelled area.

An example profile showing these phases is presented in Figure A5.1, which shows the modelled profile of a Boeing 737-800 Stage 1 departure using Runway 28.

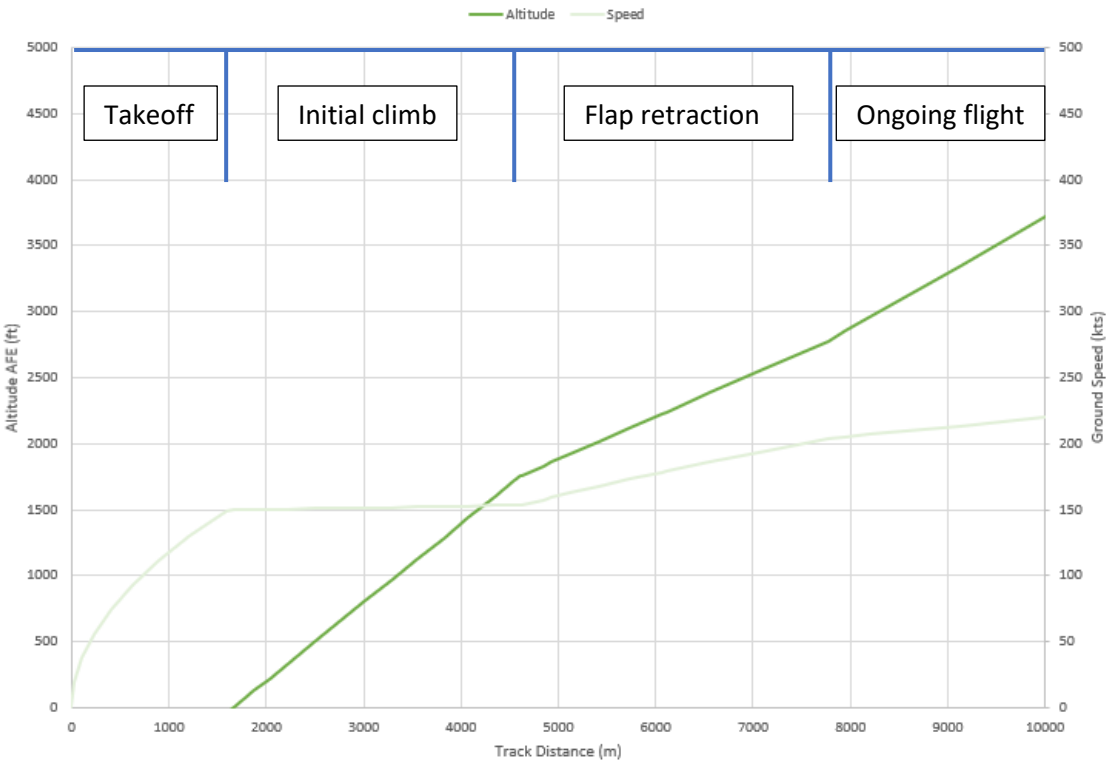


Figure A5.1: Phases of Flight Profile

The steps followed to produce the modelled profiles are outlined below. A profile was created separately for each combination of runway end (10/28 only), aircraft type, and stage length,

where sufficient data was available. For stage lengths with insufficient data, the same approach was adopted, with the takeoff thrust extrapolated based on the relative modelled departure weights from the modelled profiles of stage lengths which had sufficient data for the same runway end and aircraft type. The resulting Runway 28 profiles were also used for Runway 16/34 operations.

- Identify the base AEDT type for each actual aircraft type.
- Compare the average radar profile (altitude and ground speed) with the model output from AEDT.
- If necessary, reduce takeoff thrust from maximum to better match the climb gradient in the initial climb phase. For Runway 10 a further consideration is the distance from the start of roll location which is affected by whether intersection departures are used. The takeoff thrust was never reduced lower than 75% of the AEDT default value, based on the guidance in ECAC Doc 29 that this is often stipulated as a lower limit by airworthiness authorities.
- If necessary, adjust the initial climb altitude to better match the radar data.
- Leaving the flap retraction speeds as per the default profiles, set the percentage of thrust used for accelerating in the flap retraction phase to match the altitude and speed from the radar data as closely as possible. If necessary, adjust the default climb thrust.
- Set the percentage of thrust used for accelerating in the continued flight phase to match the altitude and speed from the radar data as closely as possible.

The base AEDT types for each actual aircraft type considered are given in Table A5.1 below.

Operational Aircraft Code(s)	Description	Base AEDT Type
ABY	Airbus A300-600	A300-622R
319 / 32D	Airbus A319	A319-131
320 / 32A	Airbus A320	A320-211
32N	Airbus A320neo	A320-271N
321 / 32B	Airbus A321	A321-232
32Q	Airbus A321neo	A320-271N[1]
333 / 33Y	Airbus A330-300	A330-301
AT7 / ATF / ATR	ATR 72	ATR72-212A
734 / 73P	Boeing 737-400	737400
73G / 73W / BBJ	Boeing 737-700	737700
738 / 73H / 73K / 7S8	Boeing 737-800	737800

Operational Aircraft Code(s)	Description	Base AEDT Type
763 / 76F / 76V / 76W / 76Y	Boeing 767-300	767300
764	Boeing 767-400	767400
772 / 77L / 77X	Boeing 777-200	777200
773 / 777 / 77W	Boeing 777-300	777300
781 / 788 / 789 / 78J	Boeing 787	7878R
7M8	Boeing 737 MAX 8	7378MAX
E90	Embraer E190	EMB190

[1] For the Airbus A321neo, the base AEDT type was the A320-271N, but modified with an increased weight and thrust based on the difference between the Airbus A320neo and Airbus A321neo.

Table A5.1: Operational Aircraft Types and Base AEDT Types

An example of a resulting modelled aircraft profile overlaid on the actual radar profiles is given in Figure A5.2 for altitude and Figure A5.3 for ground speed, which show a sample of 500 profiles by a Boeing 737-800 Runway 28 Stage 1 departure. The individual actual profiles are shown faintly in blue and green in the altitude and speed figures respectively. The averages of the actual profiles are shown in dark blue and dark green. The modelled profiles are shown in light blue and red.

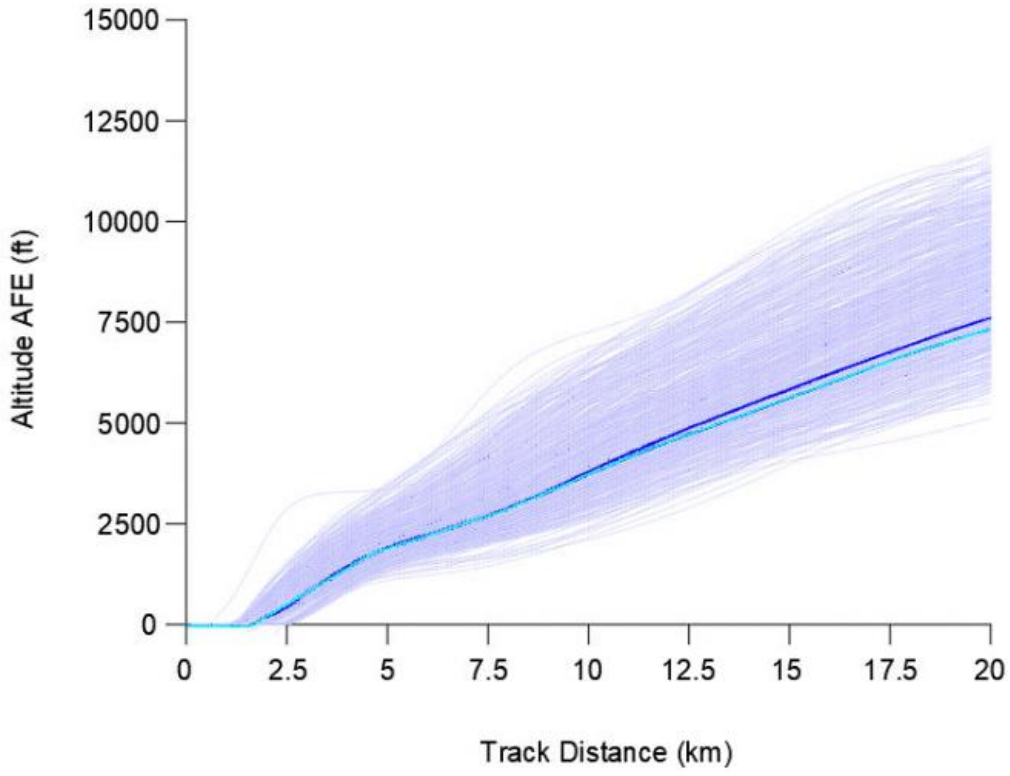


Figure A5.2: Example of Modelled and Actual Flight Profiles – Altitude

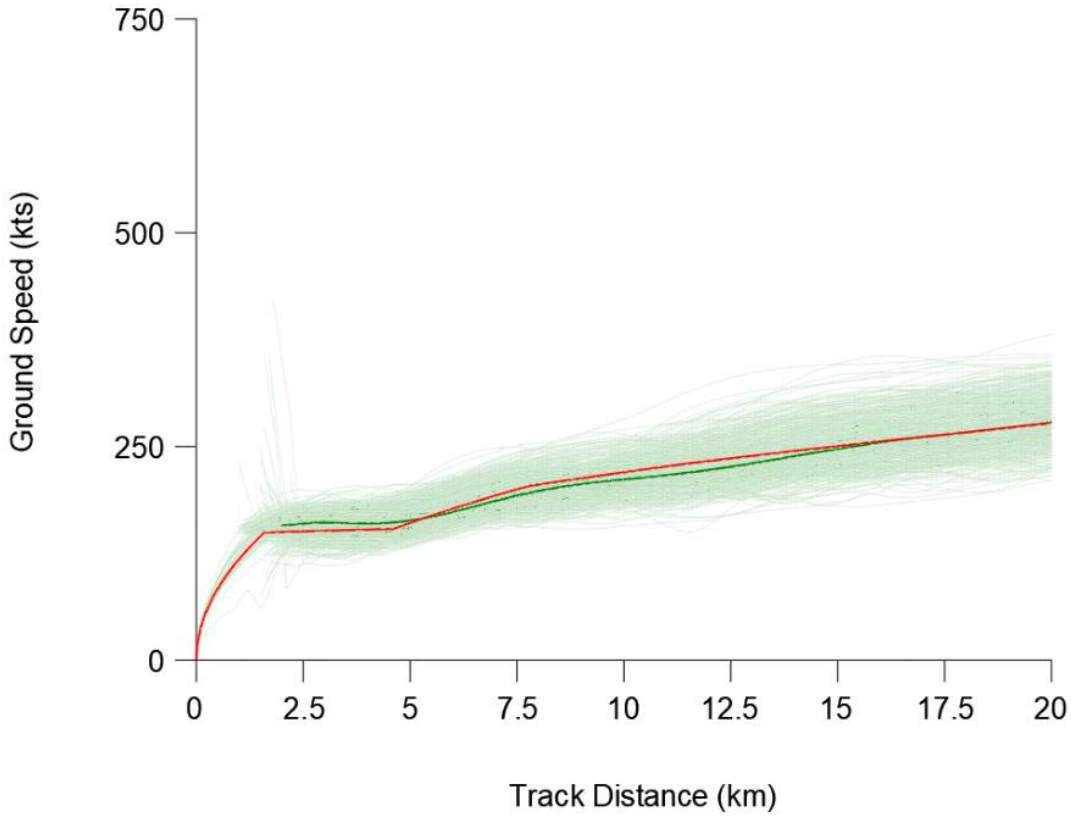


Figure A5.3: Example of Modelled and Actual Flight Profiles – Ground Speed

APPENDIX 6
DERIVATION OF AIRCRAFT ROUTES

This appendix describes the process followed to convert the radar data into a set of average departure tracks. This process was done separately for each combination of runway end, aircraft category (i.e. A/B or C/D) and route. An example of a resulting set of dispersed modelled flight tracks overlaid on the actual radar tracks is given in Figure A6.1, which shows a sample of 500 tracks which followed the Runway 28 ROTEV route for Category C/D aircraft in 2021. The seven dispersed modelled flight tracks are shown in black, with the actual radar tracks shown in green.

The full set of modelled flight tracks are shown in Figures DR004 to DR010 at the end of this appendix. These figures show the initial portion of the route; the model assumes that aircraft continue to fly straight after these initial routes end. The steps followed to produce these are outlined below.

1. Assign each radar track to a route group, as these are not currently populated automatically by the recording system at the airport. The route group was assigned based on where the track was heading once it was a certain distance from the airport. Some route groups were not used for all runway ends, and some route groups were combined where they are initially identical. In some cases, it was necessary to subdivide route groups to account for the range of locations where aircraft turn. The route groups are given in Table A6.1 below.

Route Group (Track Name)	Description
DEXEN	Initial turn south, heading east
INKUR	Heading west
LIFFY	Initial turn north, heading east Note – split into 2 groups for C/D aircraft
NEPOD	Heading south Note – split into 2 groups for C/D aircraft
OLONO	Heading south-south-west
PELIG	Heading southwest
ROTEV	Heading north
SUROX	Heading northwest

Table A6.1: Route Groups

2. For each route group determine a proxy mean flight track from the radar data.
3. For each route group, create a series of “gates” along the mean flight track.
4. For each gate, calculate the point at which each track (in the same route group) goes through the gate.

5. For each route group, create a mean track and a number of sub-tracks. The route for each sub-track has been based on the average of the tracks within the relevant percentiles at each gate. The number of sub-tracks and percentiles used has been based on the values given in ECAC Doc 29 4th Edition Volume 2, Appendix C.

The ECAC document recommends that normally 7 discrete sub-tracks (including the mean track) will be adequate. This has been followed except where a limited number of actual tracks are available to base them on, and in these cases a lower number of sub-tracks have been used.

The percentages in the ECAC document are based on a normal distribution and mean that the area within the outermost sub tracks will contain the large majority of the radar tracks, but not every single one.

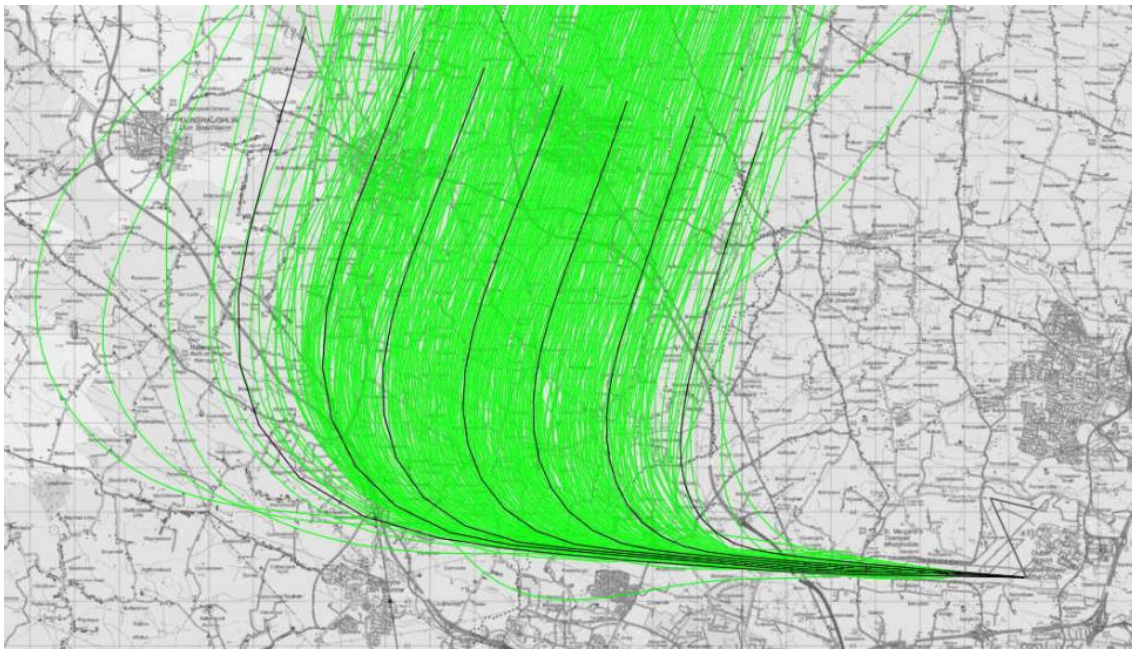


Figure A6.1: Example of Modelled and Actual Flight Tracks

CYAL50218188

LEGEND:

- Runway 10
- Runway 28
- Runway 16
- Runway 34

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

Modelled Arrival Routes

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:250000@A4

FIGURE No:

A11469_02_DR004_1.0

CYAL50218188

LEGEND:

- DEXEN
- INKUR
- LIFFY
- NEPOD
- PELIG
- ROTEV
- SUROX

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

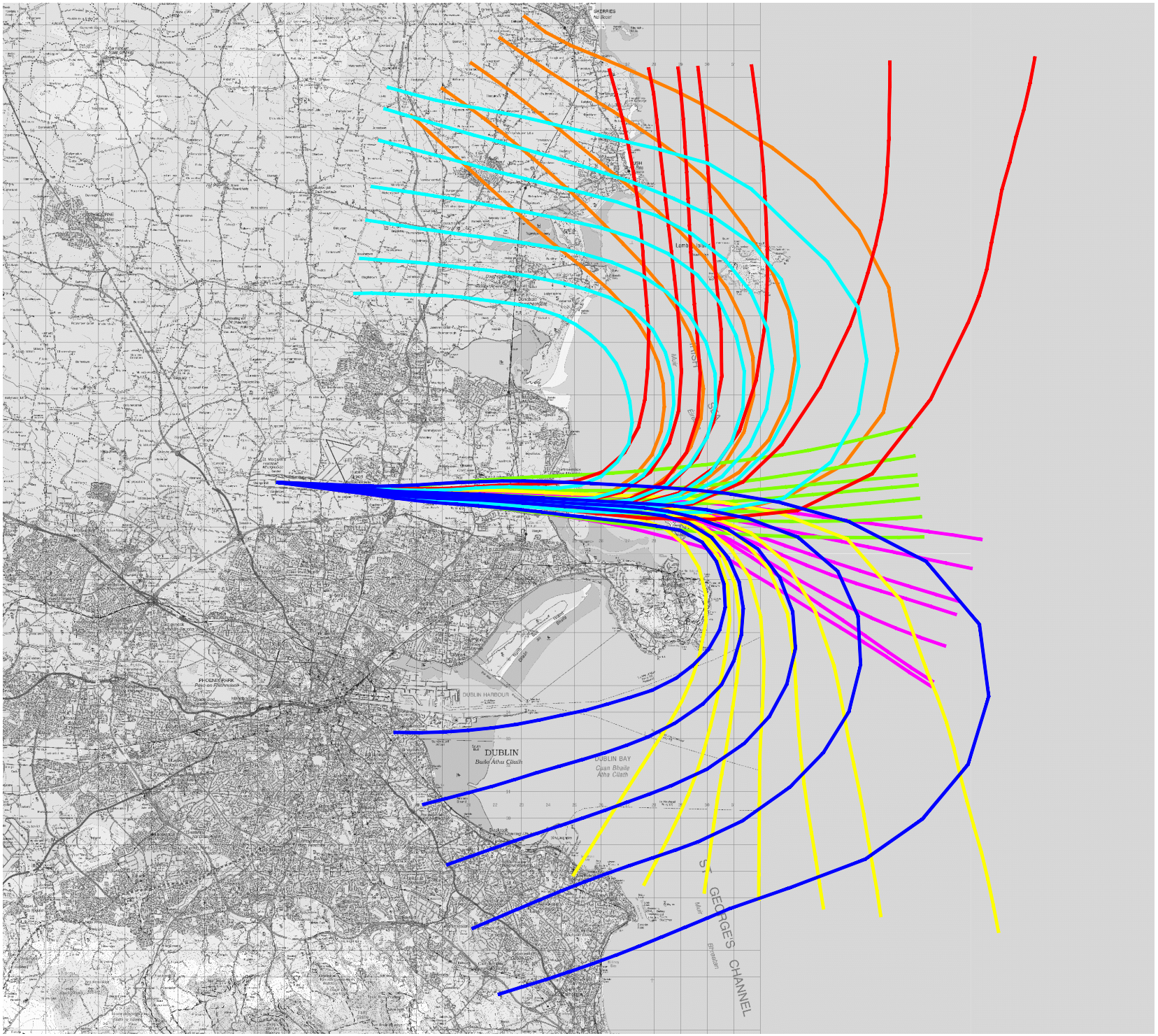
Modelled Departure Routes
Runway 10 Category A/B Aircraft

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR005_1.0



LEGEND:

- DEXEN
- INKUR
- LIFFY
- NEPOD
- PELIG
- ROTEV
- SUROX

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

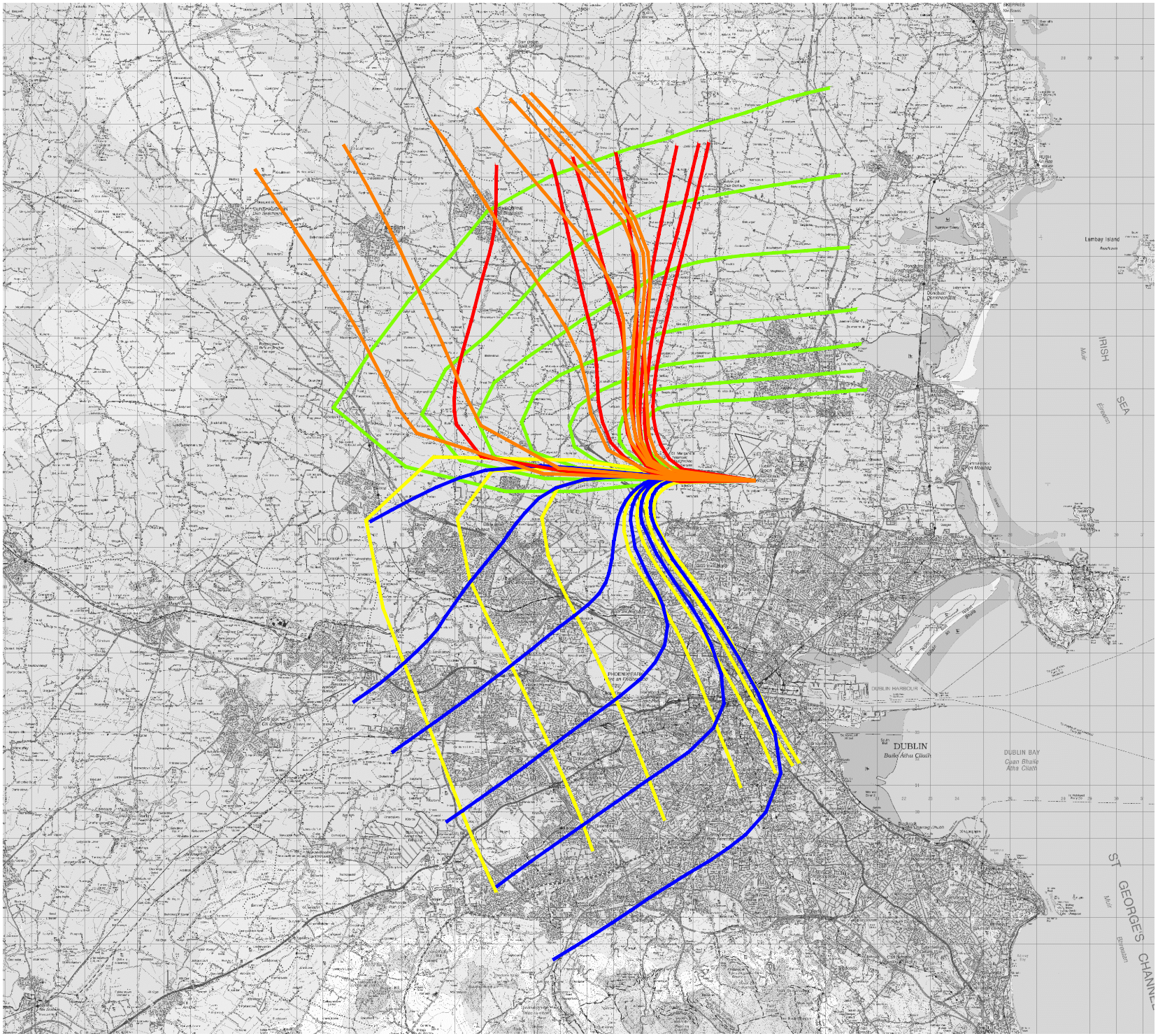
Modelled Departure Routes
Runway 10 Category C/D Aircraft

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR006_1.0



CYAL50218188

LEGEND:

- LIFFY
- NEPOD
- PELIG
- ROTEV
- SUROX

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

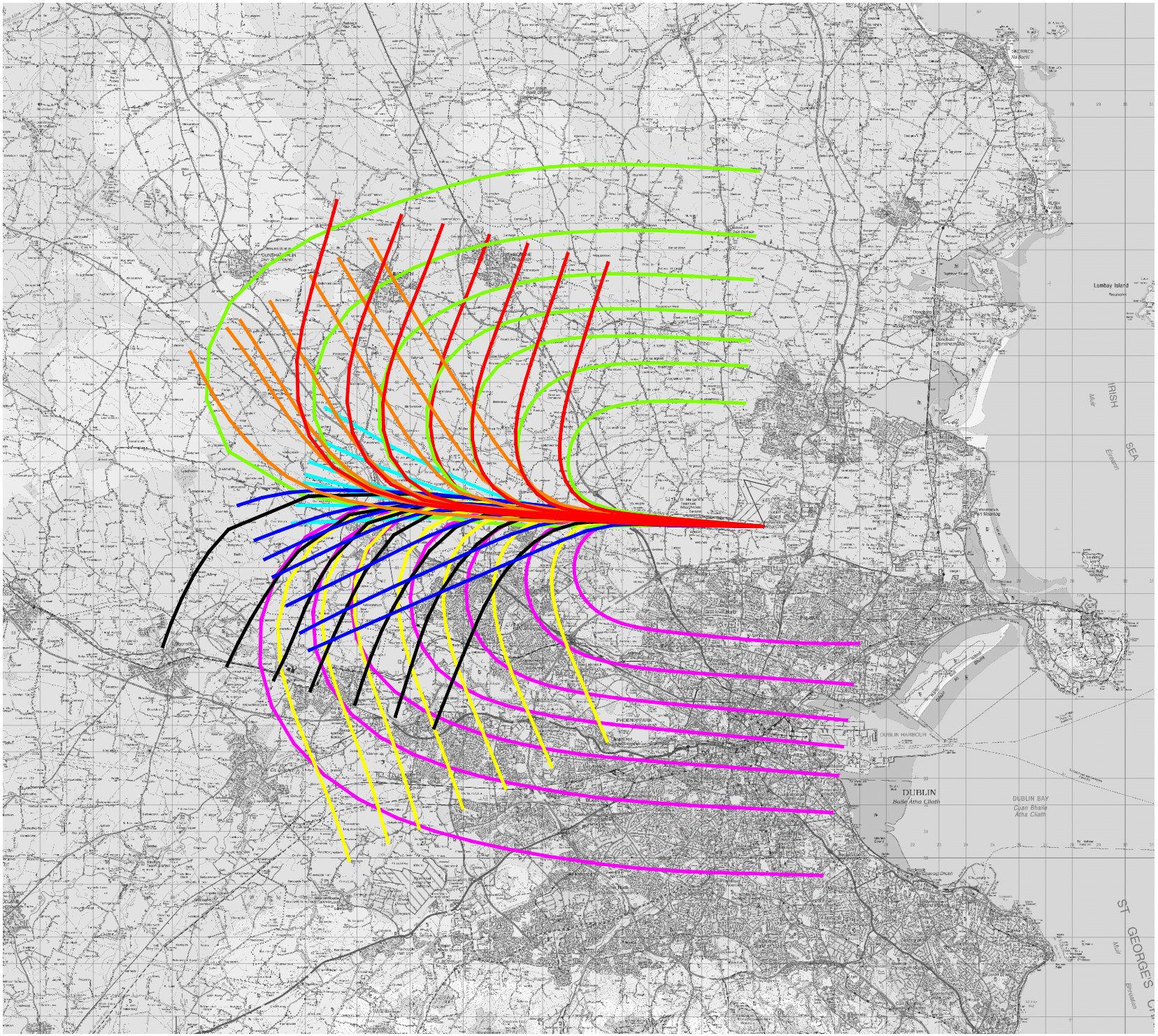
Modelled Departure Routes
Runway 28 Category A/B Aircraft

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR007_1.0



LEGEND:

- DEXEN
- INKUR
- LIFFY
- NEPOD
- OLONO
- PELIG
- ROTEV
- SUROX

Rev	Date	Description	Initials

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Modelled Departure Routes
Runway 28 Category C/D Aircraft

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR008_1.0

CYAL50218188

LEGEND:

- INKUR
- LIFFY
- NEPOD
- PELIG
- ROTEV
- SUROX

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Modelled Departure Routes
Runway 16

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR009_1.0

LEGEND:

- DEXEN
- INKUR
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- NEPOD
- PELIG

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Modelled Departure Routes
Runway 34

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

FIGURE No:

A11469_02_DR010_1.0

APPENDIX 7
VALIDATION OF AIRCRAFT NOISE LEVELS

This appendix describes the process followed to account for the Noise Monitoring Terminal (NMT) results and the adjustments made to the model.

Measured noise levels taken by the Dublin Airport Noise and Track Keeping (NTK) system have been used to carry out a noise validation exercise. Specifically, the results from Noise Monitoring Terminals (NMTs) 1, 2 and 20 between January and December 2021 have been used.

The noise levels from the monitors are automatically correlated with aircraft movements using the radar track keeping system and the average determined by aircraft type and operation. Several parameters are measured by the system, and for this validation the Sound Exposure Level (SEL) of the individual aircraft movements has been used.

To take into account the measured levels, first the logarithmic average has been computed for each aircraft type and operation, at each NMT. Next the AEDT software has been used to predict the logarithmic average level at the NMT locations using the base AEDT aircraft type with the same distribution of stage lengths as the measurements.

These two levels have been compared for each aircraft type when separately arriving and departing. Adjustments were then made to the modelled aircraft noise levels to minimise differences between the measured and predicted results. This was done by adjusting the AEDT NPD data for the modelled aircraft types so that the movement-weighted average modelled noise levels at the NMTs matched that measured.

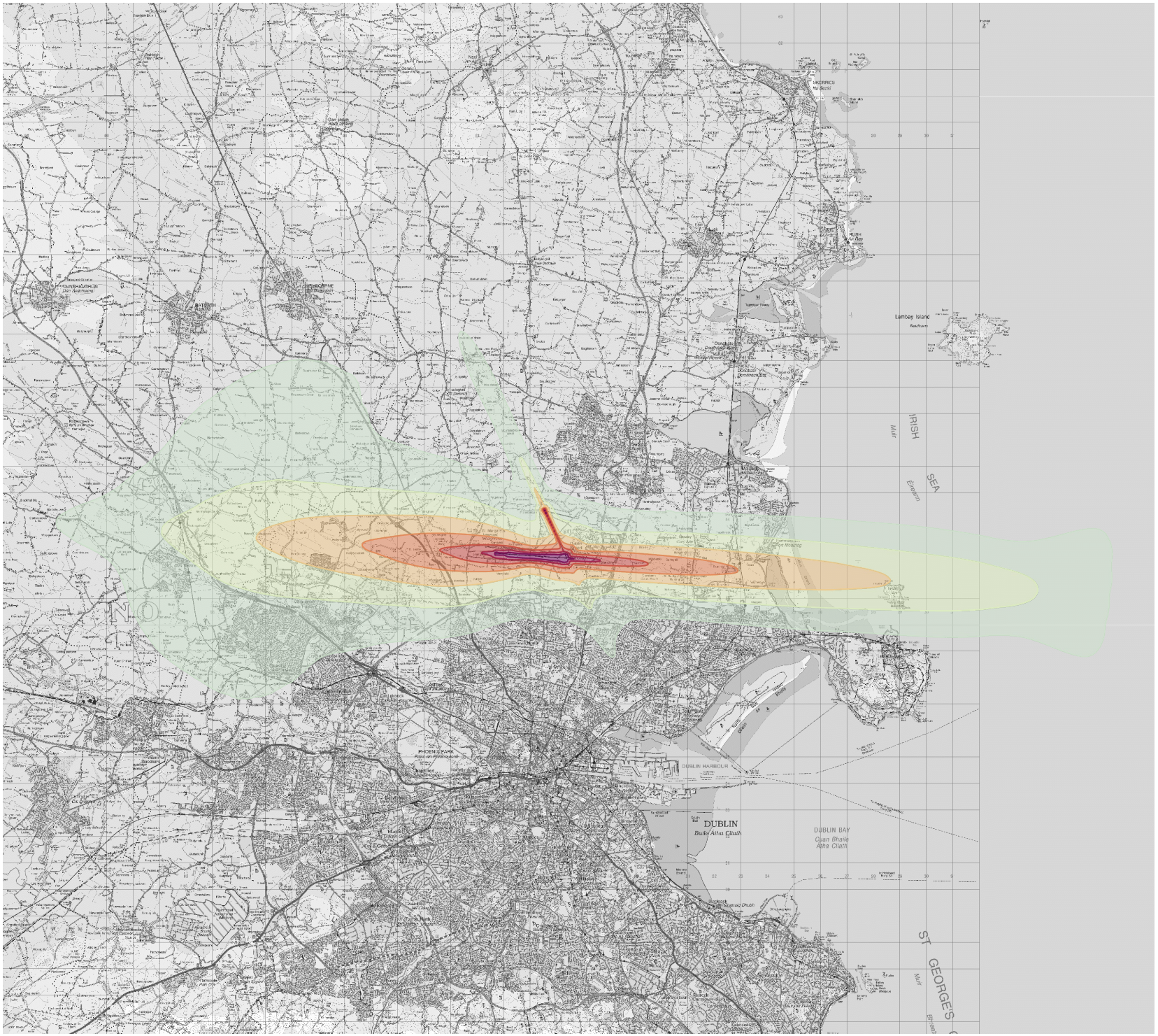
Eighteen aircraft have had modifications made to their arrival and departure noise assumptions. The modifications are detailed in Table A7.1 below.

Aircraft Type Description	Base AEDT Type	Arrival Adjustment (dB)	Departure Adjustment (dB)
Airbus A300-600	A300-622R	-3.5	-1.8
Airbus A319	A319-131	-0.9	-0.3
Airbus A320	A320-211	-1.0	-2.1
Airbus A320neo	A320-271N	-0.5	-1.1
Airbus A321	A321-232	-0.8	-1.0
Airbus A321neo	A320-271N[1]	-0.6	-2.0
Airbus A330-300	A330-301	-1.3	-1.8
ATR 72	ATR72-212A	+3.4	+0.1
Boeing 737-400	737400	+0.3	-1.4

Aircraft Type Description	Base AEDT Type	Arrival Adjustment (dB)	Departure Adjustment (dB)
Boeing 737-700	737700	-1.7	-2.9
Boeing 737-800	737800	-1.4	-2.7
Boeing 767-300	767300	-2.0	-5.5
Boeing 767-400	767400	+0.3	+0.8
Boeing 777-200	777200	0.0	-0.7
Boeing 777-300	777300	-1.0	-3.6
Boeing 787	7878R	-0.2	+0.3
Boeing 737 MAX 8	7378MAX	-0.4	-2.1
Embraer E190	EMB190	-1.1	-1.8

Table A7.1: Noise Level Adjustments

APPENDIX 8
STRATEGIC NOISE MAPS



LEGEND:

- 45 - 49 dB(A) L_{den}
- 50 - 54 dB(A) L_{den}
- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

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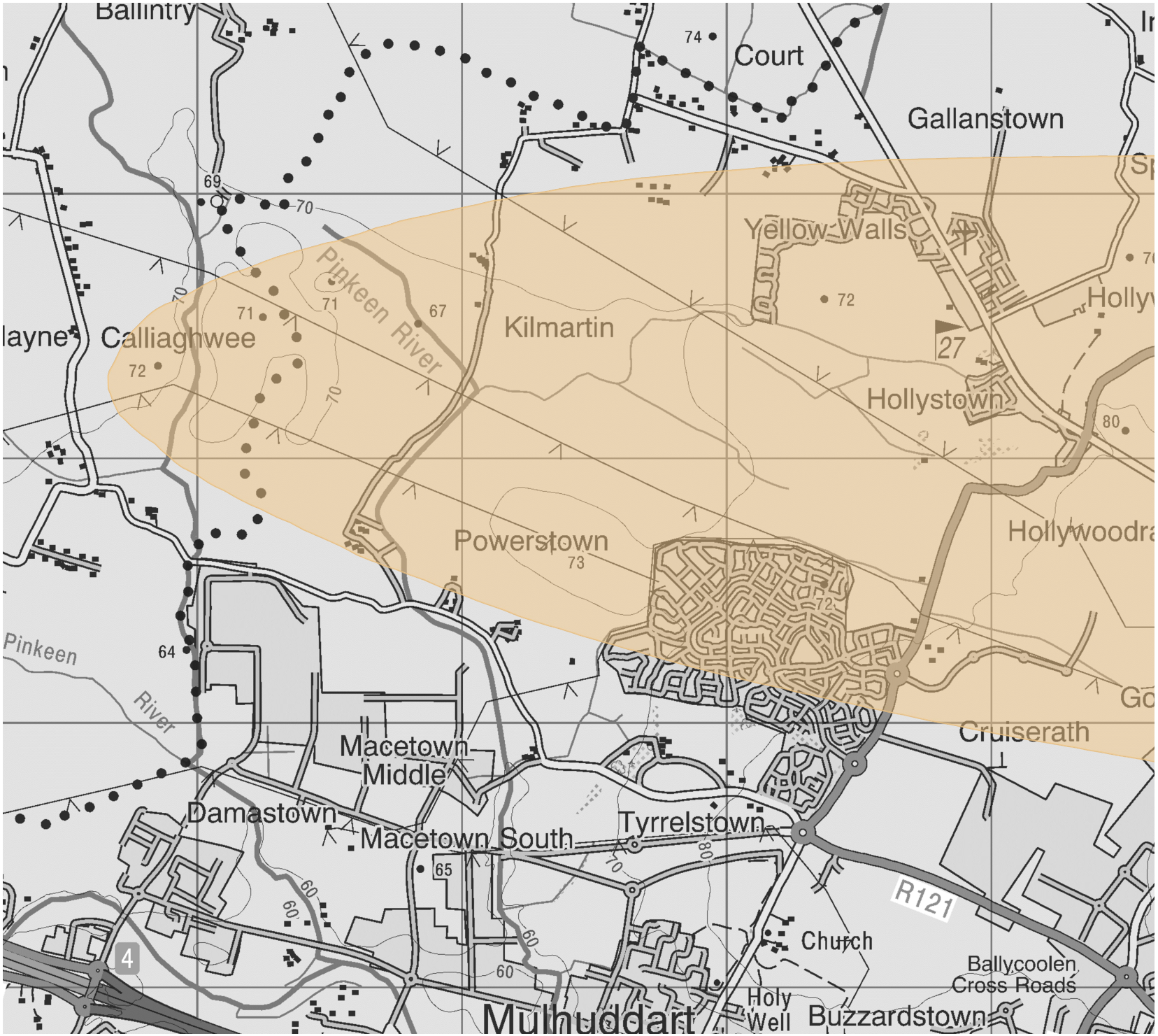
Airborne Aircraft Noise Contours
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR011_1.0



CYAL50218188

LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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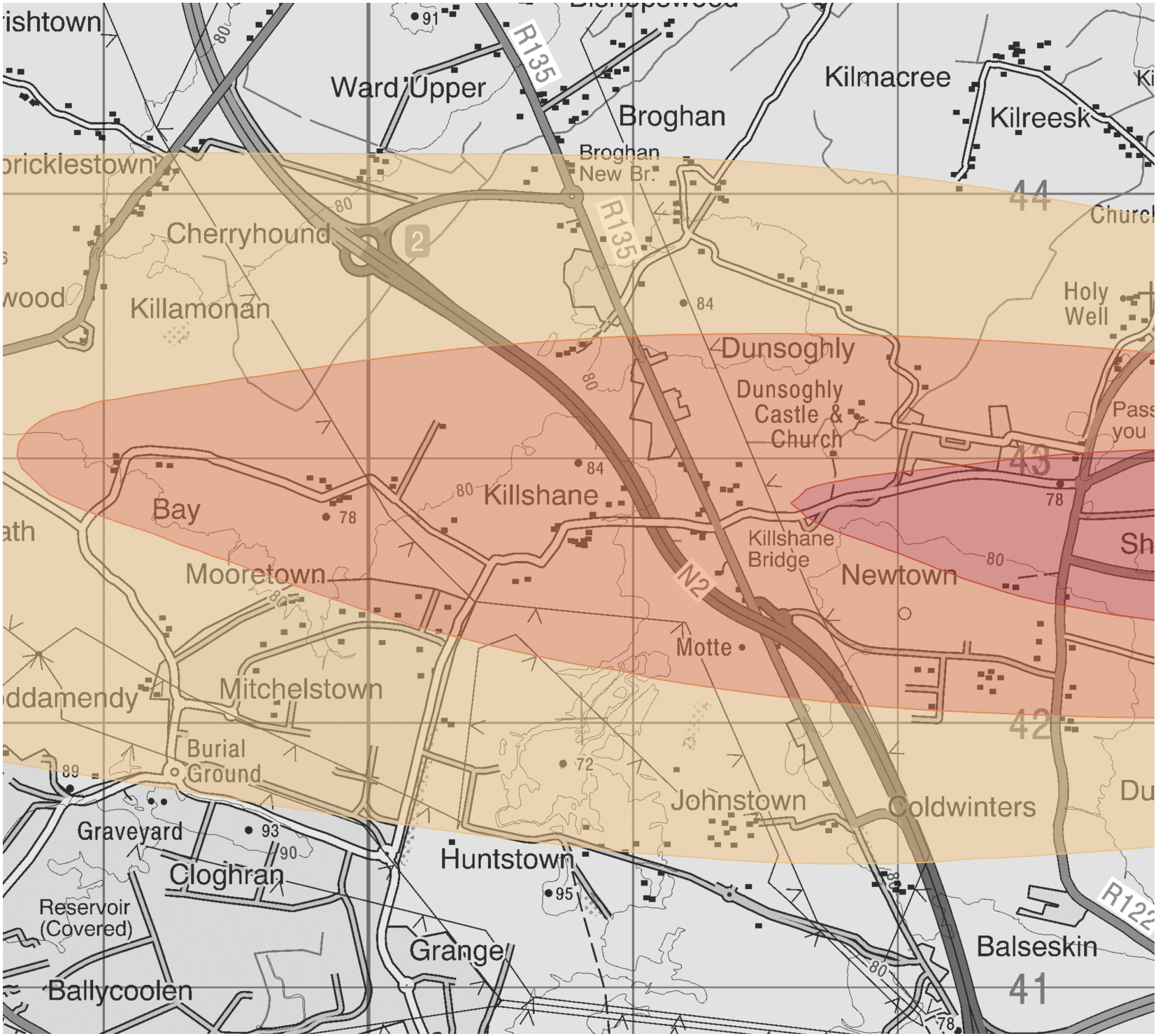
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR011a_1.0



CYAL50218188

LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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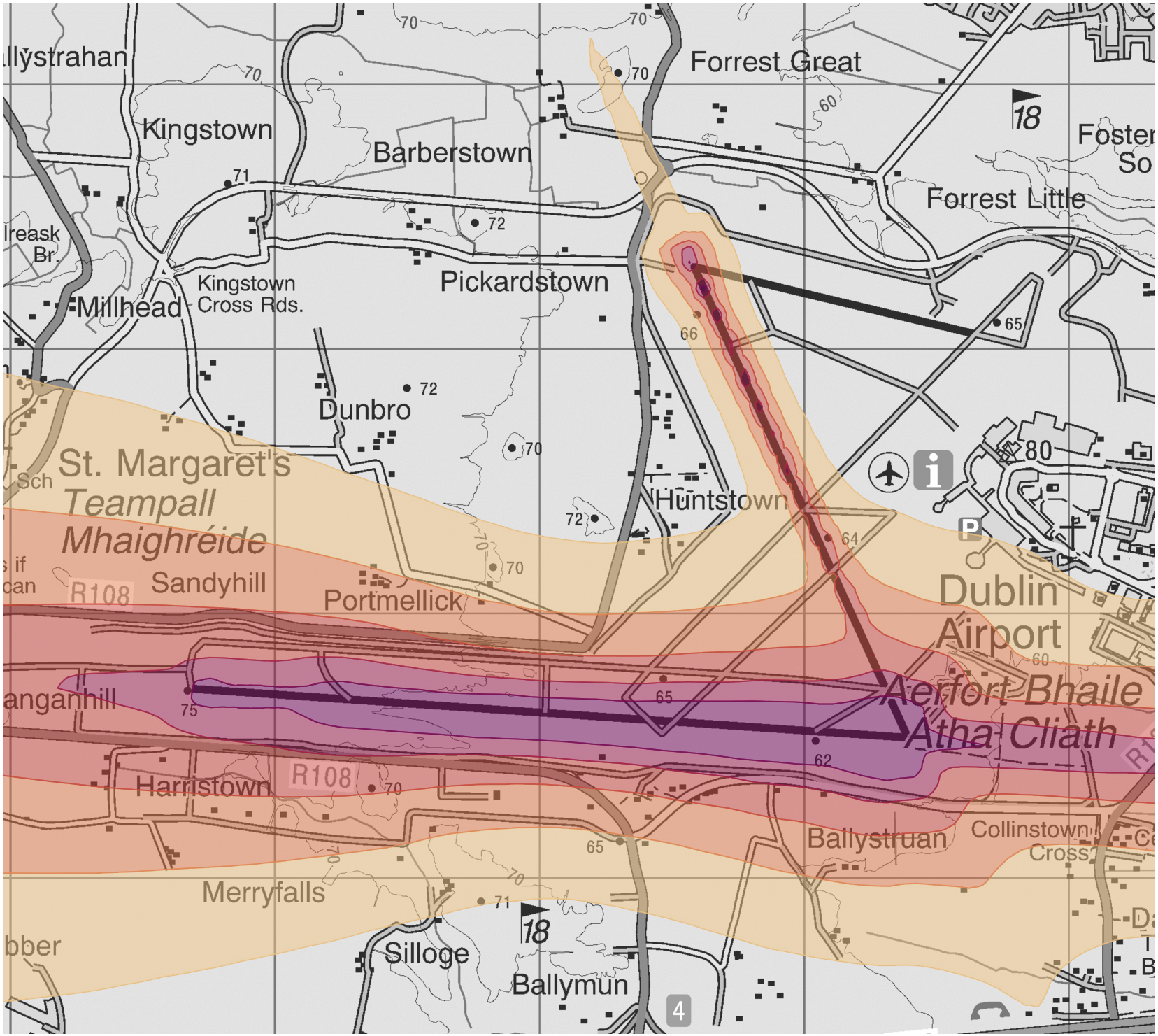
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR011b_1.0



CYAL50218188

LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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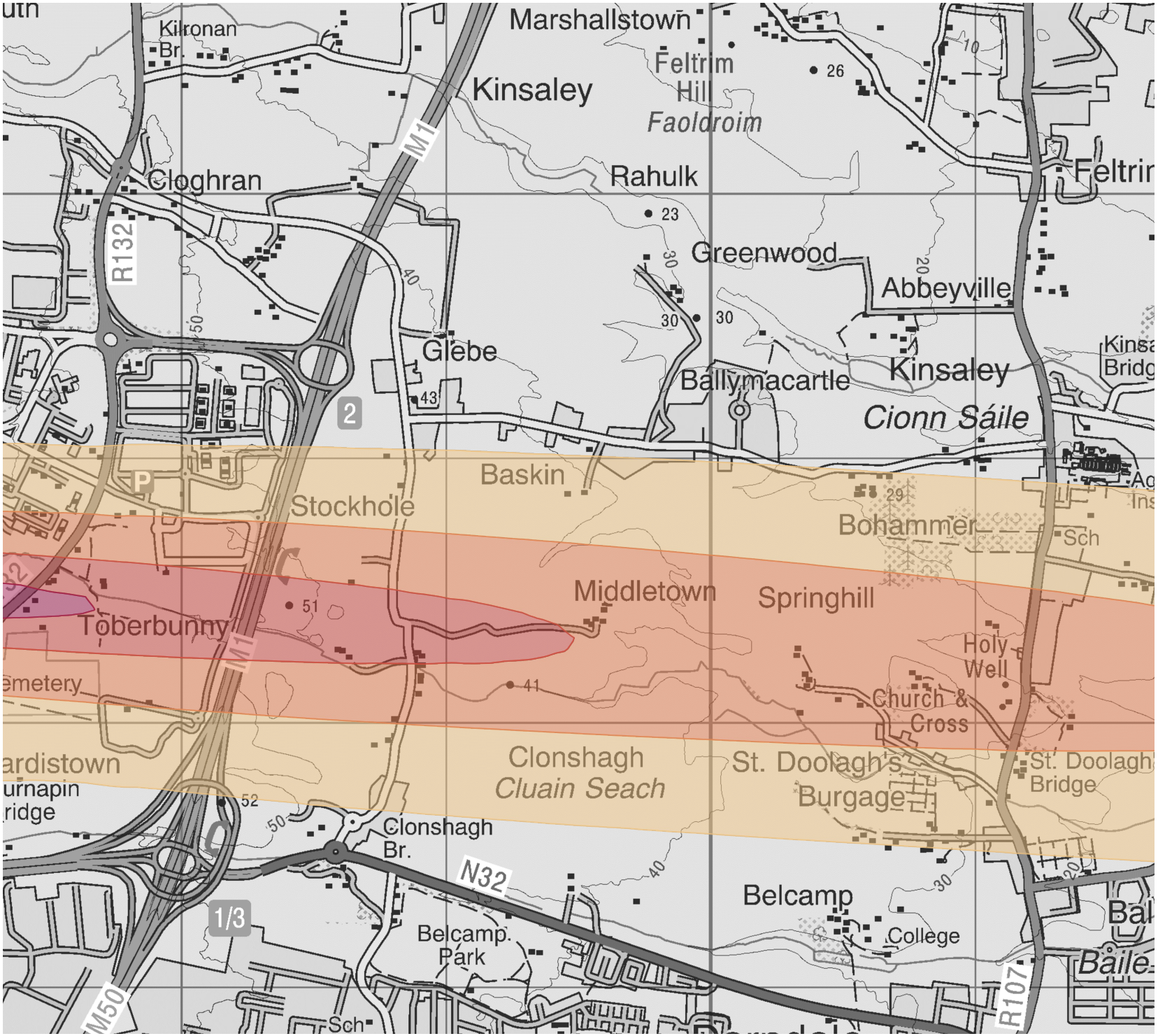
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR011c_1.0



CYAL50218188

LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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Annual Lden

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DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

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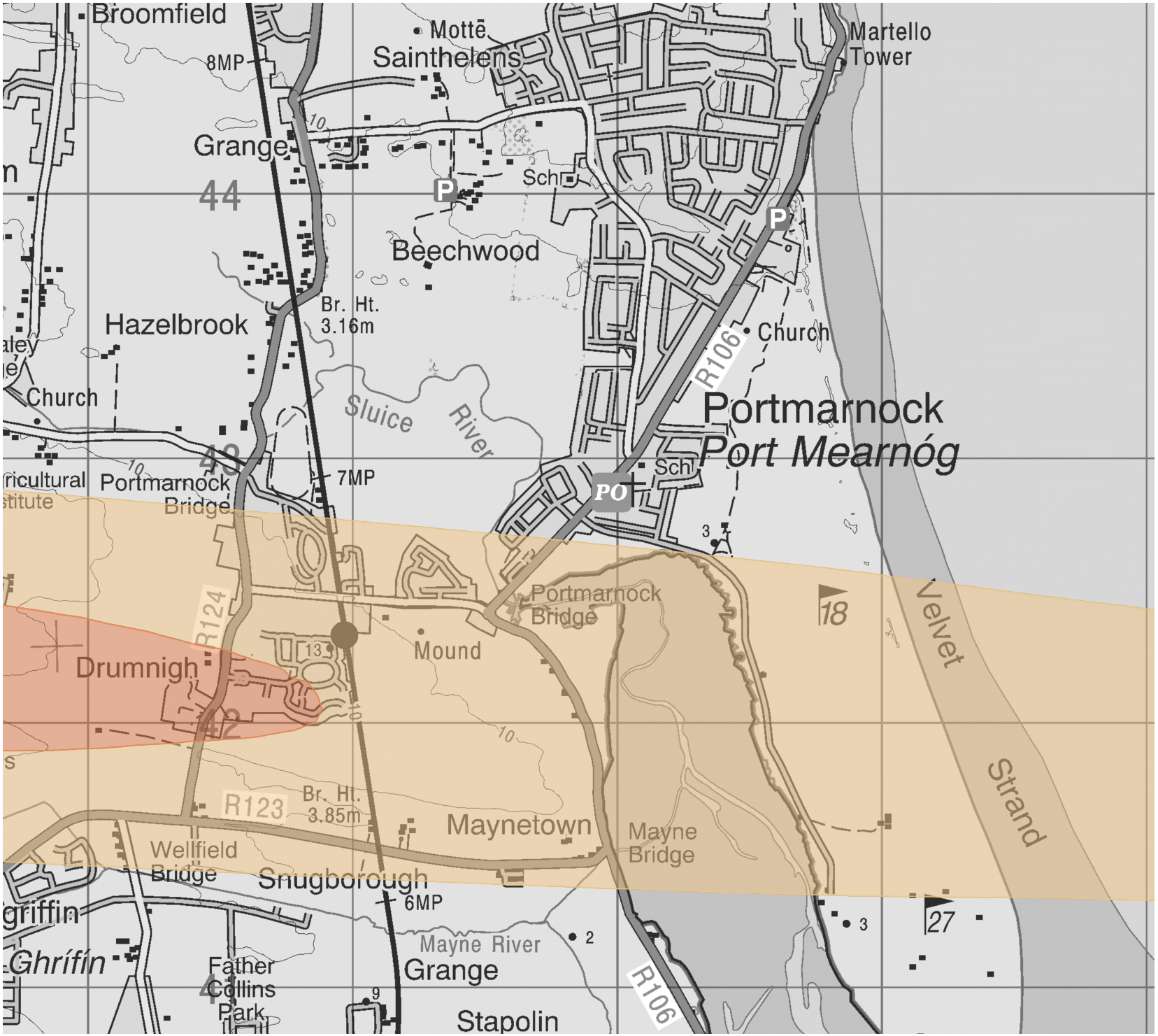

CYAL50218188

LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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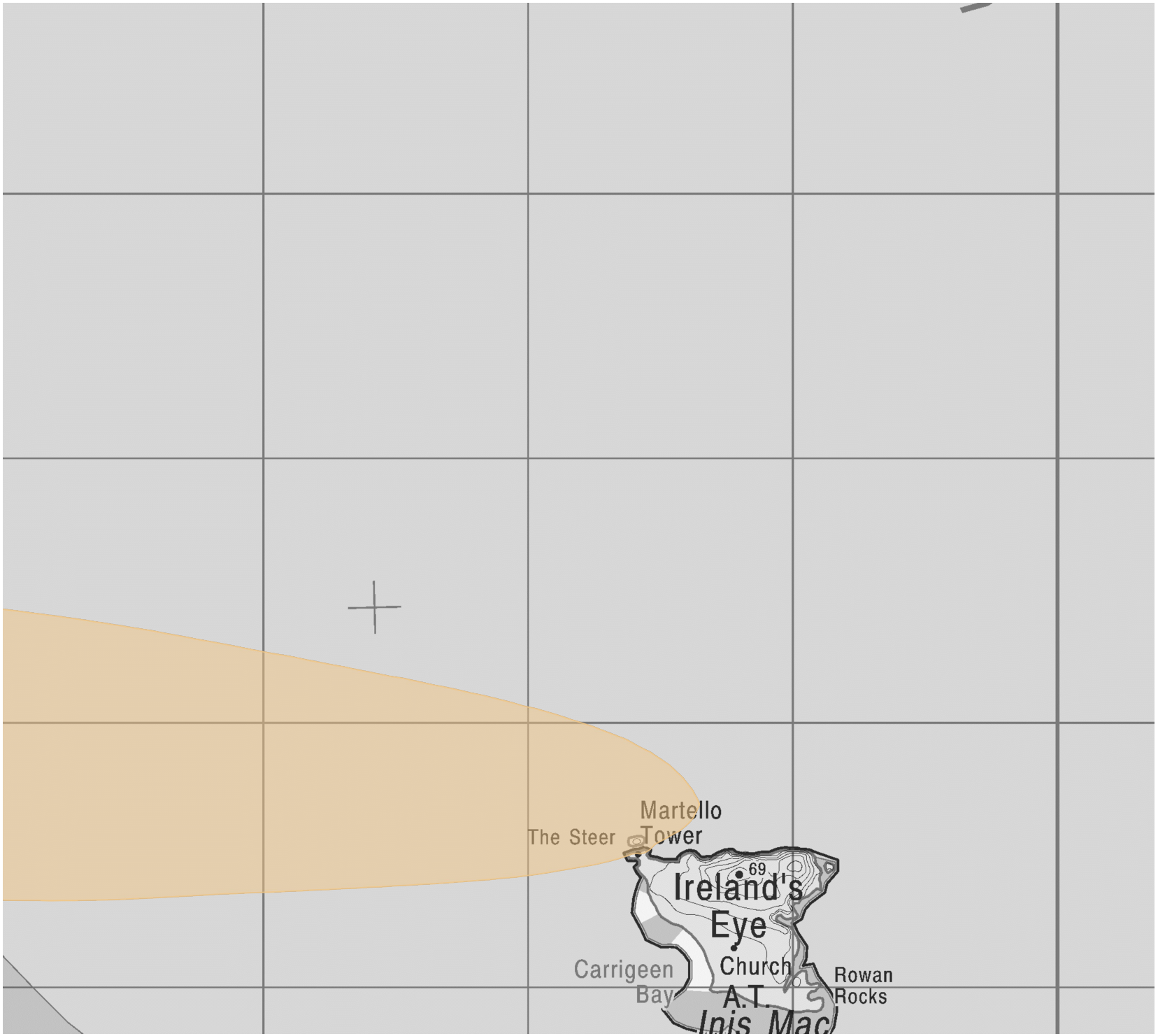
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR011e_1.0



LEGEND:

- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

11a	11b	11c	11d	11e	11f

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Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

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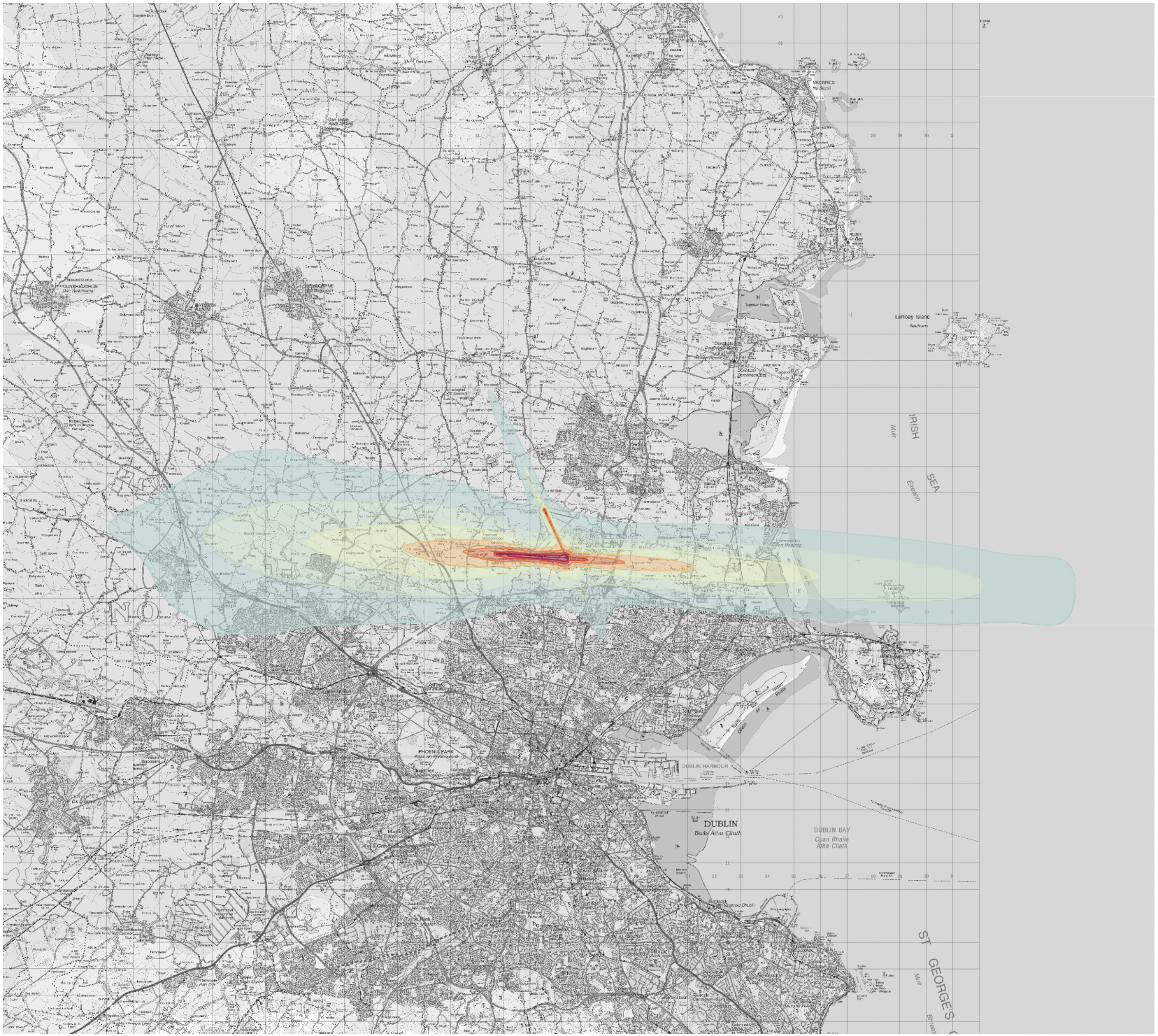

CYAL50218188

LEGEND:

- 40 - 44 dB(A) L_{night}
- 45 - 49 dB(A) L_{night}
- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

Rev	Date	Description	Initials

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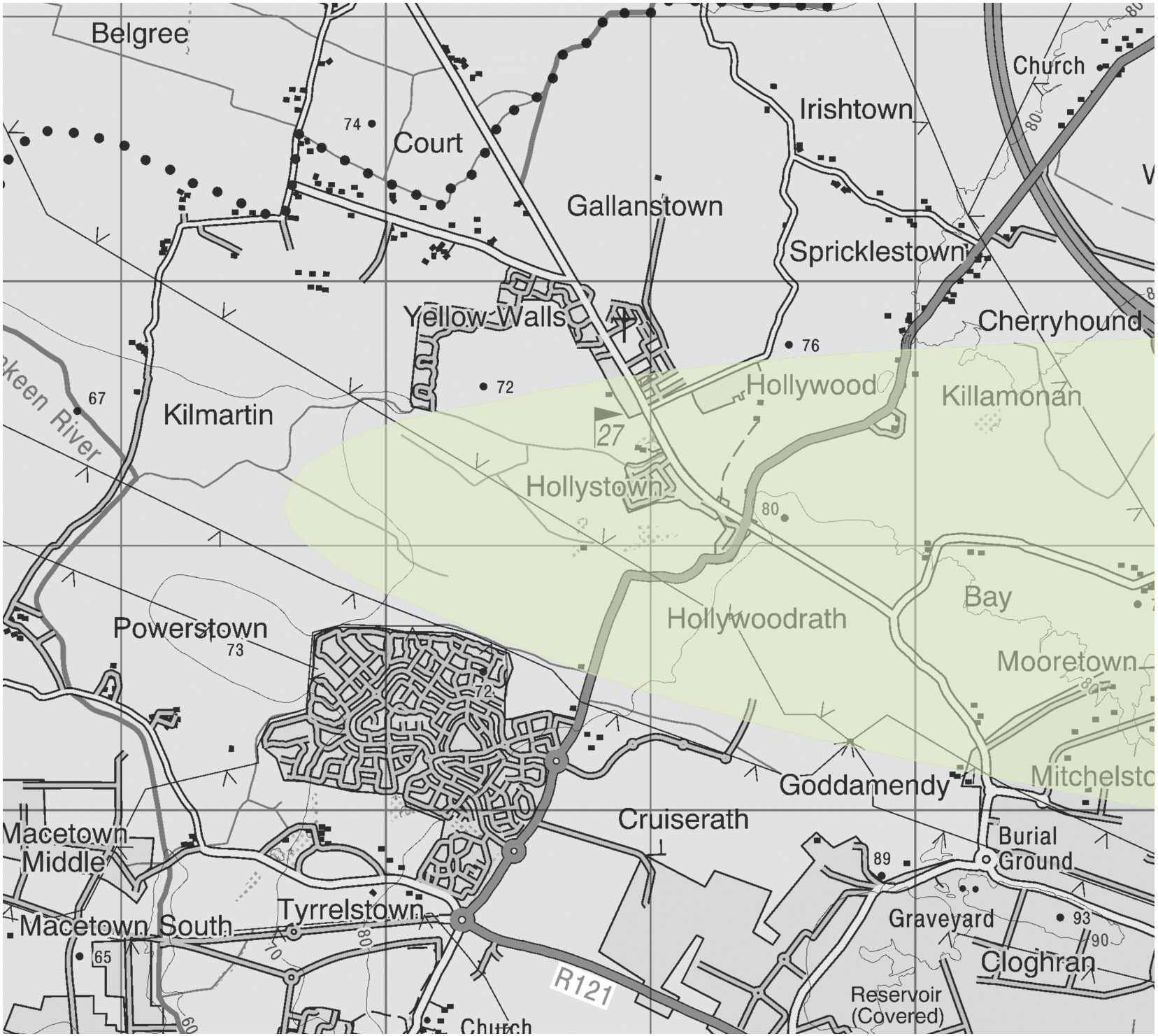
Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR012_1.0



CYAL50218188

LEGEND:

- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

12a	12b	12c	12d	12e

Rev	Date	Description	Initials

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Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

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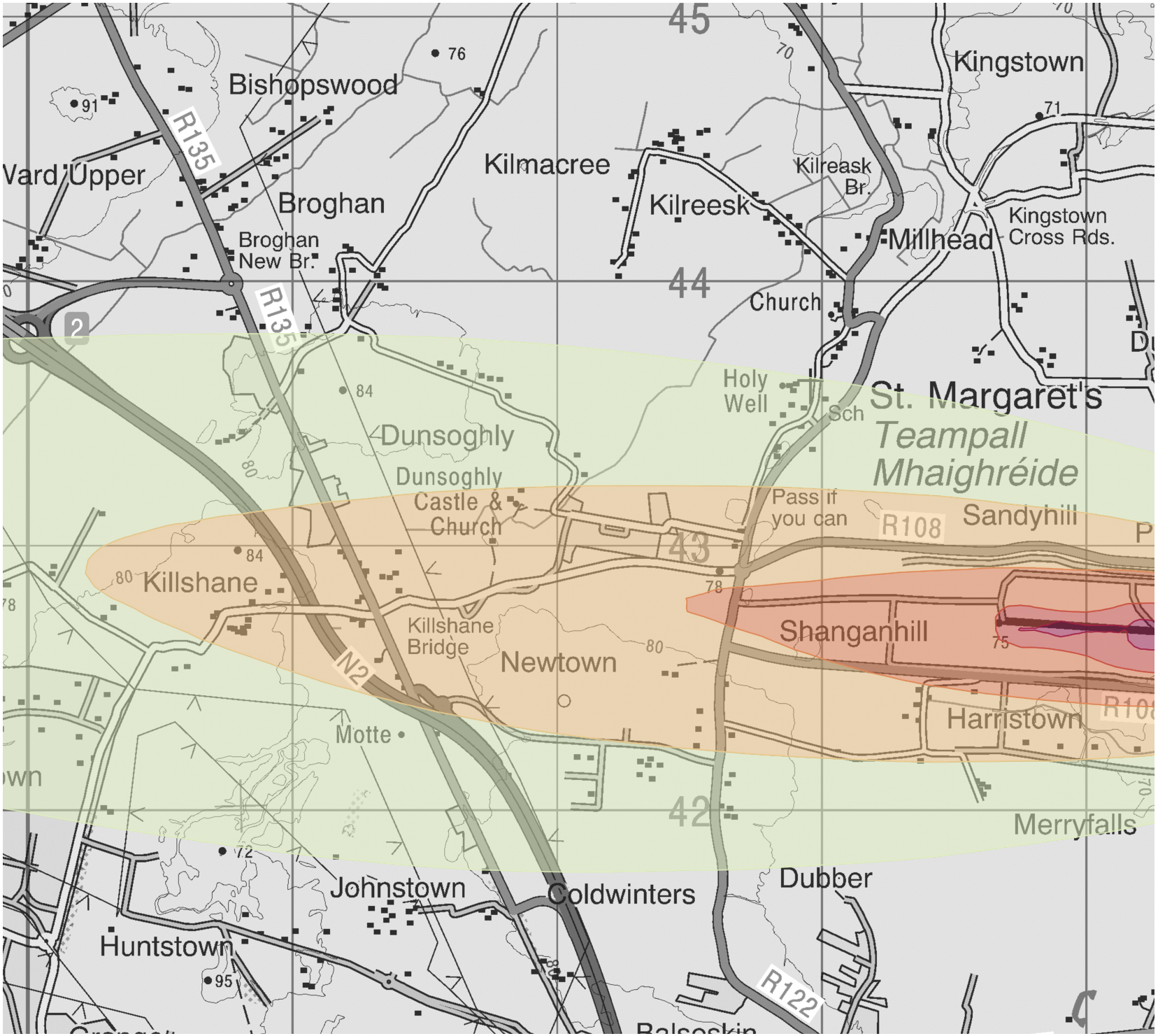

LEGEND:

- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

12a	12b	12c	12d	12e

Rev	Date	Description	Initials

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Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR012b_1.0

CYAL50218188

LEGEND:

- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

12a	12b	12c	12d	12e

Rev	Date	Description	Initials

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Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

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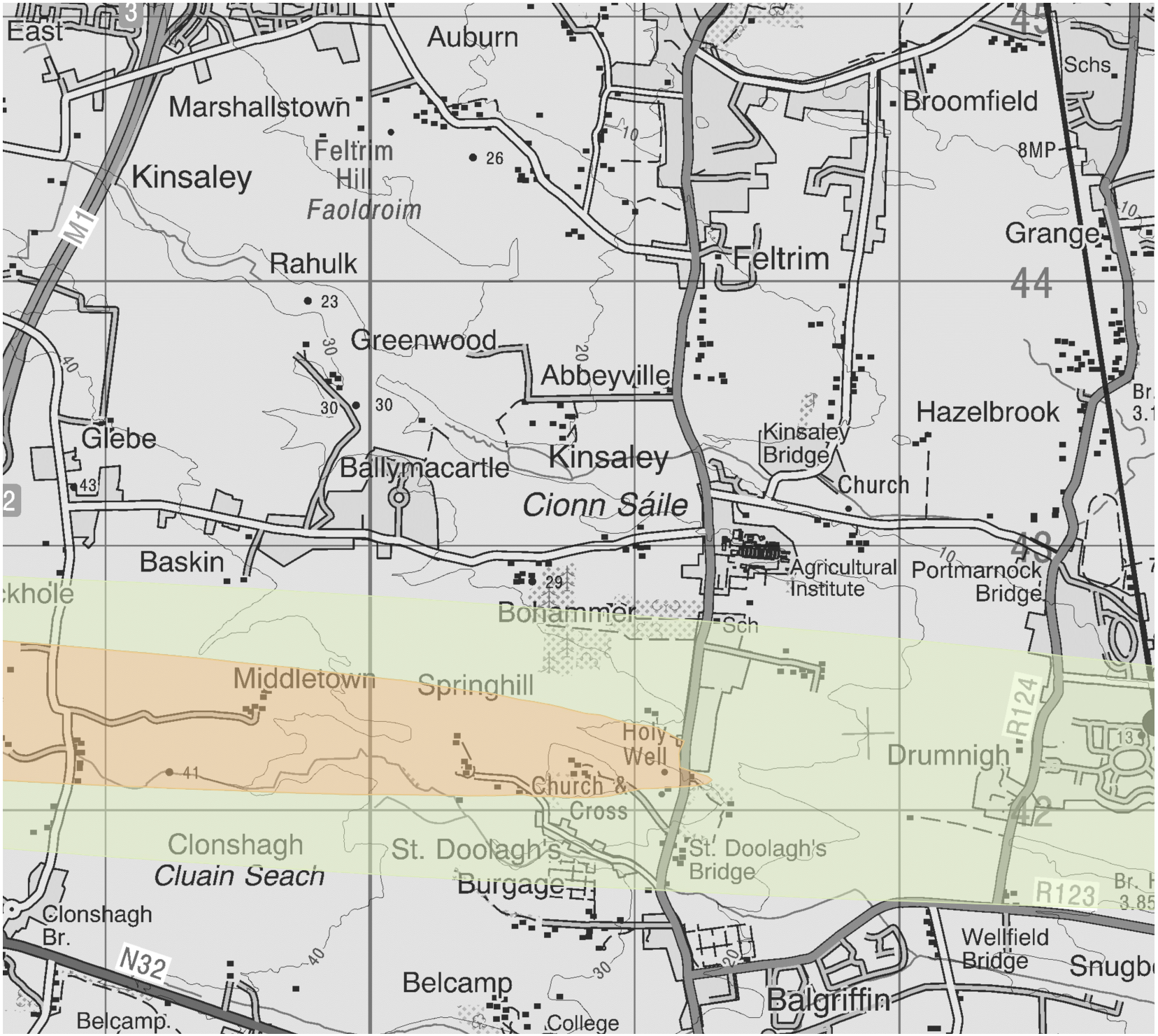

LEGEND:

- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

12a	12b	12c	12d	12e

Rev	Date	Description	Initials

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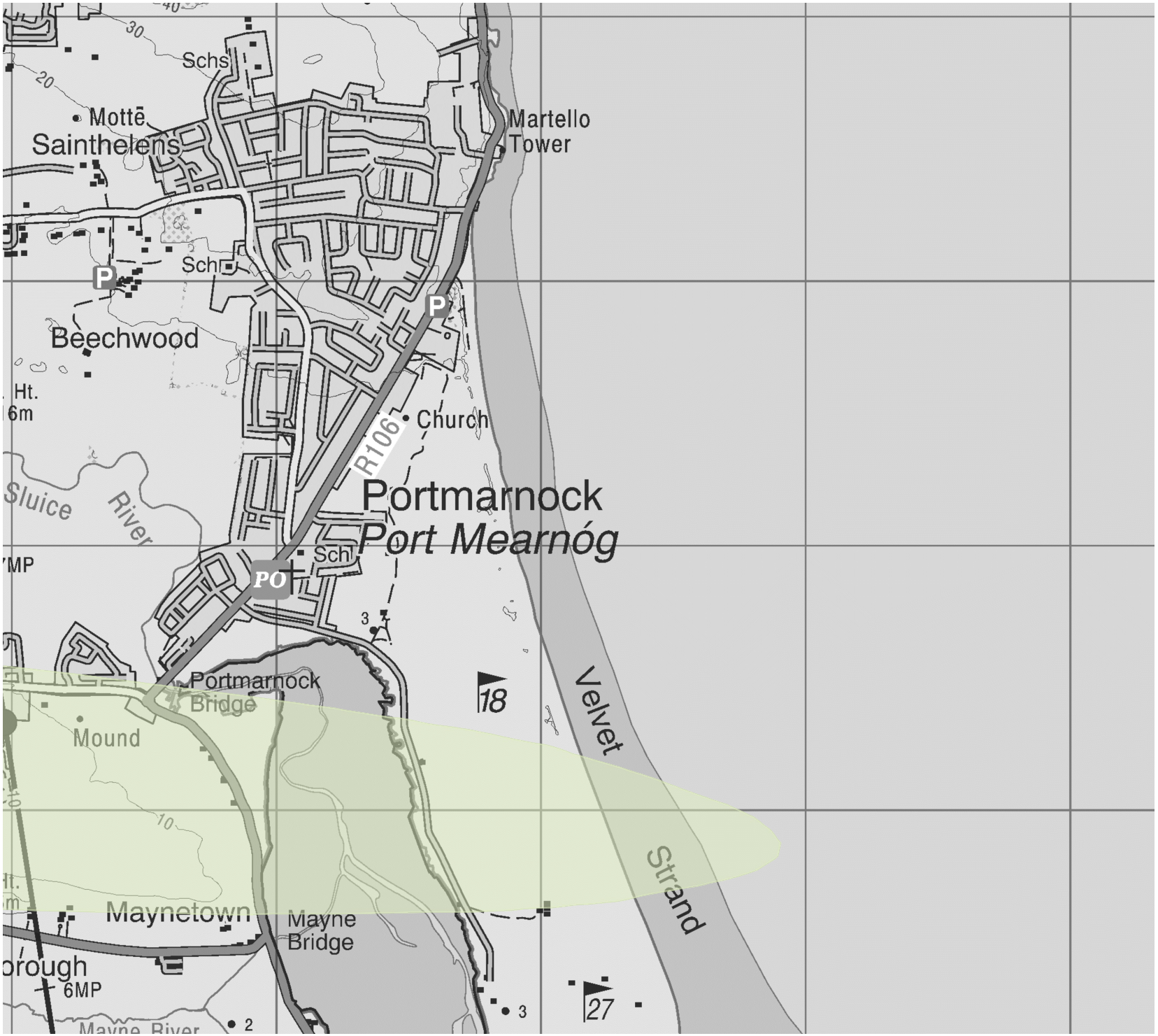
Airborne Aircraft Noise Contours
Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR012d_1.0



LEGEND:

- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

12a	12b	12c	12d	12e

Rev	Date	Description	Initials

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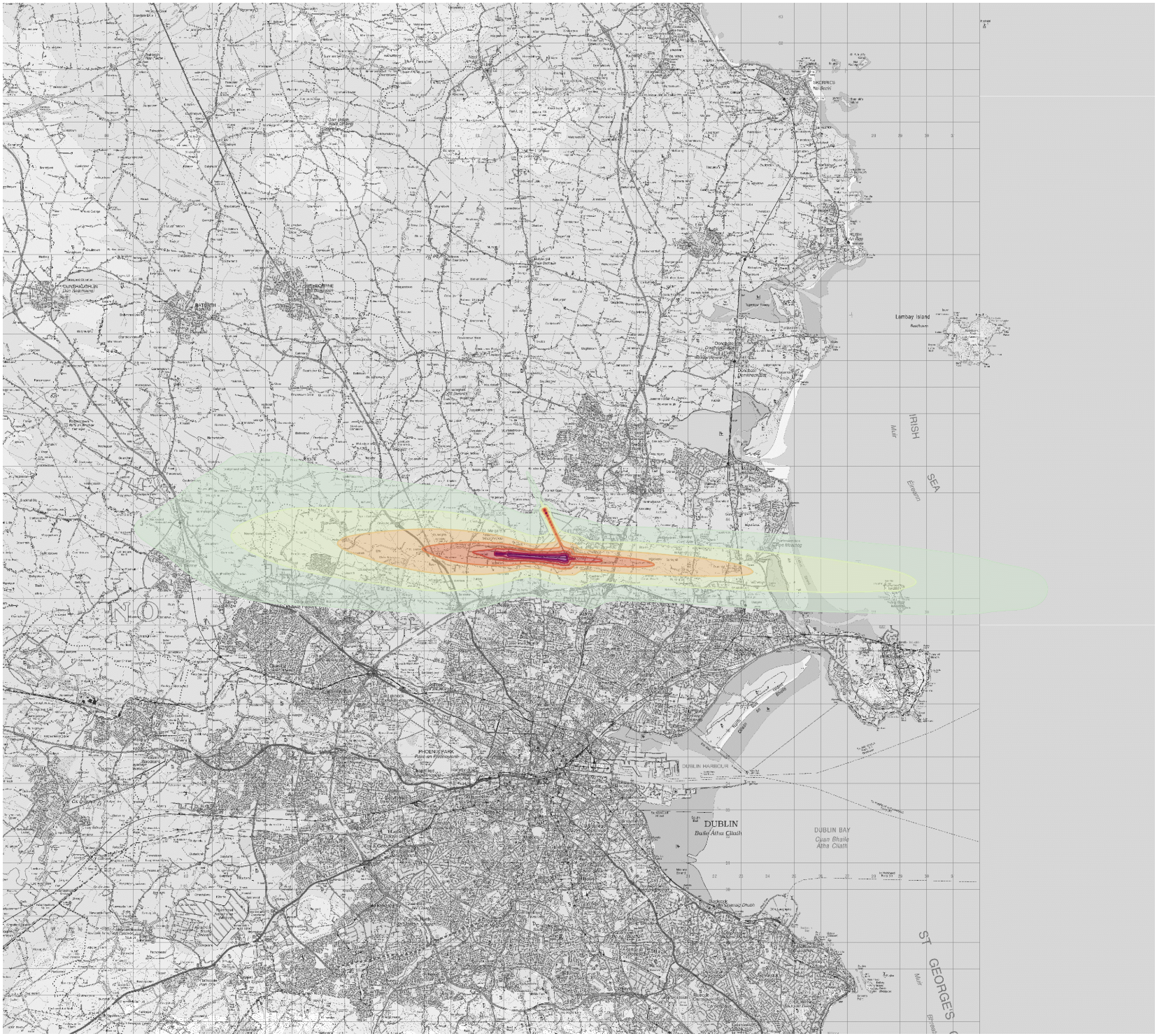
Airborne Aircraft Noise Contours
Annual Lnight

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:20000@A4

Drawing No:

A11469_02_DR012e_1.0



CYAL50218188

LEGEND:

- 45 - 49 dB(A) $L_{Aeq,16h}$
- 50 - 54 dB(A) $L_{Aeq,16h}$
- 55 - 59 dB(A) $L_{Aeq,16h}$
- 60 - 64 dB(A) $L_{Aeq,16h}$
- 65 - 69 dB(A) $L_{Aeq,16h}$
- 70 - 74 dB(A) $L_{Aeq,16h}$
- 75+ dB(A) $L_{Aeq,16h}$

Rev	Date	Description	Initials

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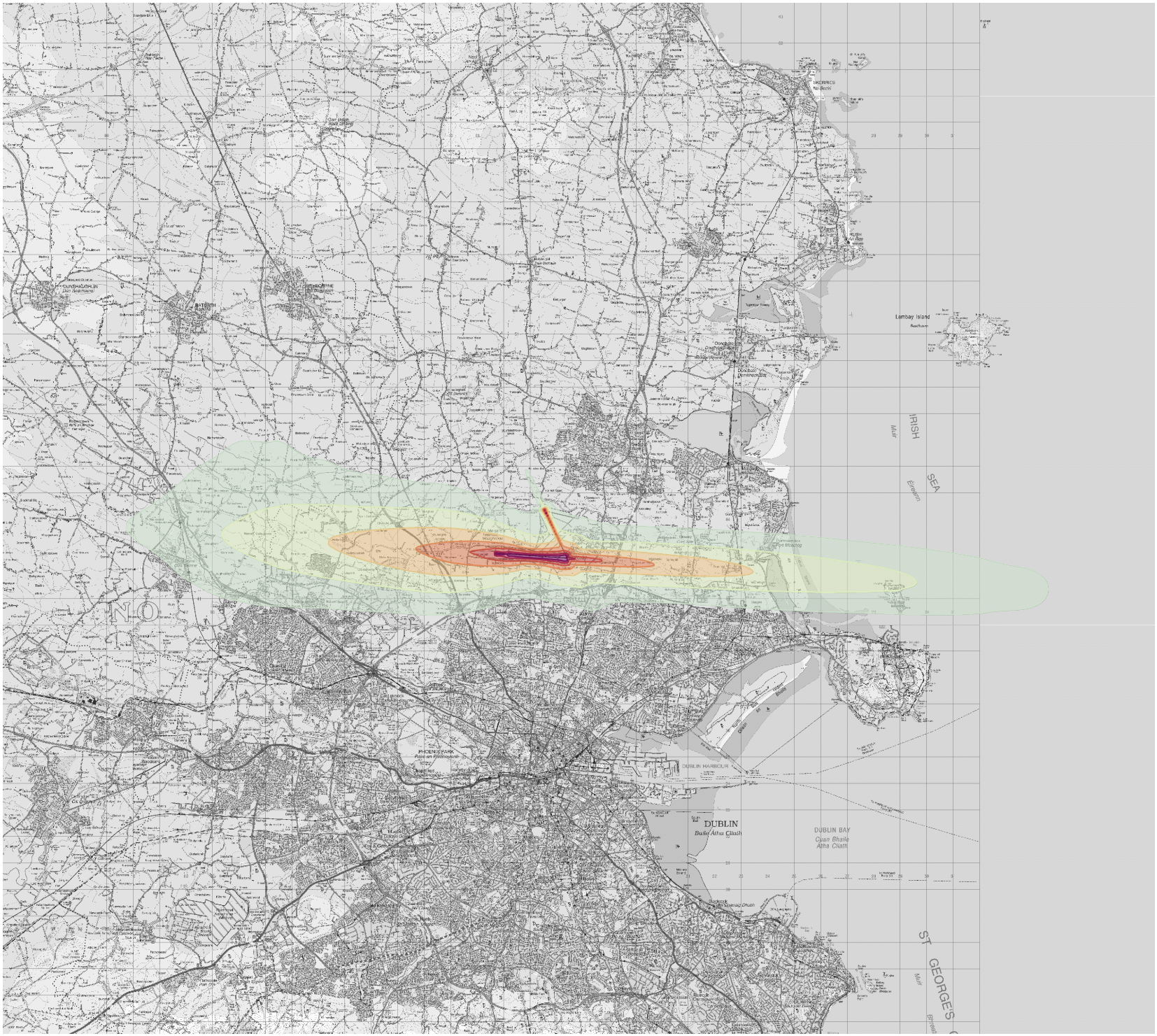
Airborne Aircraft Noise Contours
Annual LAeq,16h

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR013_1.0



CYAL50218188

LEGEND:

- 45 - 49 dB(A) L_{day}
- 50 - 54 dB(A) L_{day}
- 55 - 59 dB(A) L_{day}
- 60 - 64 dB(A) L_{day}
- 65 - 69 dB(A) L_{day}
- 70 - 74 dB(A) L_{day}
- 75+ dB(A) L_{day}

Rev	Date	Description	Initials

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Airborne Aircraft Noise Contours
Annual Lday

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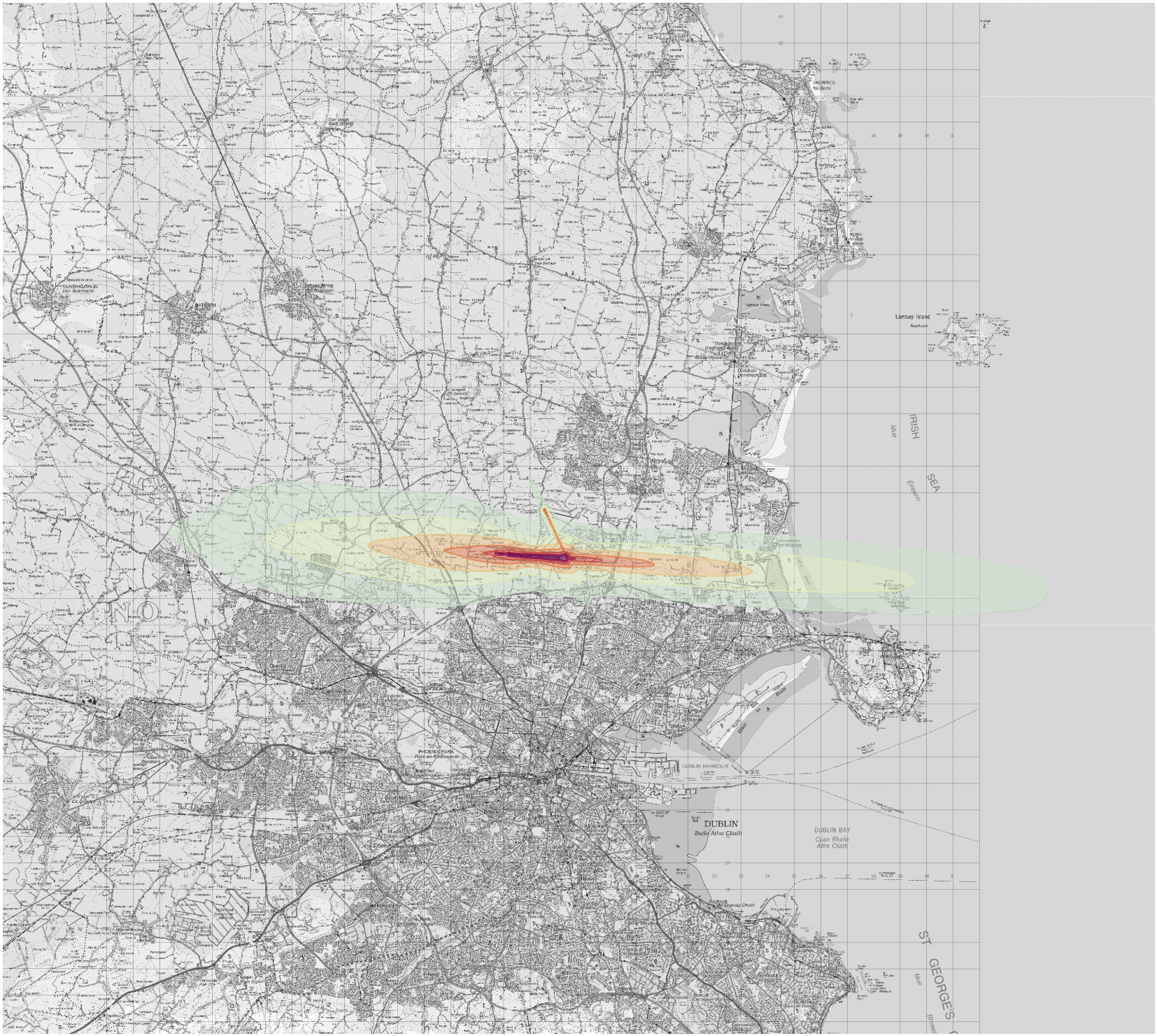
DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR014_1.0



CYAL50218188

LEGEND:

- 45 - 49 dB(A) $L_{evening}$
- 50 - 54 dB(A) $L_{evening}$
- 55 - 59 dB(A) $L_{evening}$
- 60 - 64 dB(A) $L_{evening}$
- 65 - 69 dB(A) $L_{evening}$
- 70 - 74 dB(A) $L_{evening}$
- 75+ dB(A) $L_{evening}$

Rev	Date	Description	Initials

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Airborne Aircraft Noise Contours
Annual Levening

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR015_1.0

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SUPPLEMENTARY REPORT FOR SUBMISSION TO THE EPA UNDER THE EUROPEAN COMMUNITIES (ENVIRONMENTAL NOISE) REGULATIONS 2018

DUBLIN AIRPORT 2021

Prepared By: David Charles, Partner
Bickerdike Allen Partners LLP, 121 Salusbury Road, London, England
On Behalf Of daa

Approved By: Ian Clarke
daa, Dublin Airport, Co Dublin

A11469_01_RP004_1.0
6 March 2023

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

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

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

Contents

Page No.

1.0 INTRODUCTION

1.1 Background

Directive 2002/49/EC of the European Parliament and of the Council ("the Directive") relates to the assessment and management of environmental noise, and is commonly referred to as the Environmental Noise Directive or END[1].

The aim of the Directive is:

"to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise".

Three stages are set out, the first of which is to undertake strategic noise mapping to determine exposure to environmental noise from the main sources, i.e. major roads, major railways, major airports and across agglomerations. The Directive required the first round of mapping to be conducted based on what occurred in 2006, and for the exercise to be repeated every 5 years leading to the fourth round being conducted now, based on the activity in 2021.

In Ireland, the Directive is transposed by the European Communities (Environmental Noise) Regulations 2018, S.I. No. 549 of 2018 ("the Regulations"), as amended by the European Communities (Environmental Noise) (Amendment) Regulations 2021, S.I. No. 663 of 2021 ("the Amendment Regulations"). The strategic mapping duties of the relevant designated Noise Mapping Bodies (NMBs) is given under Article 11 of the Regulations.

As Dublin Airport had over 50,000 movements in 2021, excluding those purely for training purposes on light aircraft, it is classed as a 'major airport' by the definitions given in the Directive and the Regulations and so strategic noise mapping must be undertaken for it. The relevant Noise Mapping Body (NMB) is the airport operator, daa, who has retained Bickerdike Allen Partners LLP (BAP) to carry out the mapping.

1.2 Aim of the Document

A full report on the strategic noise mapping (Ref:A11469_02_RP003) has been prepared by BAP. This supplementary report aims to include the main elements of each of the minimum requirements set out in Annex IV of the Directive. It provides summary information regarding the computation and measurement methodologies used to generate the statistics reported in the full report. It also provides information regarding the robustness of the results presented.

[1] Official Journal of the European Union, L 189, 12-25, 18 July 2002.
Available from: http://eur-lex.europa.eu/JOIndex.do?ihmlang=en [accessed July 2017]

2.0 COMPUTATION METHODS

2.1 Definition of the Time Periods

The END requires noise contours to be generated using the L_{den} and L_{night} noise indices. Noise contours have also been generated for the $L_{Aeq,16h}$, L_{day} and $L_{evening}$ indices. The L_{den} is an L_{Aeq} for the whole 24 hour period but includes weightings depending on when during the 24 hour period the noise occurs. This has required the activity during the year to be split into three periods using the local time on the particular days. The periods are a 12 hour day (07:00h – 19:00h), a 4 hour evening (19:00h – 23:00h) and an 8 hour night (23:00h – 07:00h).

The L_{night}, $L_{Aeq,16h}$, L_{day} and $L_{evening}$ indices are a simple L_{Aeq} of the relevant periods with no weighting applied, being a duration of 8, 16, 12 and 4 hours respectively.

2.2 Statement as to whether the results have been derived from computation or measurement

The results of the strategic noise mapping for Dublin Airport have been derived from computation.

2.3 The Computation Method Used

The Directive has been amended a number of times for the purposes of adapting to scientific and technical progress, in accordance with Article 12. The most significant of these was to replace Annex II of the Directive by removing the recommended interim methods and establishing common noise assessment methods. There is a consolidated version of Directive available which includes all amendments, dated 29 July 2021[2]. For aircraft noise, this is based on the method given in ECAC Doc 29 4th Edition. The Regulations have similar requirements.

In the EPA Guidance[3] the calculation methods for aircraft noise are discussed in Section 8. Recommendations are made to follow the guidance given in ECAC Doc 29 4th Edition, and to meet the requirements of Noise Modelling Category C as described in the Civil Aviation Authority (CAA) document CAP 2091 *CAA Policy on Minimum Standards for Noise Modelling*.

This computation method complies with the guidance given in ECAC Doc 29 4th Edition, and meets the requirements of both the Directive and the Regulations.

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[2] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02002L0049-20210729

[3] DRAFT Guidance Noise for Strategic Noise Mapping, Part 2: Calculation Methodology & Noise Modelling for the Environmental Noise Regulations 2018 (amended), DRAFT Version 3 July 2022

2.4 Adaptation of Computation Method Used

The requirements of CAP 2091 Noise Modelling Category B have been followed. These are more involved than those of Category C and include the use of local noise monitoring data for noise levels and local track-keeping data for flight profiles and tracks, all for the main noise dominant aircraft types.

2.5 The Measurements Used

Noise measurements and radar data for the calendar year of 2021 have been supplied by the airport operator.

2.6 Contour Maps required by paragraph 2.7 Annex VI

Maps have been prepared for the required noise indices. Figure DR011 shows the noise level bands for L_{den} (45 – 50, 50 – 55, 55 – 59, 60 – 64, 65 – 69, 70 – 74, >=75) and Figure DR012 shows the noise level bands for L_{night} (40 – 45, 45 – 50, 50 – 54, 55 – 59, 60 – 64, 65 – 69, >=70).

3.0 EXTENT OF THE SOURCES INCORPORATED IN THE MAPPING

The noise calculations take into consideration sources of noise generated by the aircraft movements; i.e. from start-of-roll, acceleration down the runway, the period when the aircraft is airborne, and deceleration along the runway after touchdown, including reverse thrust if employed. This noise is commonly referred to as air noise. Other sources of aircraft noise generated whilst the aircraft are on the ground, such as from taxiing, manoeuvring or during engine ground running are excluded from the mapping.

4.0 CALCULATION METHODS

4.1 The software used to carry out the calculations and the version of the software

The noise mapping has been undertaken using the Federal Aviation Authority prediction software, the Aviation Environmental Design Tool (AEDT) Version 3e.

4.2 A summary of the hardware used

The AEDT software has been run on Dell Windows based computers to generate the noise bands and outputs presented in this and the associated report.

5.0 INFORMATION REGARDING THE INPUT DATASETS USED IN THE NOISE MODELS AND THE METHODOLOGIES EMPLOYED TO DERIVE THE INPUT DATASETS

There are six basic datasets required for the aircraft noise strategic mapping. These are the physical details of the airport, the topography of the surrounding area, the aircraft movements themselves, the aircraft flight profiles, the details of the routes flown by the aircraft movements and local noise measurement data.

Dublin Airport data relevant to the AEDT study is taken from the October 2022 edition of the Irish Aviation Authority (IAA) Integrated Aeronautical Information Publication (AIP). This includes details of the location, length and orientation of the runways as well as information relating to departure routes. Although included in the entry, no aircraft operations have been assigned to the North Runway (designated 10L-28R).

The AEDT model developed for Dublin Airport does contains data for the terrain in the area surrounding the airport. The terrain data has been provided by eMapSite.

Details of all the aircraft movements during the 2021 calendar year were provided for Dublin Airport by daa. This information included for each movement the date and local time, the aircraft type (aircraft operational code), whether the movement was an arrival or a departure, and the origin or destination. This actual aircraft movement data was processed to enable input into the AEDT software.

Aircraft profiles for the main noise-dominant aircraft types have been derived from radar data for the calendar year of 2021, which has been provided by daa. For other aircraft types the ”STANDARD” aircraft profiles given in the AEDT software have been used.

Aircraft routes were derived from radar data for the calendar year of 2021, which has been provided by daa.

The measurements taken by the airport's Noise Monitoring Terminals (NMTs) for the calendar year of 2021 was provided by daa.

The actual aircraft movement data supplied by daa has been processed to enable input into the AEDT software. This section of the report describes this processing in more detail and considers Aircraft type (Aircraft Operational Code), Time period, Runway, Operation, Stage Length, Aircraft Profile, Aircraft Route and Noise Monitoring Data.

There were a total of 92,046 aircraft movements in the data supplied by daa. Of these, 999 were by helicopters, approximately 1% of the total. Helicopter movements at this level are unlikely to have a significant effect on the overall noise contours and have therefore been excluded from the modelling.

5.1.1 Aircraft type

The AEDT software includes noise information for many common aircraft types, but it does not include data for every aircraft type. Therefore, the aircraft operational codes used in the movement data need to be mapped to Aircraft Noise and Performance (ANP) aircraft types in the AEDT software. For some aircraft types, substitutions are proposed by the AEDT software where a similar alternative aircraft type is used to model the actual type. Where AEDT has no guidance, an aircraft type has been assigned based on the aircraft size and engine details. In a small number of cases, BAP's experience is that the type suggested by AEDT is not appropriate, and therefore in these cases a more representative type has been used.

It is relevant to separately consider Category A/B aircraft and Category C/D aircraft as they operate differently, in particular having different departure routes specified in the AIP. These categories are based on aircraft approach speeds. Category A/B aircraft are typically propeller aircraft, whereas Category C/D aircraft are typically the larger jet aircraft.

5.1.2 Time period

The actual time of each movement in the log is given to the nearest minute, in local time. Using this, each movement has been categorised as occurring in the day (07:00-19:00), evening (19:00-23:00) or night (23:00-07:00) as appropriate. Movements occurring on a boundary between periods have been counted as being in the later period, e.g. a movement occurring at 07:00 would be counted as being in the day period.

5.1.3 Runway

The actual runway used by each aircraft is given in the movement log, and this has been used in the modelling.

5.1.4 Operation

Each movement in the data is categorised as either an arrival or a departure and has been modelled as such.

5.1.5 Stage Length

For the departure movements, the AEDT software offers a number of flight profiles for most aircraft types, particularly the larger aircraft types. These relate to different departure weights, which are greatly affected by the length of the flight and consequently the fuel load. In the AEDT software this is referred to as the stage length.

For the contours in this report, destination airports were given with the aircraft movement data. Stage lengths have been calculated for each aircraft departure, where AEDT offers the option, based on the distance of these airports from Dublin Airport.

5.1.6 Aircraft Profile

For each of the main noise-dominant aircraft types, the radar data was reviewed and a custom profile created to match the actual flown profile as closely as possible. This was done separately for Runway 10 and Runway 28, and for each stage length option available. It involved changes to the initial departure thrust and the initial climb altitude for many aircraft types. Due to the limited number of flights on Runway 16 and Runway 34, the profiles for Runway 28 were used for these runways also. For other aircraft types the "STANDARD" or "MODIFIED_AW" profiles available in AEDT were used, depending on the stage length.

5.1.7 Aircraft Routes

Arrival operations have been modelled as following the extended runway centreline. Runway 10 and Runway 28 arrival operations have been dispersed after a distance of 17 km from the runway.

Departure operations have been assigned to departure routes based on the radar data. It is standard practice to represent departure routes in the modelling software using a set of dispersed tracks, as aircraft do not follow precisely the routes they are assigned to. This has been done for each of the departure routes with the set of dispersed tracks derived from analysis of the radar data.

5.1.8 Noise Monitoring Data

Results from the Dublin Airport Noise and Track Keeping (NTK) system have been used to validate the noise levels of the main noise dominant aircraft types. Specifically, the results from NMTs 1, 2 and 20 in 2021 have been used. The noise levels from the monitors are automatically correlated with aircraft movements.

To take into account the measured levels the AEDT software has been used to predict the level at the NMT locations. This has been compared to the measured averages for each of the aircraft types when separately arriving and departing. Where necessary, adjustments were made to the modelled noise levels of individual aircraft types to minimise the differences between the predicted and measured noise levels.

6.0 USE OF THE GOOD PRACTICE GUIDE AND OTHER RELEVANT INFORMATION

The WG-AEN GPG v2 toolkits have not been utilised. Alternatively in accordance with good practice, the aircraft noise modelling has utilised all the information readily.

7.0 VALIDATION OF NOISE LEVEL RESULTS

As described in Section 5.1.8, measured noise levels for each of the main noise dominant aircraft types were validated using results from the Dublin Airport NTK system.

8.0 THE DATASETS AND METHODOLOGIES USED TO DERIVE THE POPULATION EXPOSURE STATISTICS

To derive the population exposure statistics two datasets have been used. The first is the Small Areas dataset created by The National Institute of Regional and Spatial Analysis (NIRSA) on behalf of Ordnance Survey Ireland (OSi) in consultation with the Central Statistics Office (CSO). The Small Areas dataset includes the total number of people and dwellings within each area.

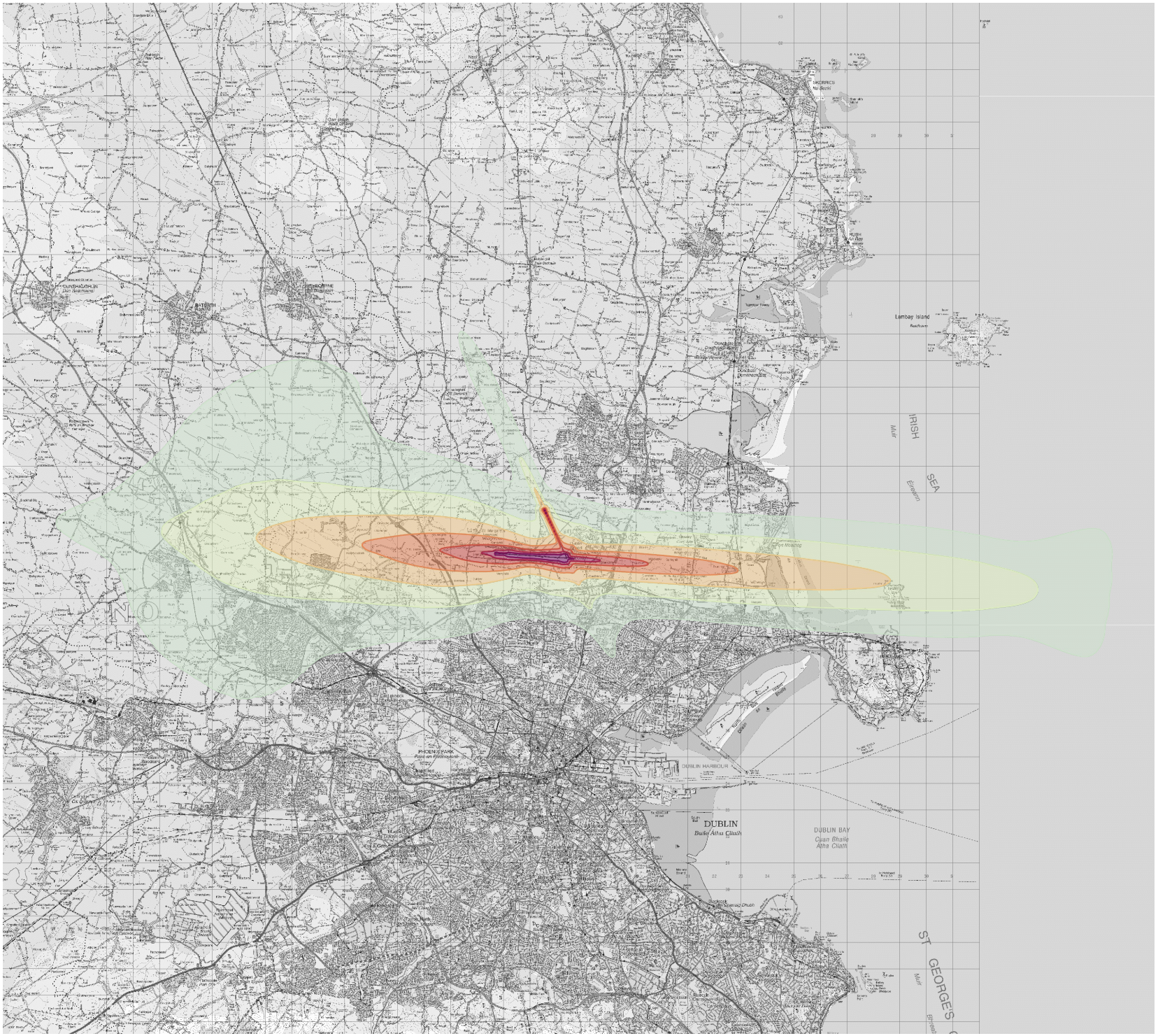
The Small Area Population Statistics (SAPS) for Census 2016 have been used as the basis as the 2022 Census results for SAPS are not available at the time of writing. However, 2022 Census results for the larger Electoral Divisions have been published. The 2022 Small Area (SA) population totals have been estimated by determining which Electoral Division (ED) each Small Area is within and applying the percentage change in the ED population from 2016 to the SA.

The second dataset is the locations of the properties. For this the GeoDirectory data developed by OSi and An Post which provides a single point location object for each building in Ireland has been used. As the GeoDirectory is updated quarterly there are four versions for 2021. The EPA have recommended that the Q4 2021 dataset should be used. BAP have been supplied with the Q1 2022 dataset. This is expected to result in a small but not material increase in the number of dwellings assessed as being within the contours, compared to using the Q4 2021 dataset.

The GeoDirectory data has been filtered in order to identify the required dataset of occupied residential buildings. This was then processed to determine into which of the Small Areas each occupied dwelling falls. The average occupancy per dwelling for the Small Area they are located in was then applied to them. The resulting location points with associated numbers of people were then used with the noise predictions to determine into which exposure band they fall.

Nick Williams
for Bickerdike Allen Partners LLP

David Charles
Partner



LEGEND:

- 45 - 49 dB(A) L_{den}
- 50 - 54 dB(A) L_{den}
- 55 - 59 dB(A) L_{den}
- 60 - 64 dB(A) L_{den}
- 65 - 69 dB(A) L_{den}
- 70 - 74 dB(A) L_{den}
- 75+ dB(A) L_{den}

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

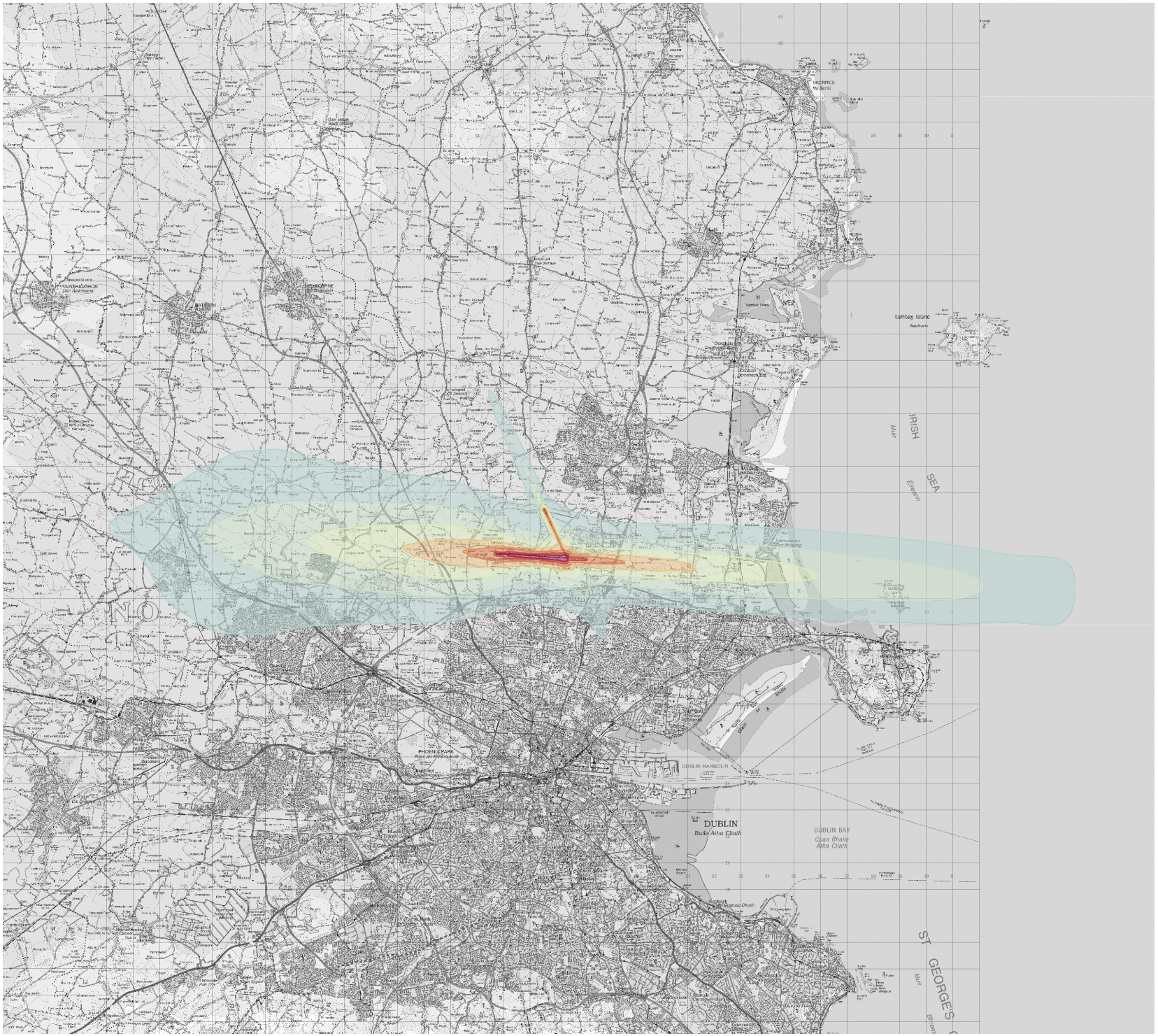
Airborne Aircraft Noise Contours
Annual Lden

DRAWN: NW CHECKED: DC

DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR011_1.0



CYAL50218188

LEGEND:

- 40 - 44 dB(A) L_{night}
- 45 - 49 dB(A) L_{night}
- 50 - 54 dB(A) L_{night}
- 55 - 59 dB(A) L_{night}
- 60 - 64 dB(A) L_{night}
- 65 - 69 dB(A) L_{night}
- 70+ dB(A) L_{night}

Rev	Date	Description	Initials

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Dublin Airport
END Noise Mapping Round 4

Airborne Aircraft Noise Contours
Annual Lnight

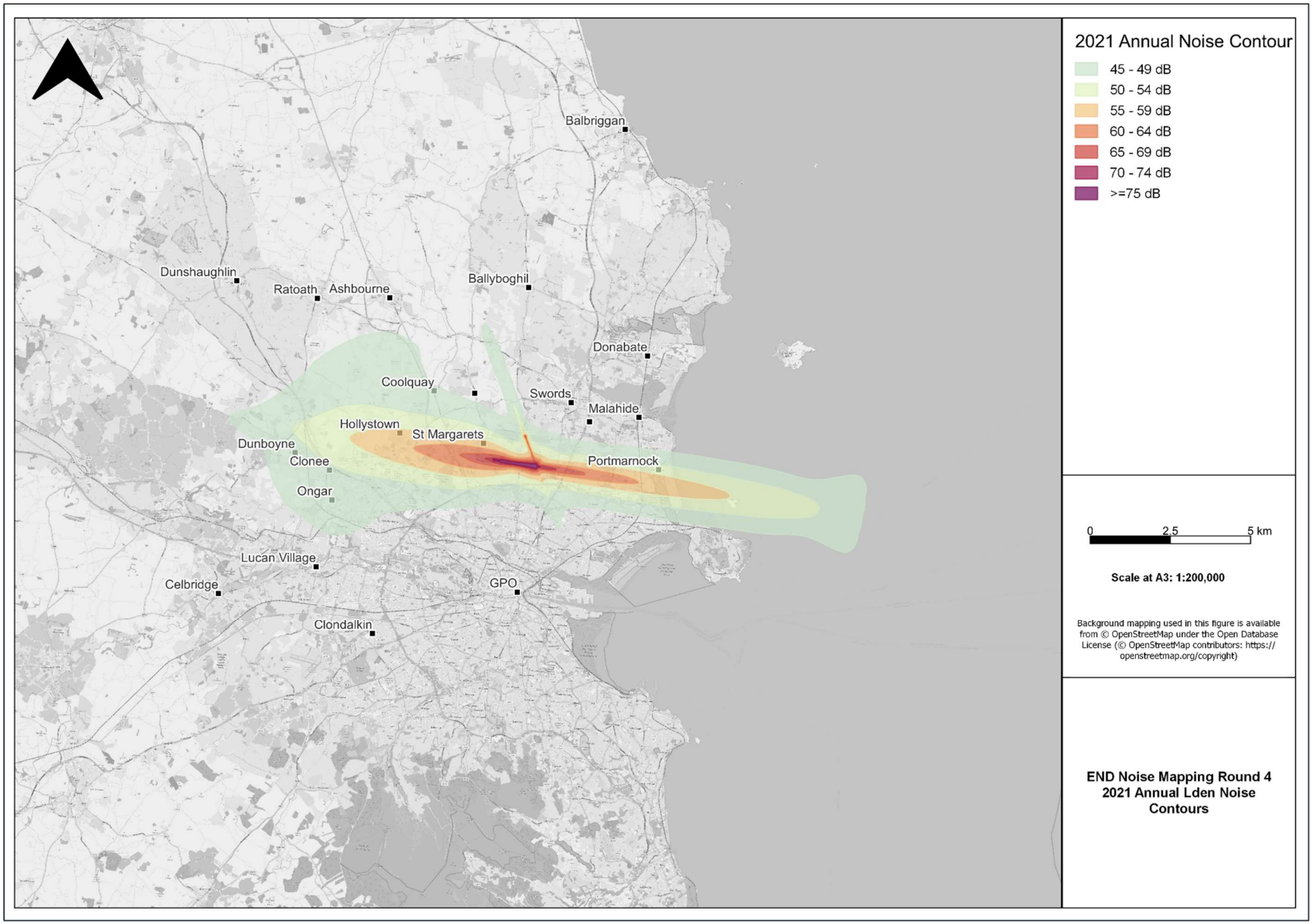
DRAWN: NW CHECKED: DC

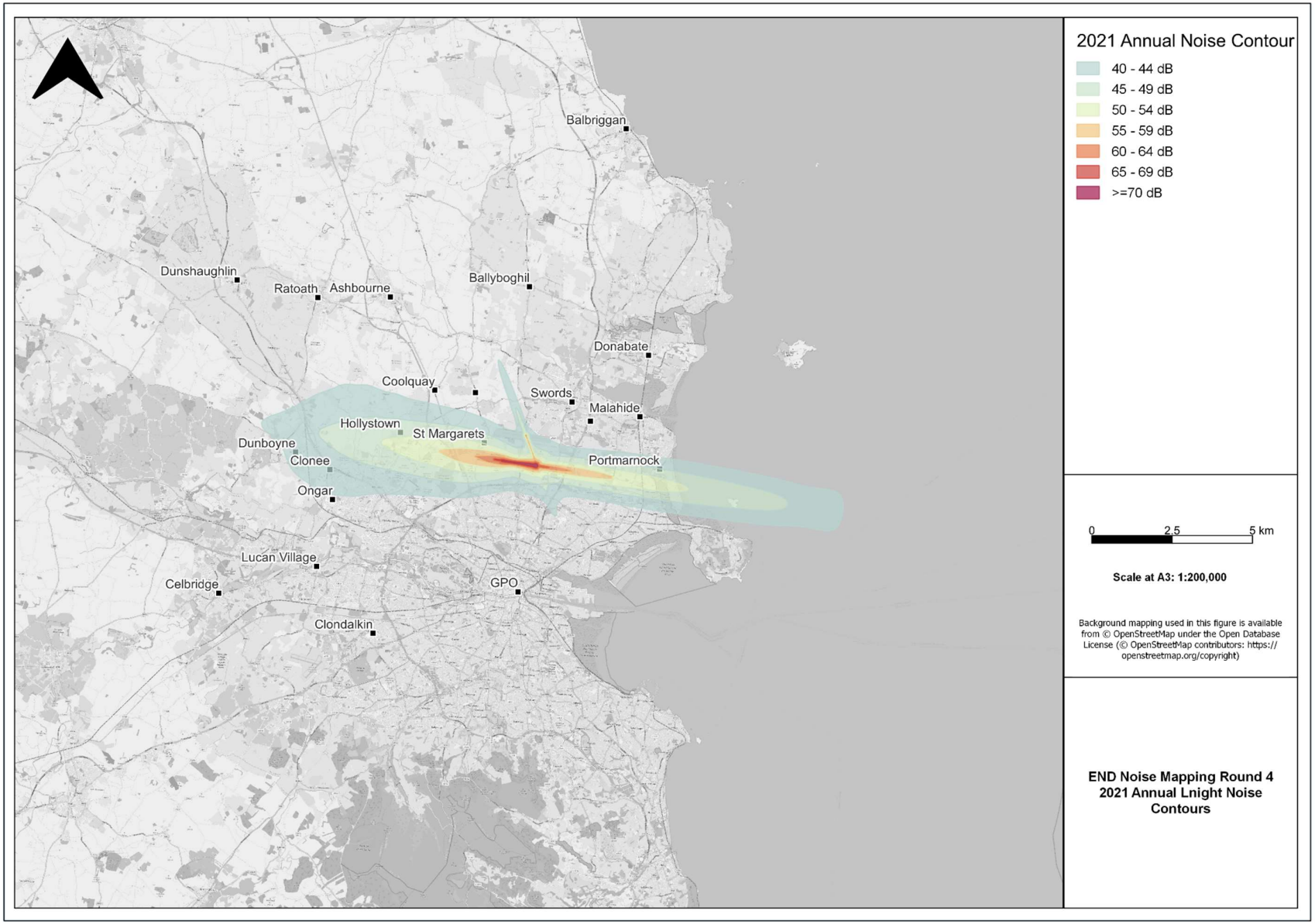
DATE: March 2023 SCALE: 1:200000@A4

Drawing No:

A11469_02_DR012_1.0

A4 END Noise Mapping Noise Contours


2021 Annual Noise Contour
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
END Noise Mapping Round 4
2021 Annual Lden Noise Contours


2021 Annual Noise Contour
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
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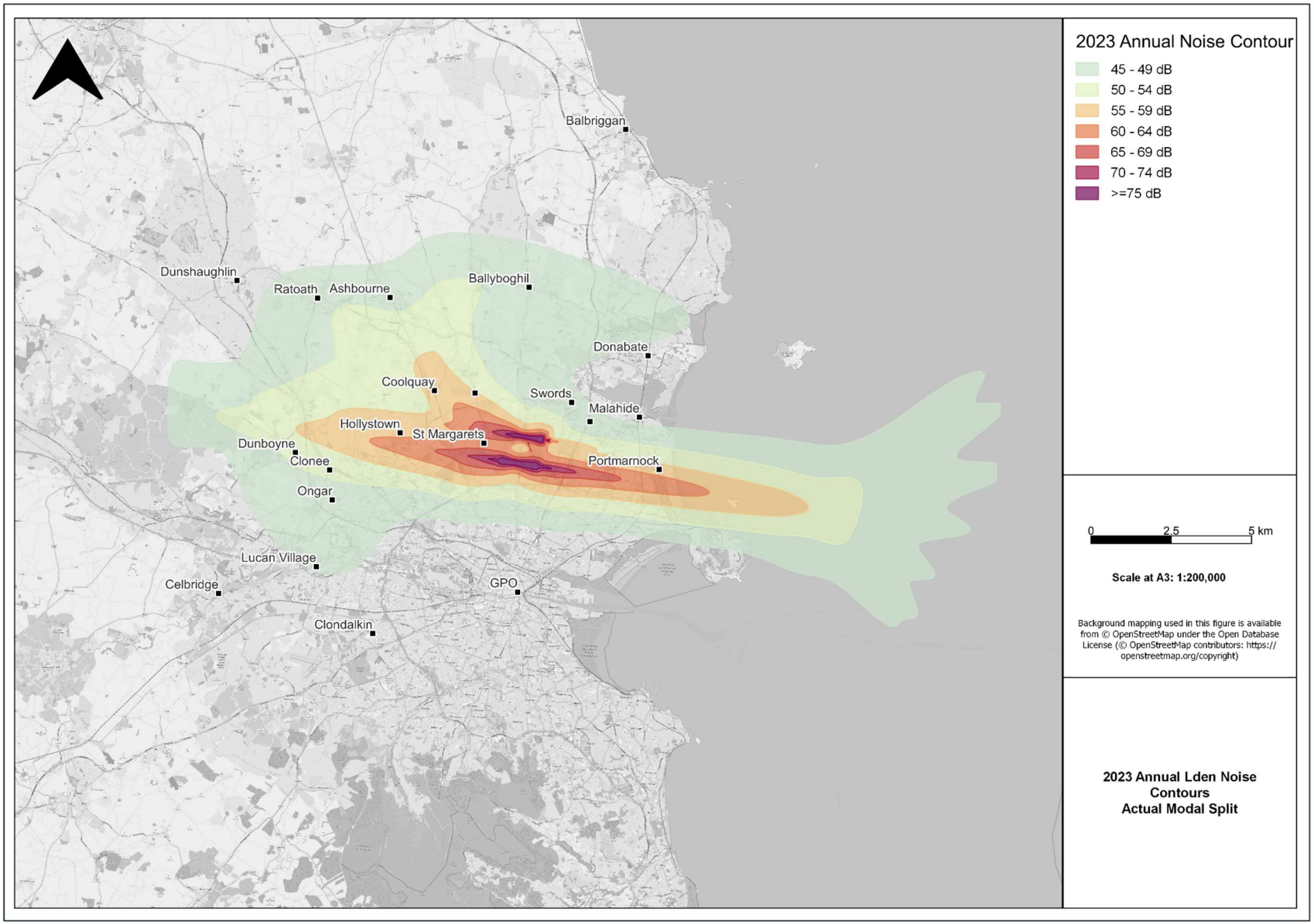
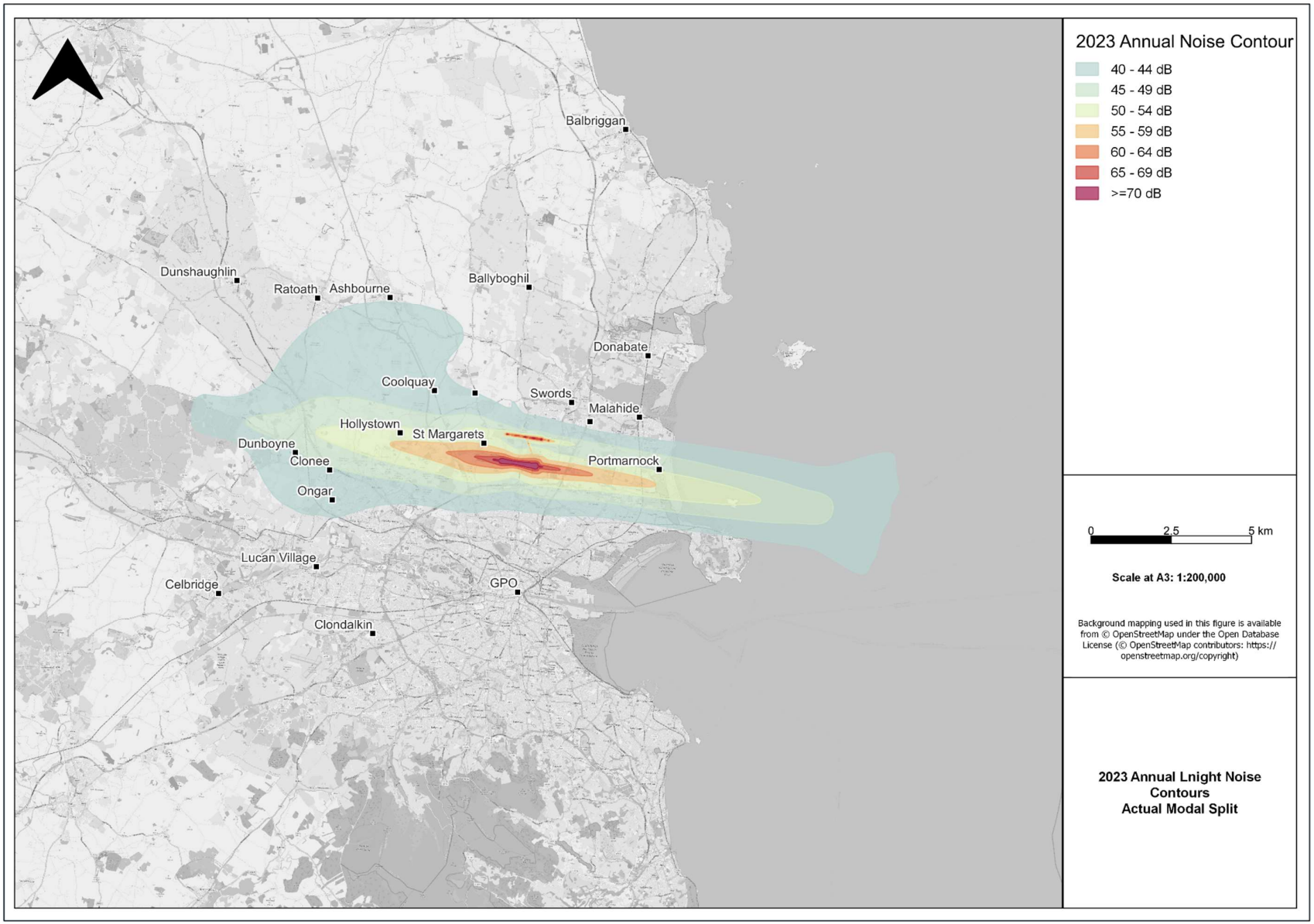
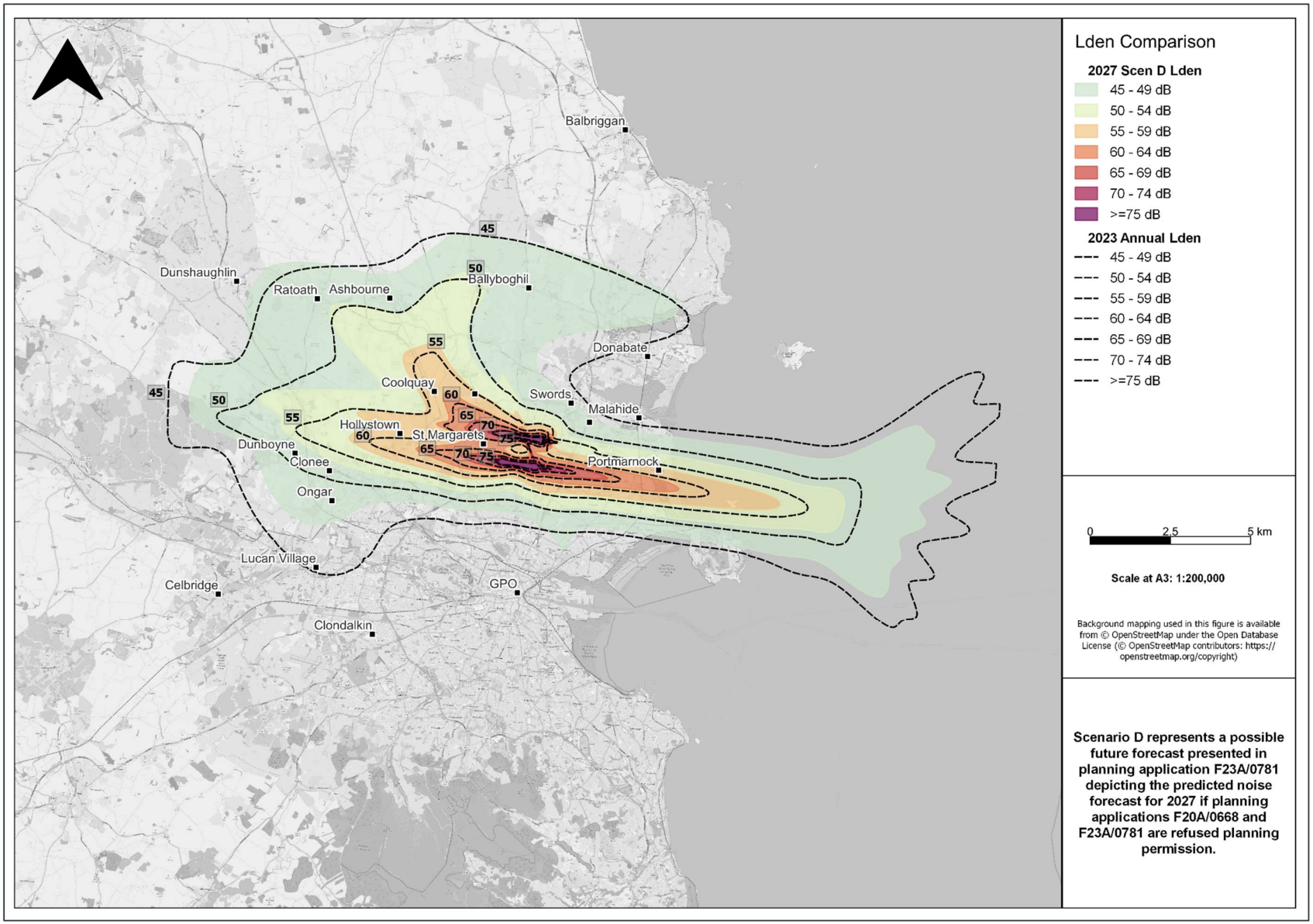
END Noise Mapping Round 4
2021 Annual Lnight Noise Contours


2023 Annual Noise Contour
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
2023 Annual Lden Noise Contours
Actual Modal Split


2023 Annual Noise Contour
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
2023 Annual Lnight Noise Contours
Actual Modal Split

A5 Future Situation Noise Contours


Lden Comparison
2027 Scen D Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
2023 Annual Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
45
50
55
60
65
70
75
0
2.5
5 km
Scale at A3: 1:200,000
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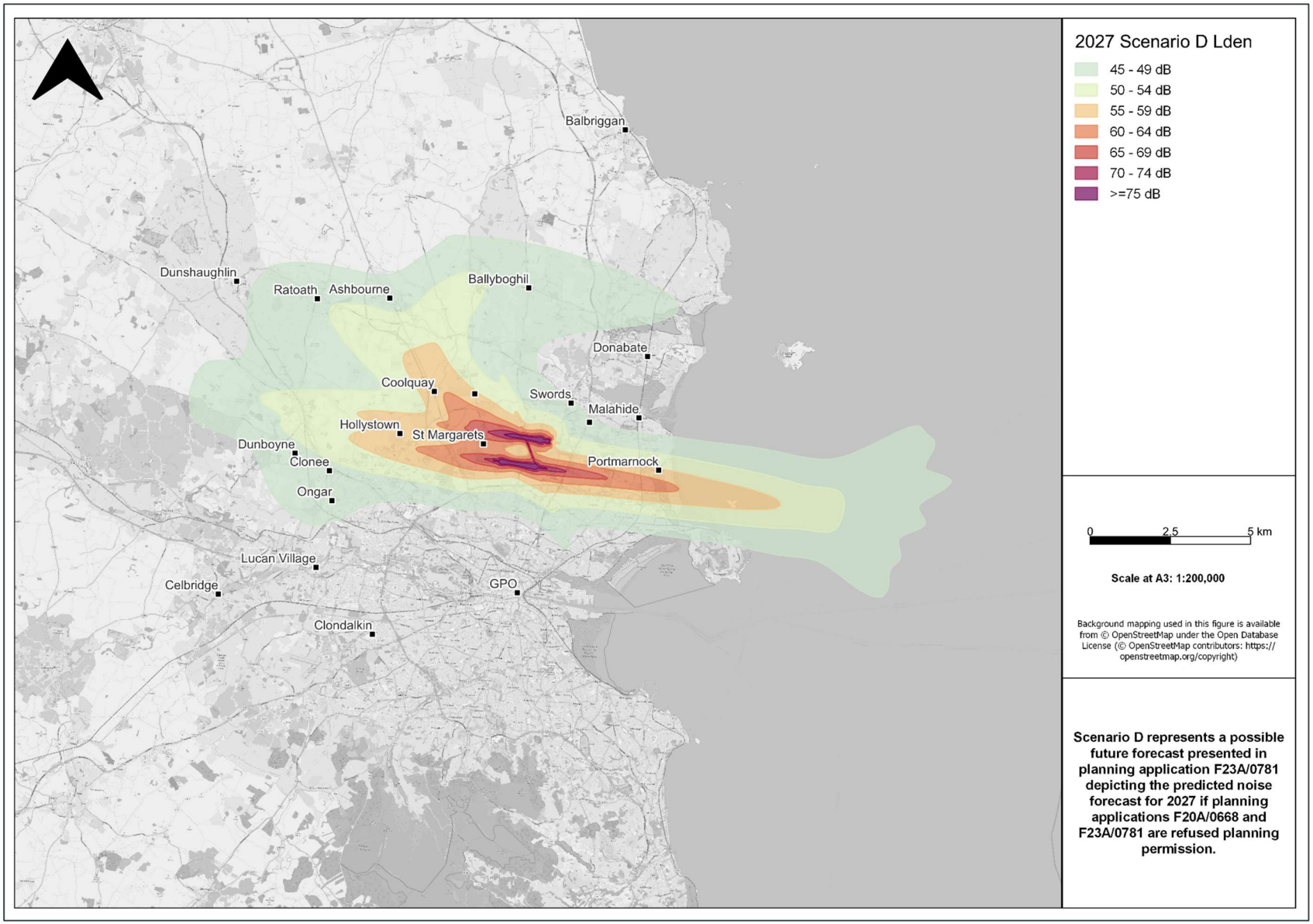
Scenario D represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 and F23A/0781 are refused planning permission.


2027 Scenario D Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
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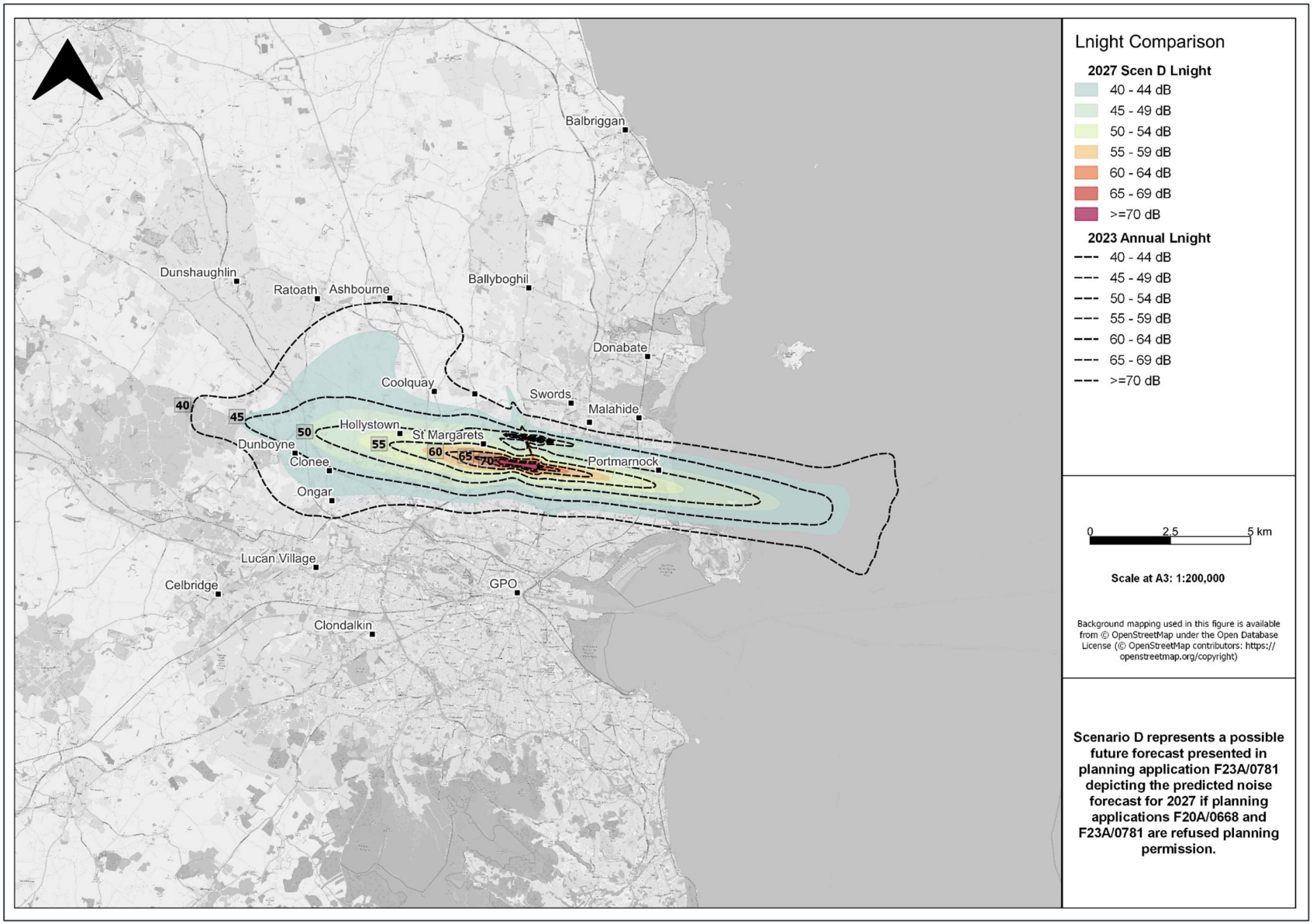
Scenario D represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 and F23A/0781 are refused planning permission.



Lnight Comparison

2027 Scen D Lnight

- 40 - 44 dB
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- >=70 dB

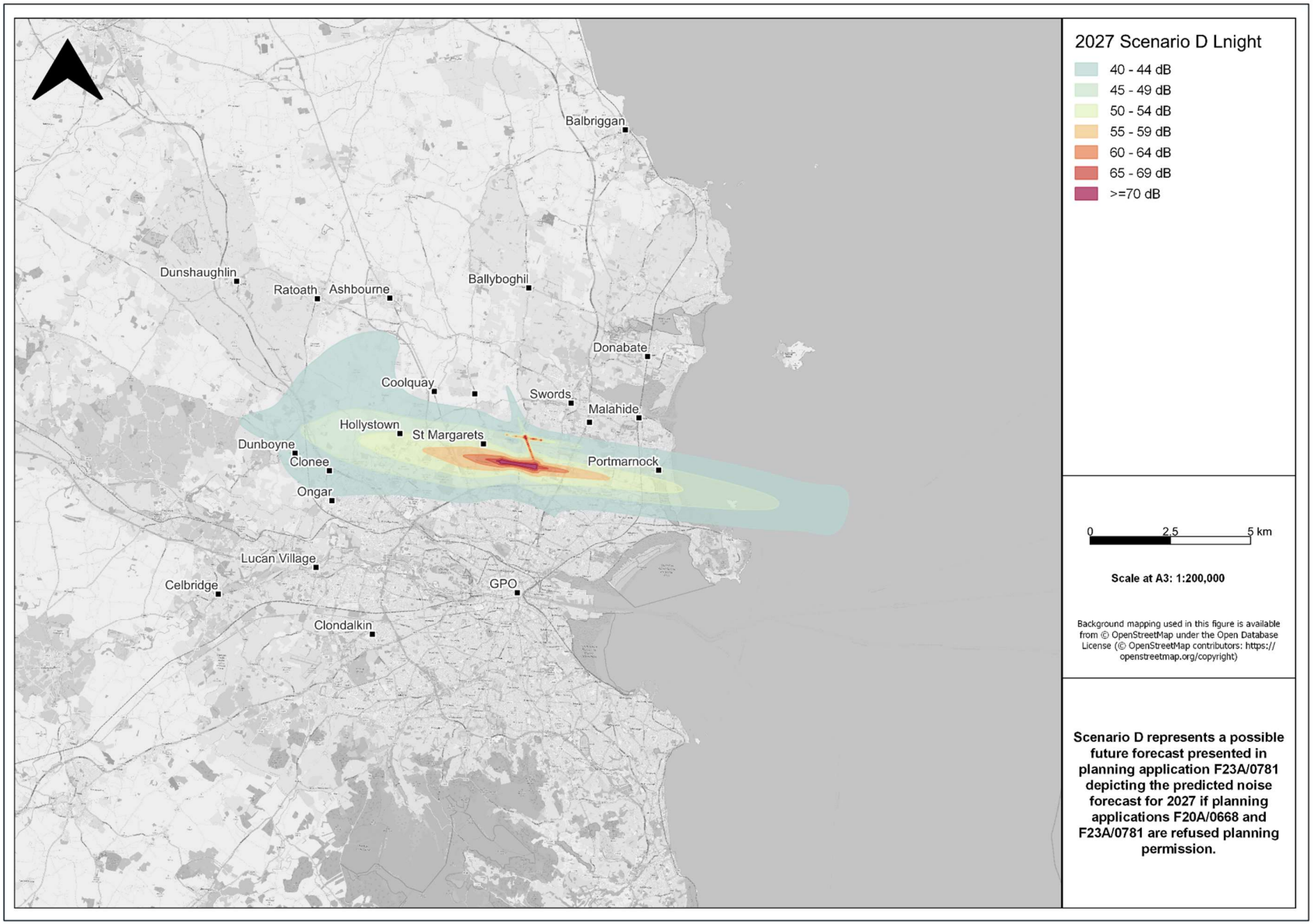
2023 Annual Lnight

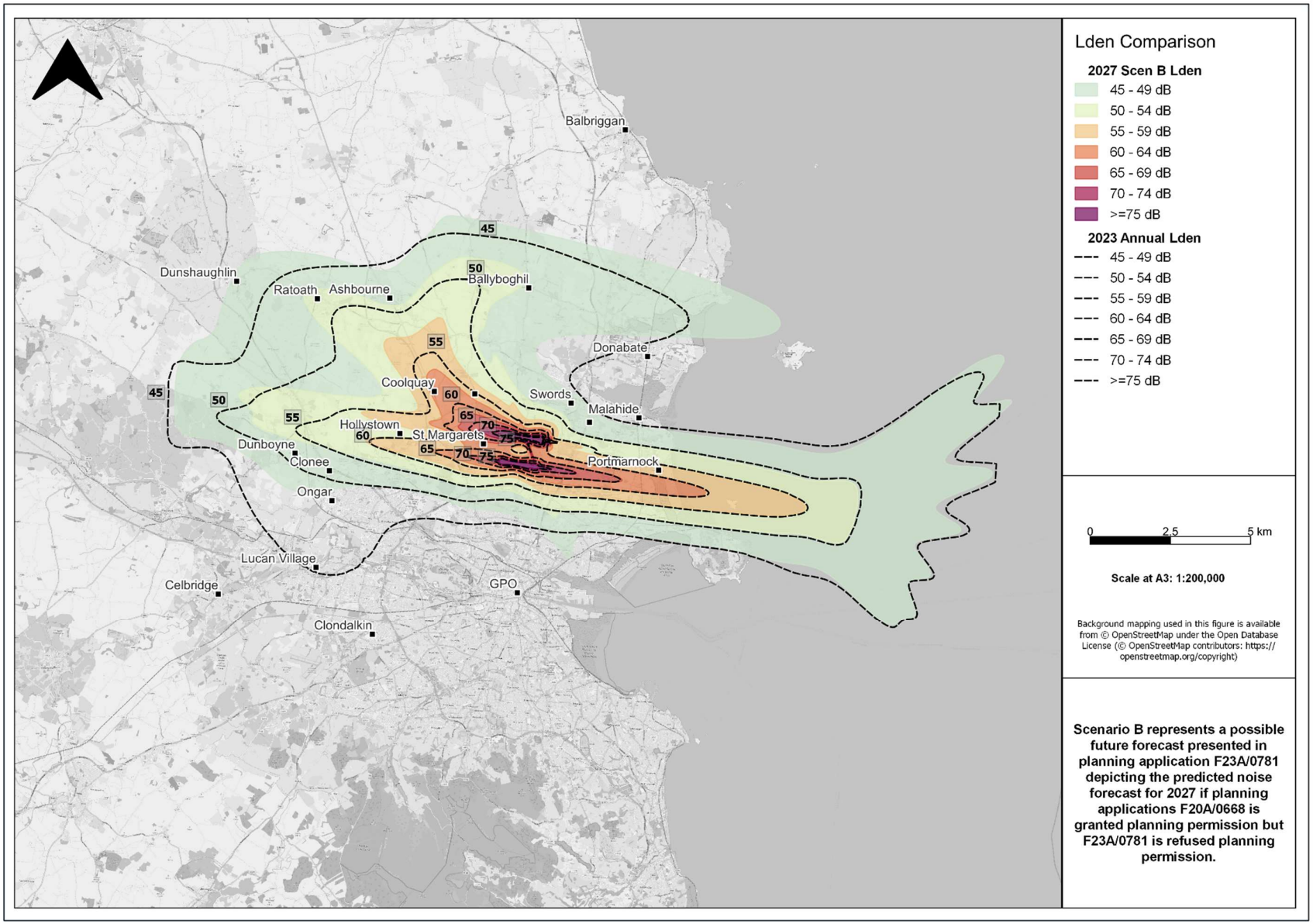
- 40 - 44 dB
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- >=70 dB

0 2.5 5 km

Scale at A3: 1:200,000

Scenario D represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 and F23A/0781 are refused planning permission.


2027 Scenario D Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario D represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 and F23A/0781 are refused planning permission.



Lden Comparison

2027 Scen B Lden

- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

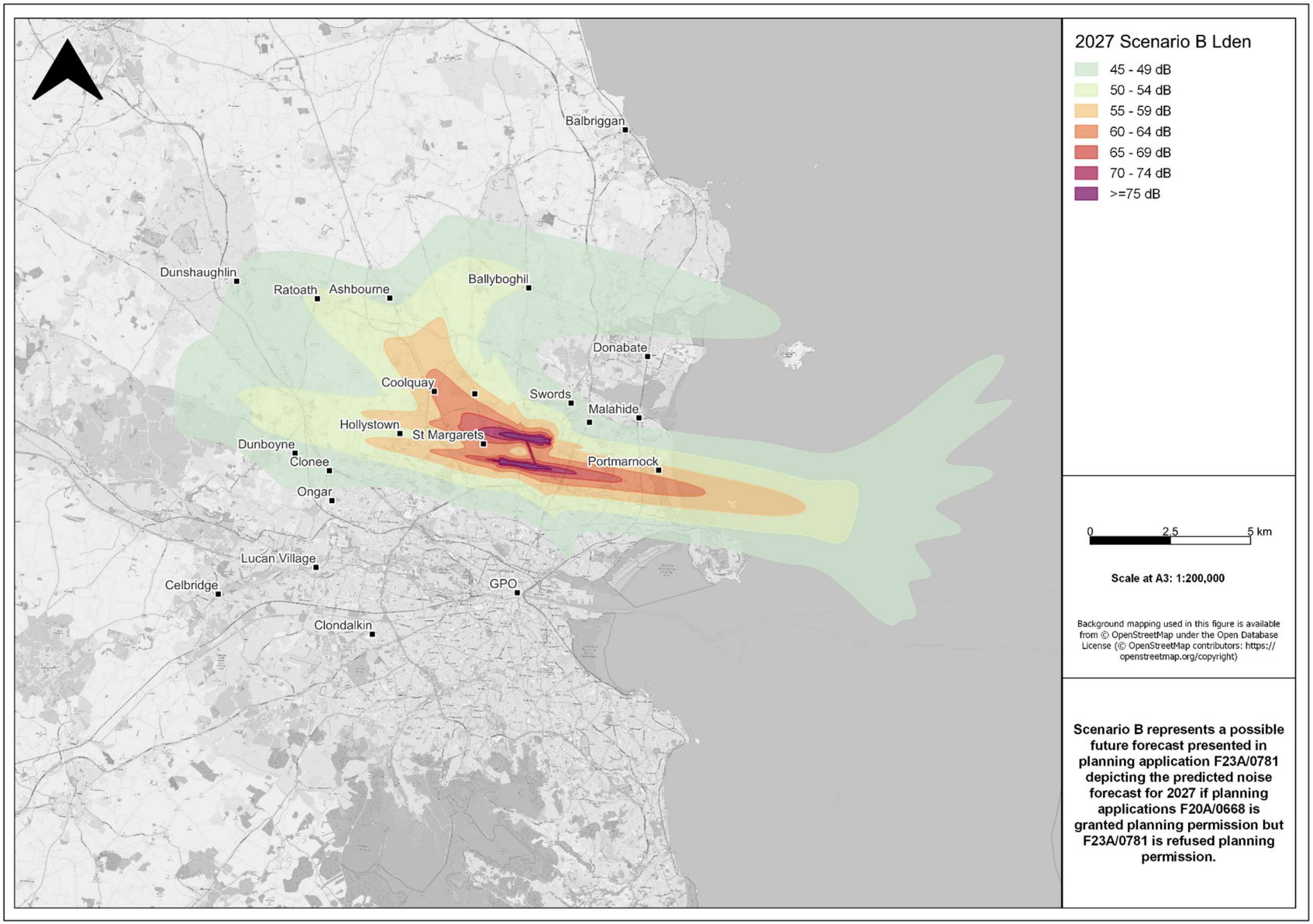
2023 Annual Lden

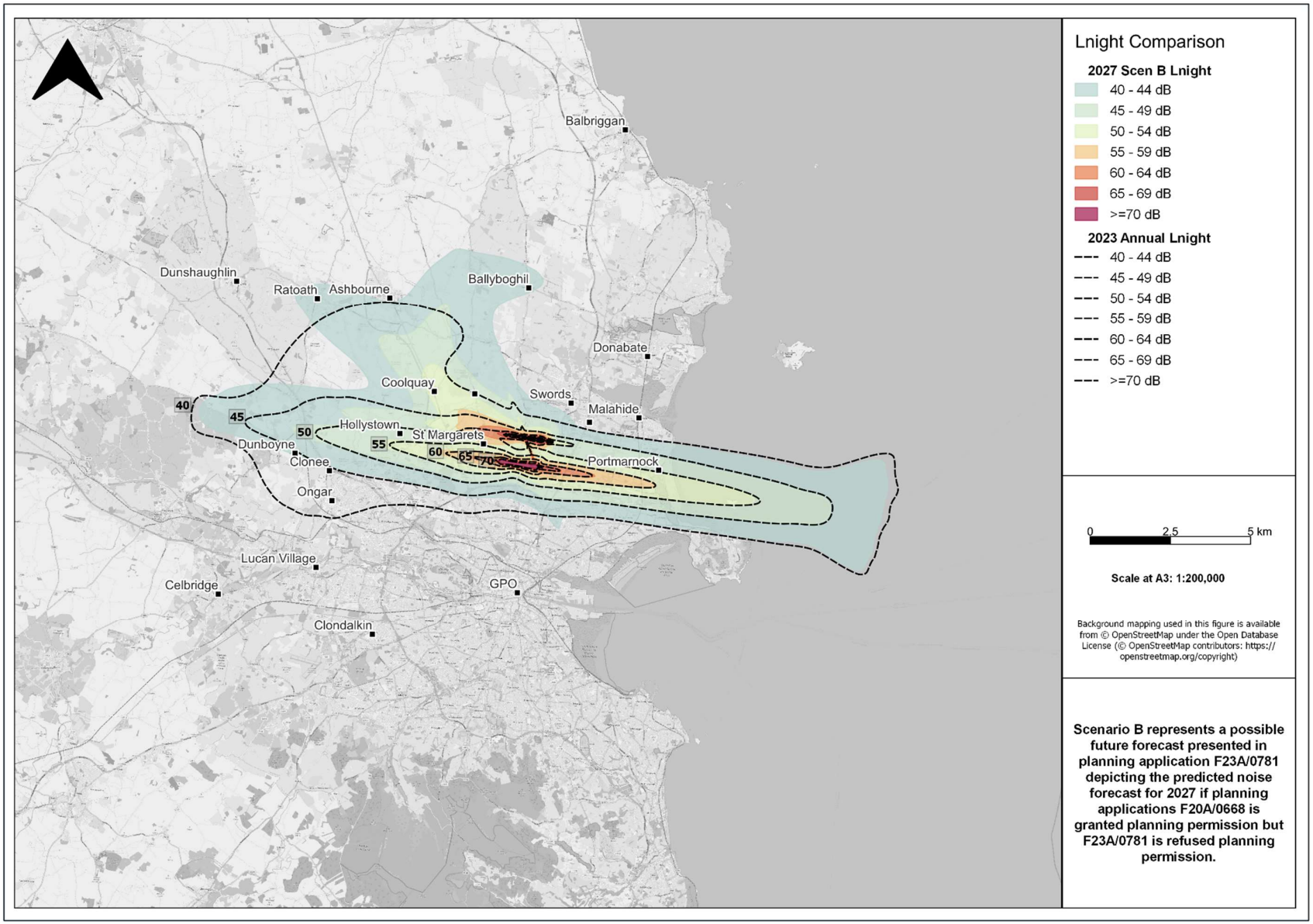
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

0 2.5 5 km

Scale at A3: 1:200,000

Scenario B represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 is granted planning permission but F23A/0781 is refused planning permission.


2027 Scenario B Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario B represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 is granted planning permission but F23A/0781 is refused planning permission.


Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
40
45
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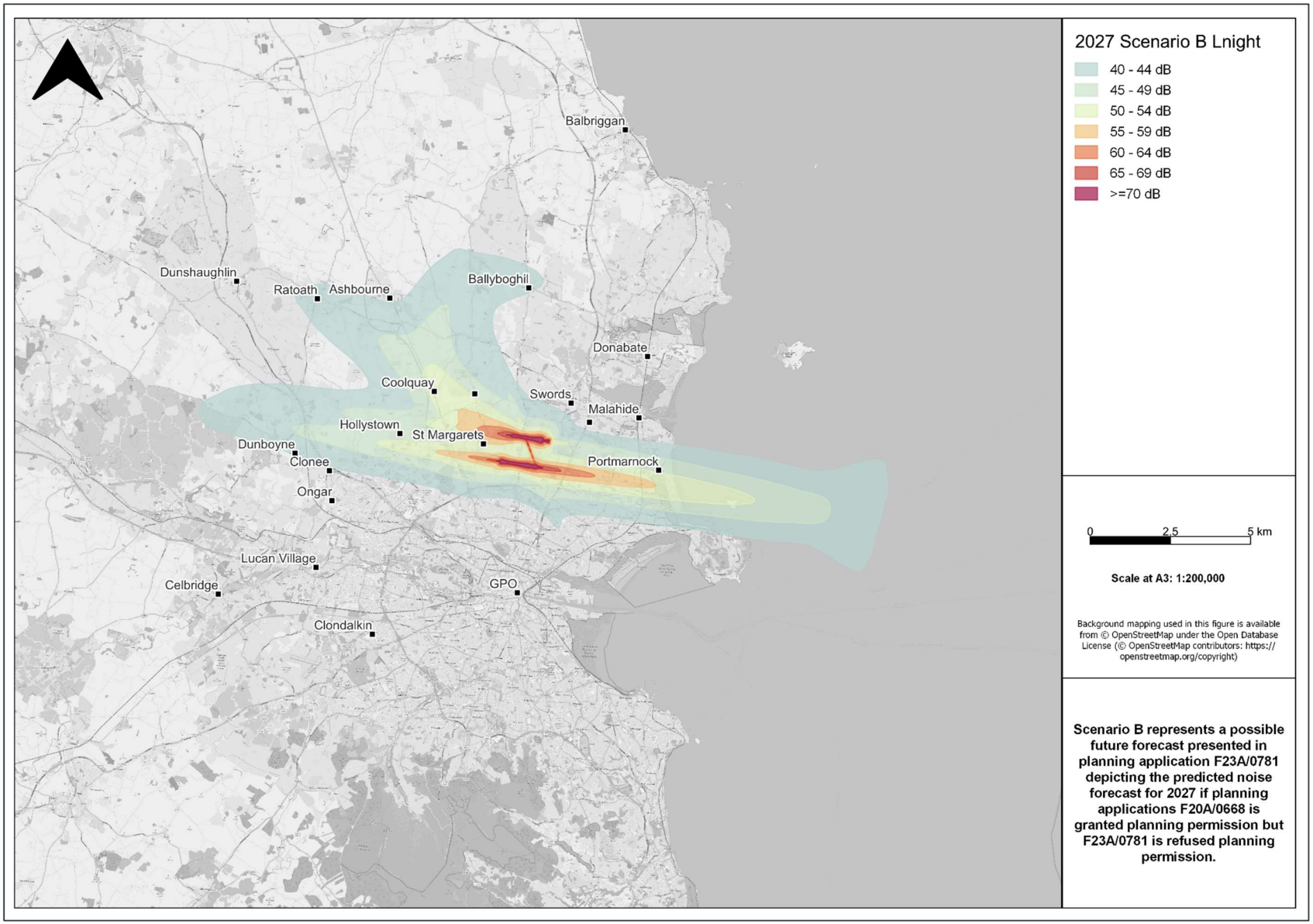
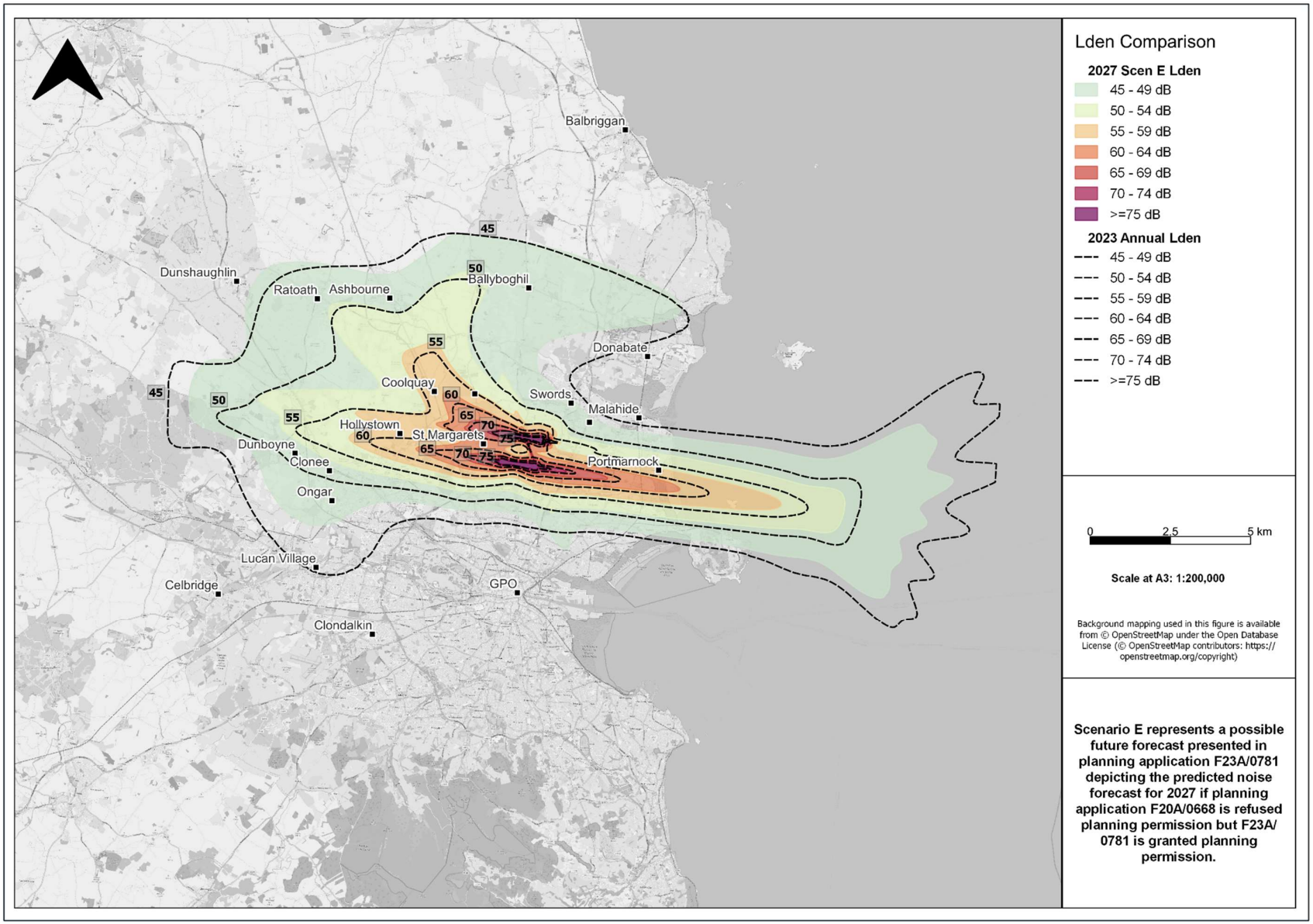
60
65
70
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
Lnight Comparison
2027 Scen B Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
2023 Annual Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario B represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 is granted planning permission but F23A/0781 is refused planning permission.


2027 Scenario B Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario B represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning applications F20A/0668 is granted planning permission but F23A/0781 is refused planning permission.



Lden Comparison

2027 Scen E Lden

- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

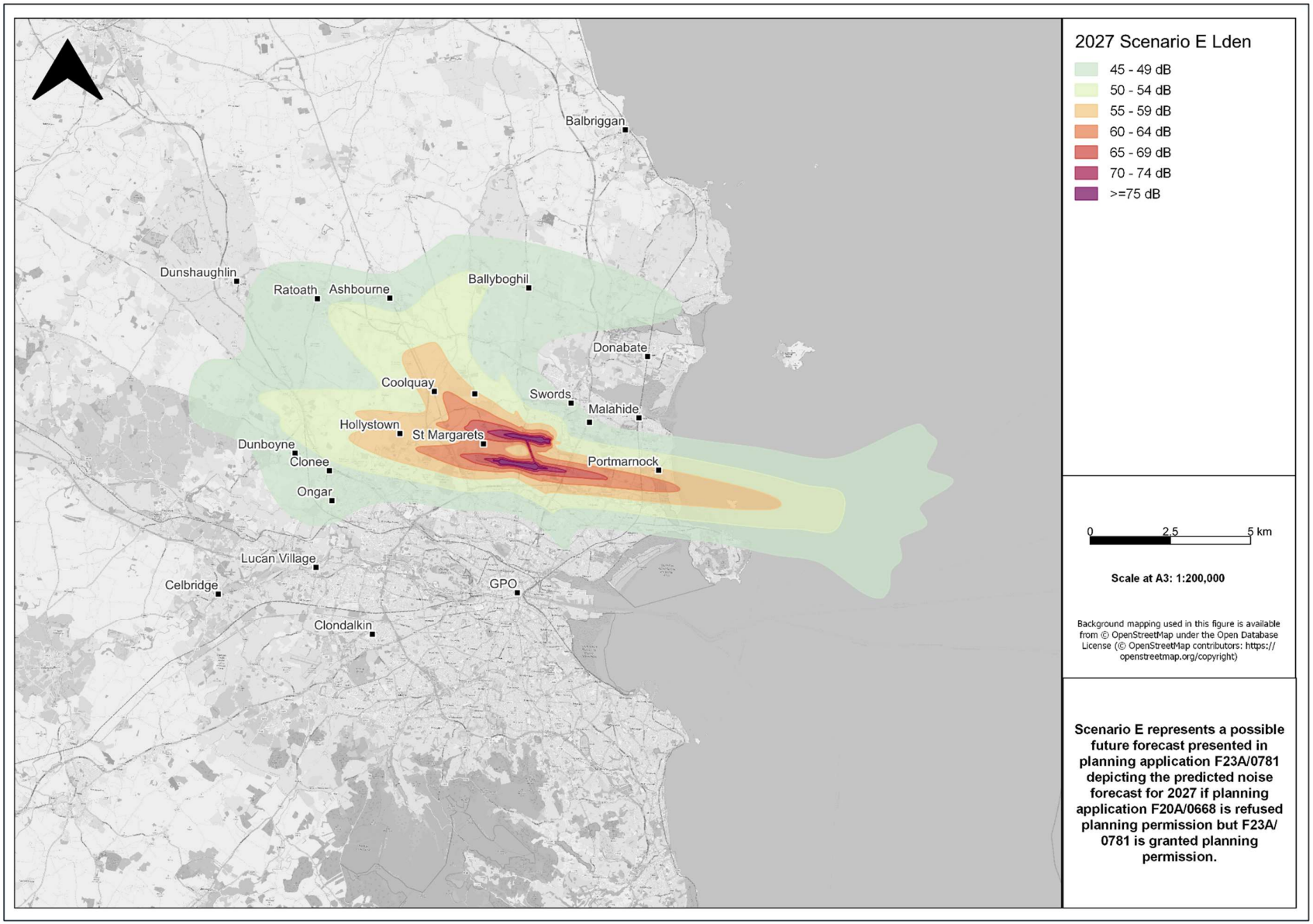
2023 Annual Lden

- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

0 2.5 5 km

Scale at A3: 1:200,000

Scenario E represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning application F20A/0668 is refused planning permission but F23A/0781 is granted planning permission.


2027 Scenario E Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
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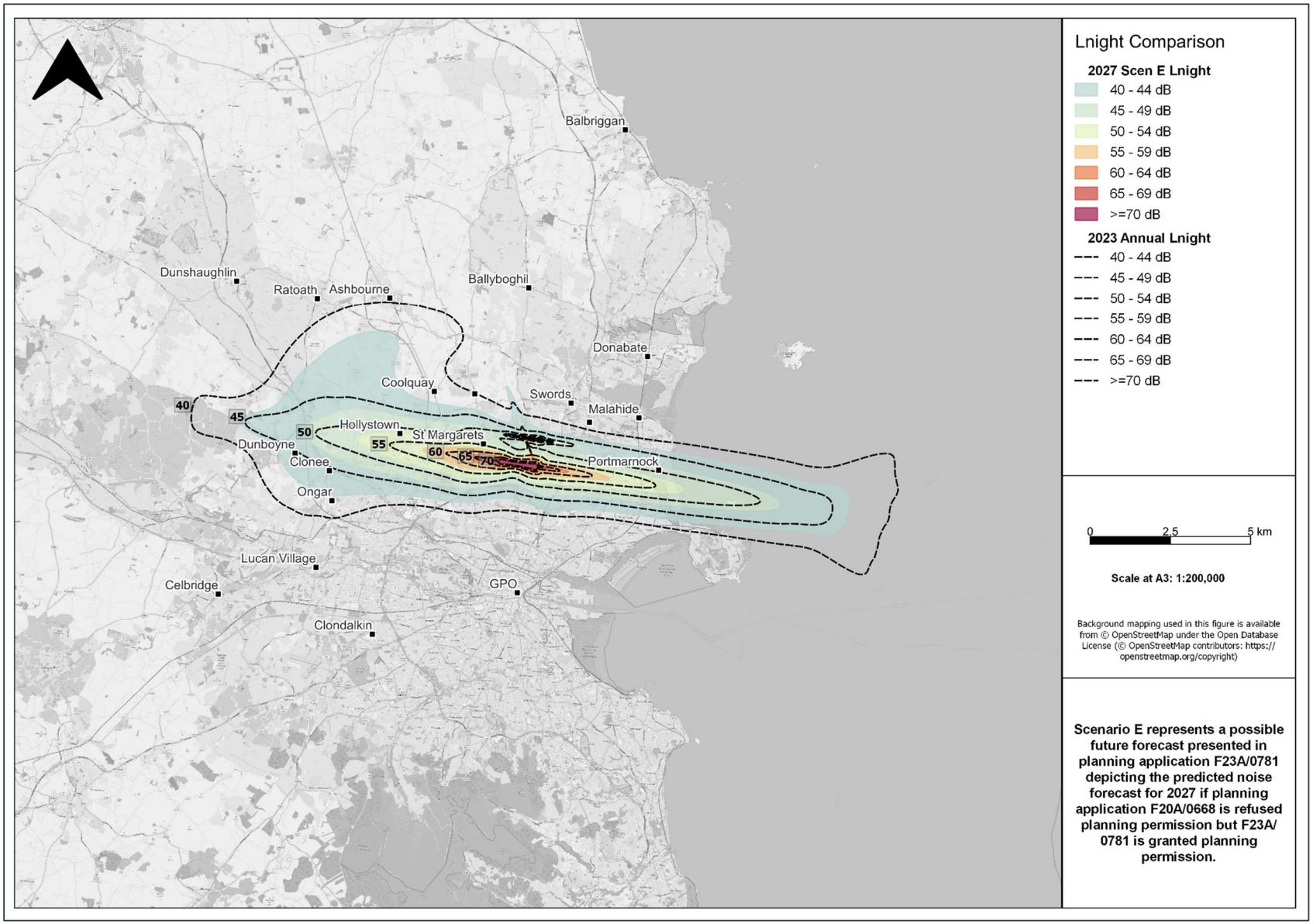


Lnight Comparison

2027 Scen E Lnight

- 40 - 44 dB
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- >=70 dB

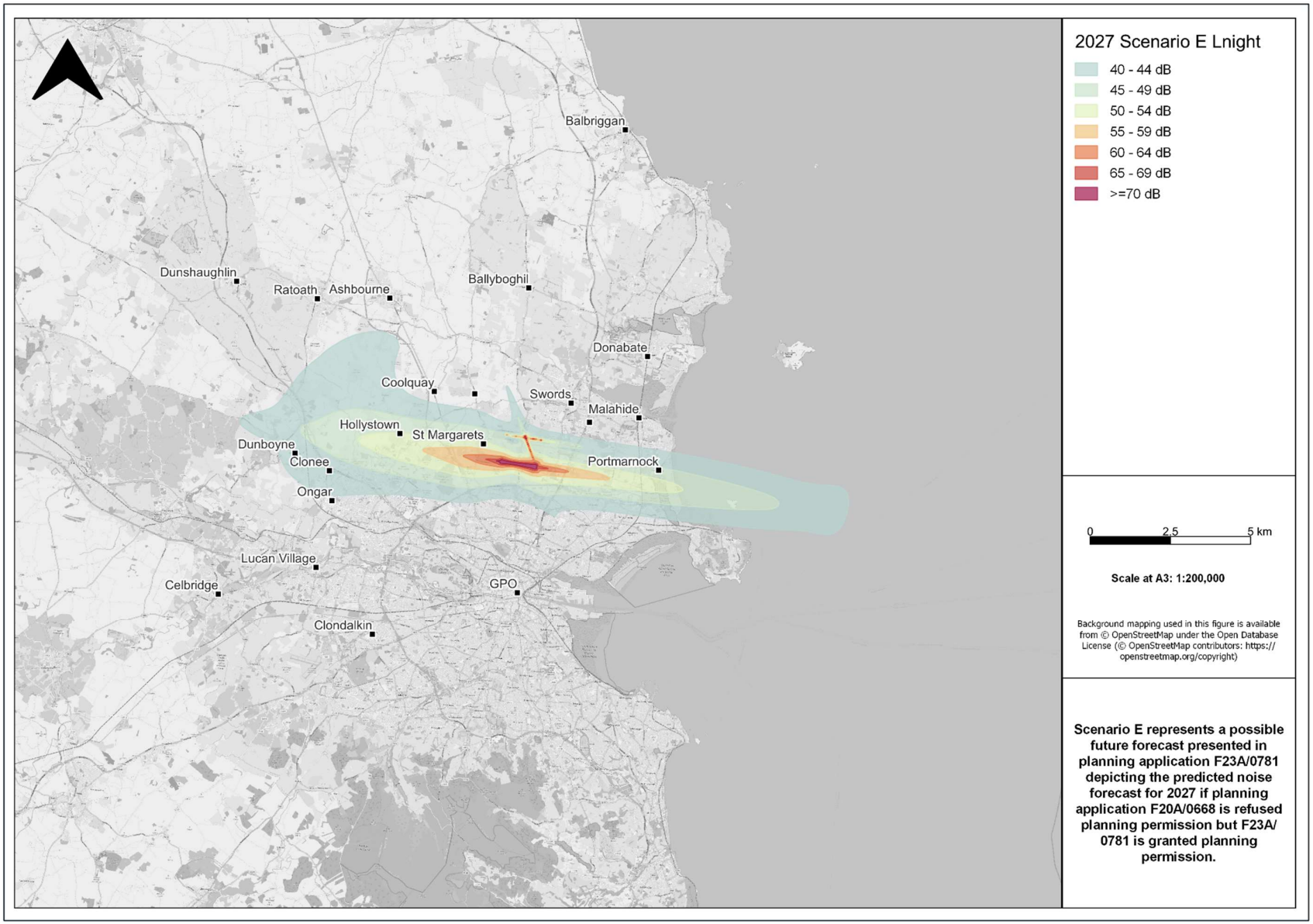
2023 Annual Lnight

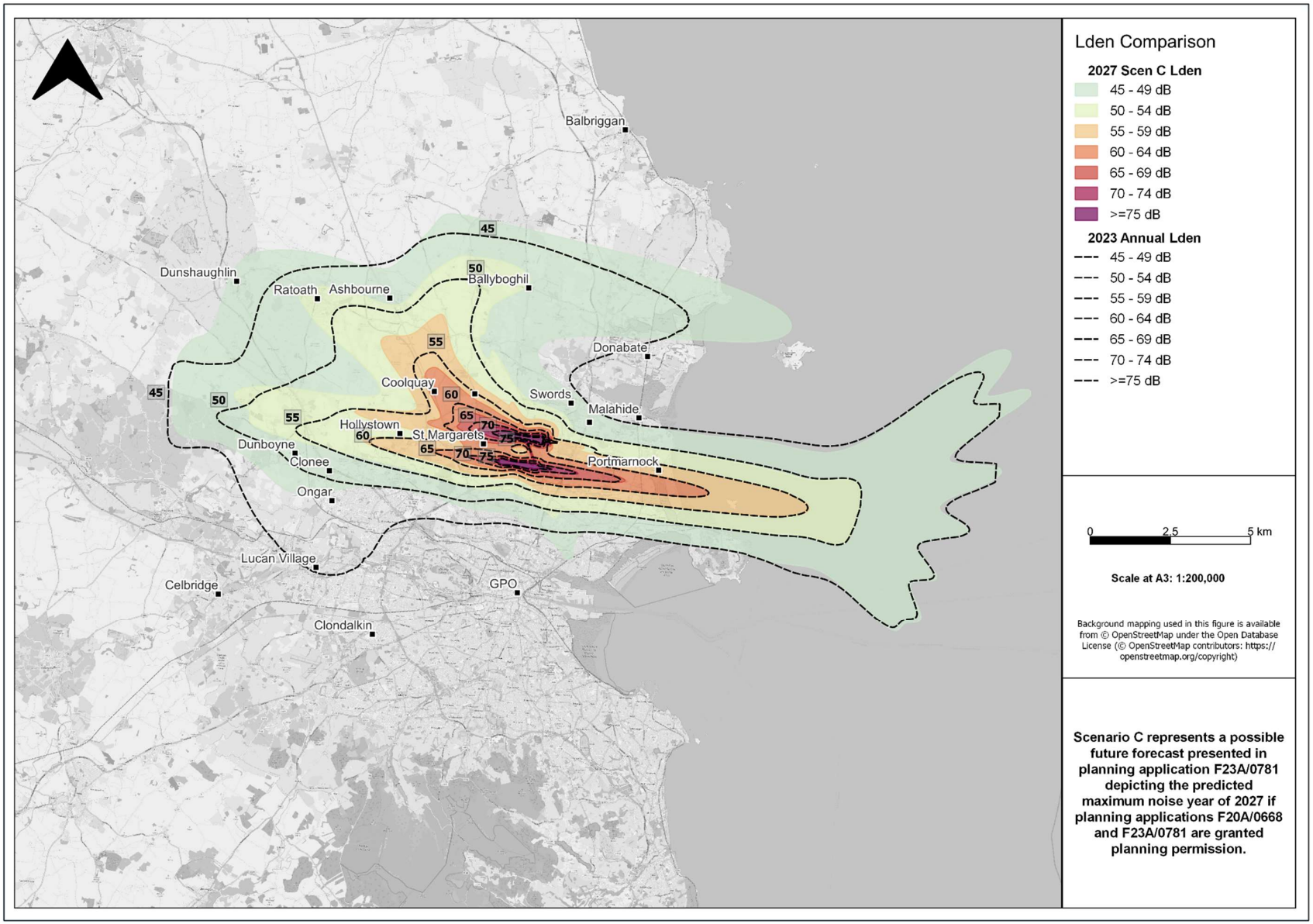
- 40 - 44 dB
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- >=70 dB

0 2.5 5 km

Scale at A3: 1:200,000

Scenario E represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning application F20A/0668 is refused planning permission but F23A/0781 is granted planning permission.


2027 Scenario E Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario E represents a possible future forecast presented in planning application F23A/0781 depicting the predicted noise forecast for 2027 if planning application F20A/0668 is refused planning permission but F23A/0781 is granted planning permission.



Lden Comparison

2027 Scen C Lden

- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

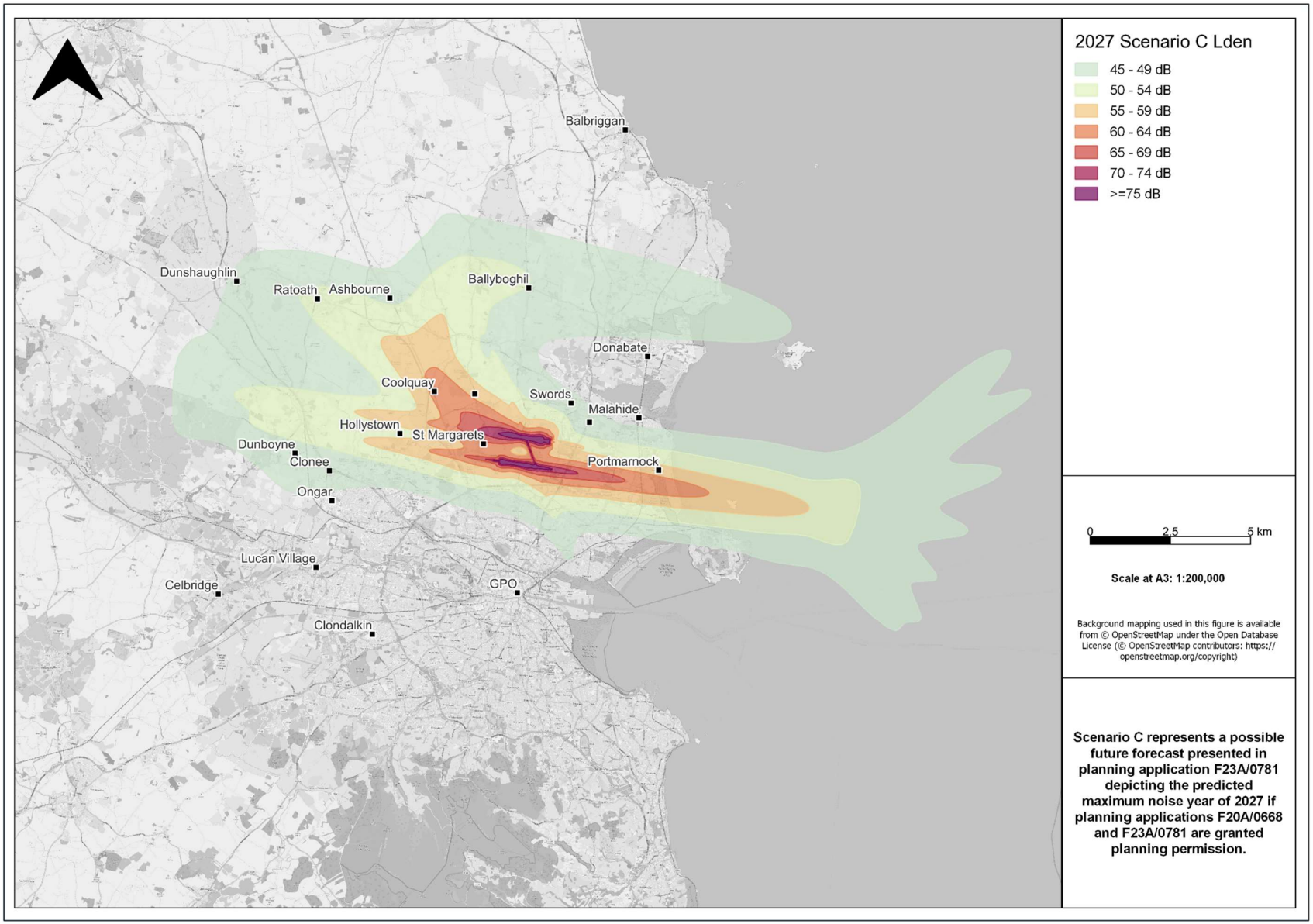
2023 Annual Lden

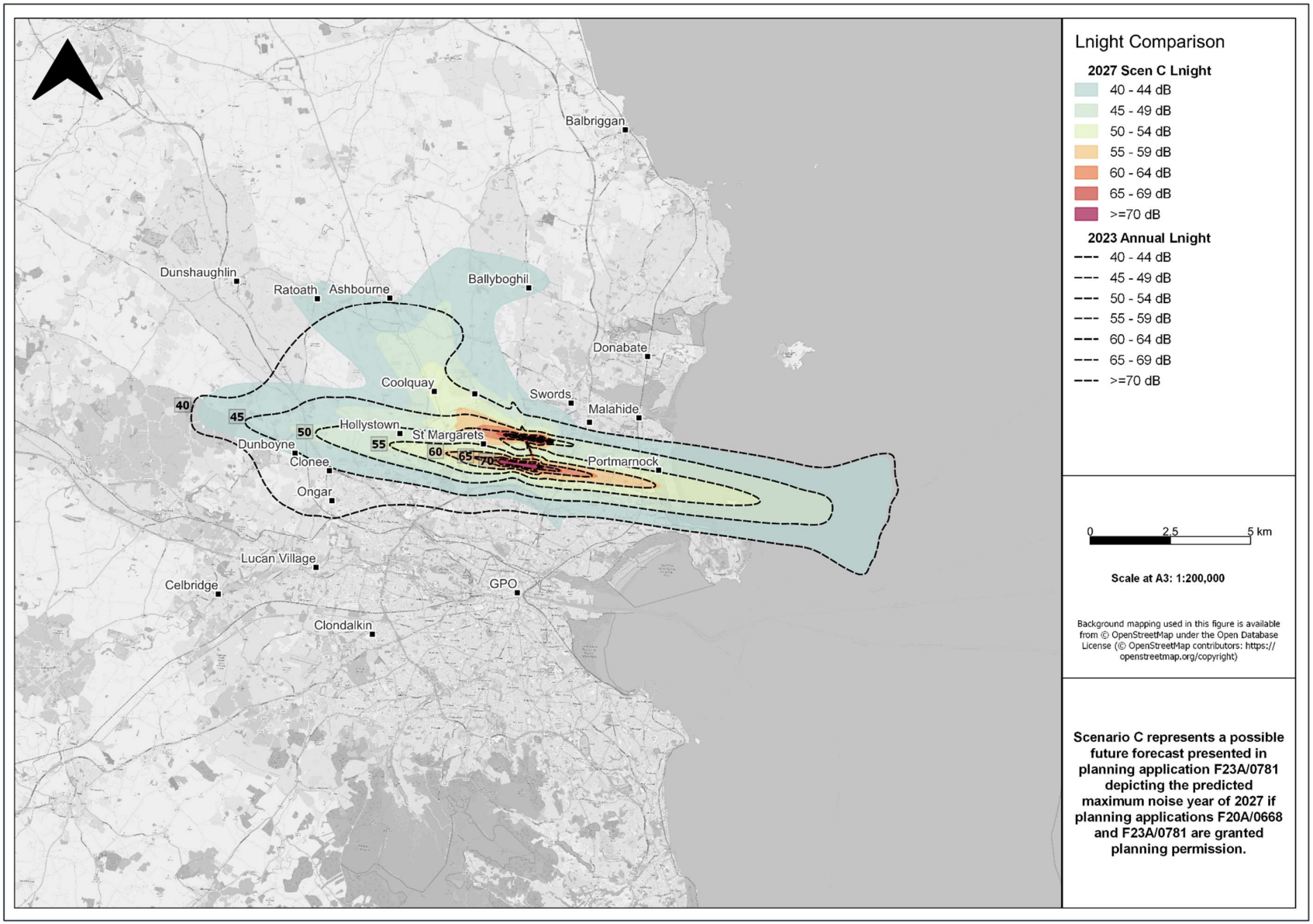
- 45 - 49 dB
- 50 - 54 dB
- 55 - 59 dB
- 60 - 64 dB
- 65 - 69 dB
- 70 - 74 dB
- >=75 dB

0 2.5 5 km

Scale at A3: 1:200,000

Scenario C represents a possible future forecast presented in planning application F23A/0781 depicting the predicted maximum noise year of 2027 if planning applications F20A/0668 and F23A/0781 are granted planning permission.


2027 Scenario C Lden
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
70 - 74 dB
>=75 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario C represents a possible future forecast presented in planning application F23A/0781 depicting the predicted maximum noise year of 2027 if planning applications F20A/0668 and F23A/0781 are granted planning permission.


Balbriggan
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St Margarets
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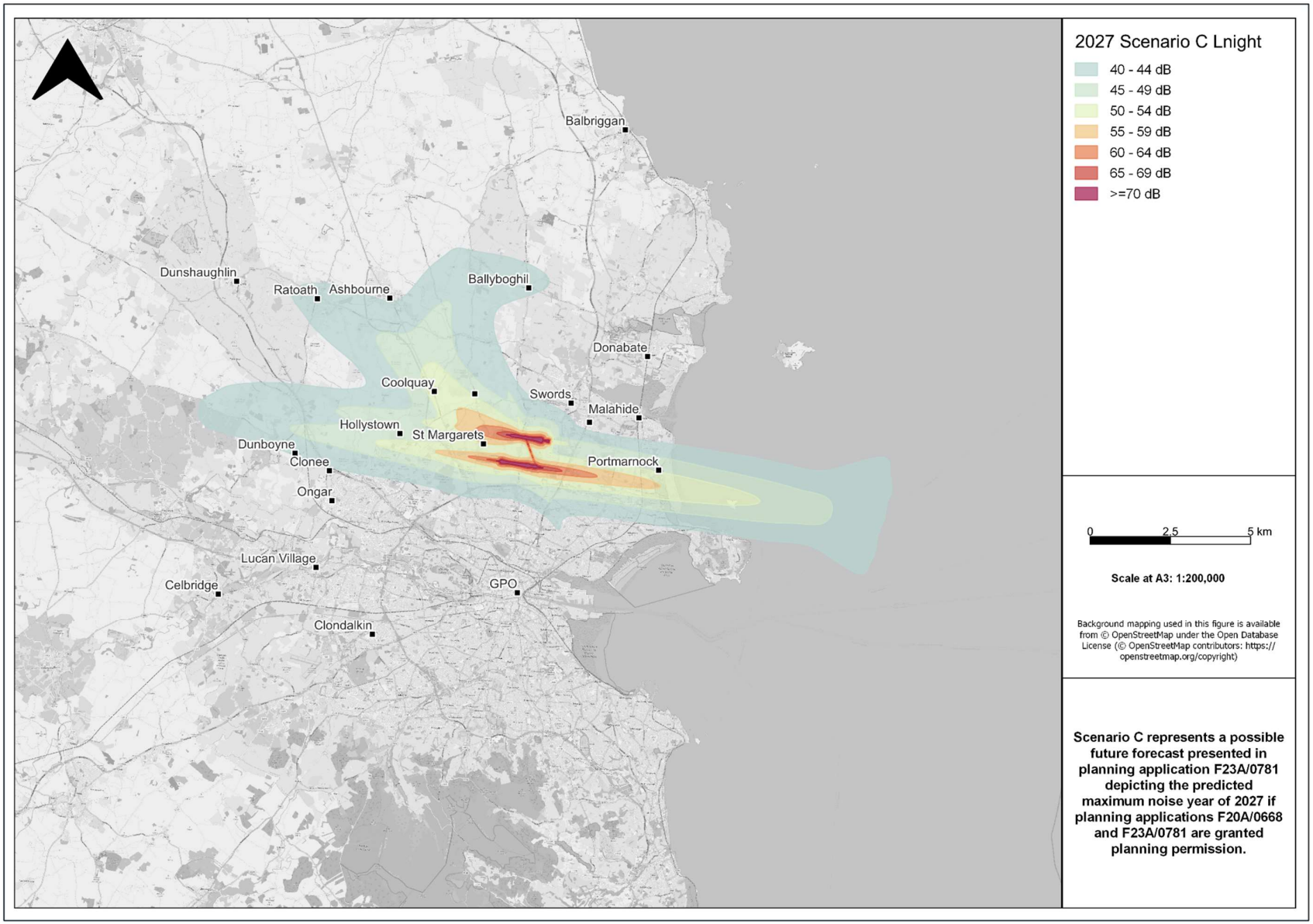
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
Lnight Comparison
2027 Scen C Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
2023 Annual Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario C represents a possible future forecast presented in planning application F23A/0781 depicting the predicted maximum noise year of 2027 if planning applications F20A/0668 and F23A/0781 are granted planning permission.


2027 Scenario C Lnight
40 - 44 dB
45 - 49 dB
50 - 54 dB
55 - 59 dB
60 - 64 dB
65 - 69 dB
>=70 dB
Balbriggan
Dunshaughlin
Ratoath
Ashbourne
Ballyboghil
Donabate
Coolquay
Swords
Malahide
Hollystown
St Margarets
Dunboyne
Clonee
Portmarnock
Ongar
Lucan Village
Celbridge
GPO
Clondalkin
0
2.5
5 km
Scale at A3: 1:200,000
Background mapping used in this figure is available from © OpenStreetMap under the Open Database License (© OpenStreetMap contributors: https://openstreetmap.org/copyright)
Scenario C represents a possible future forecast presented in planning application F23A/0781 depicting the predicted maximum noise year of 2027 if planning applications F20A/0668 and F23A/0781 are granted planning permission.

A6 Consultation: Public and Stakeholder Submissions

A6.1 Public Consultation Themes

A review of the public submissions categorised the responses into 12 themes.

Areas for improvement, which are outlined in the NAP are listed here where they align with themes presented in submissions during the public consultation. Some of these areas for improvement may come within the four NAP actions, which have a statutory basis for implementation.

A summary of the themes and submission description is given in **Table A6-1**.

Table A6-1 – Summary of Public Consultation Themes

Theme	Response	NAP Action	Amendment to draft NAP
Aircraft Noise Matters raised in relation to aircraft noise including: night-time, increasing, continuous or ongoing, constant, noise pollution, and the negative impact of noise. Financial incentives for quieter planes.	Aircraft noise is managed through regulation that applies the principles of the ICAO Balanced Approach by: Reduction of noise at source, Noise abatement operating procedures, Land use planning and management and Operating restrictions. ANCA has made a Regulatory Decision providing for a noise quote scheme, reporting requirements, a prohibition on the use of runway 10L/28R for take-off or landing between 00:00 and 05:59 (other than in specified circumstances) and a noise insulation scheme. In making regulatory decisions, reference is made to the Noise Abatement Objective (NAO) for the airport. Draft guidance from the EPA recommends	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes. **Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as	In addition to Noise Action No. 1 and No. 2, Noise Action No. 3 has been added to the Noise Action Plan to address issues raised through consultation on the draft Plan.

Theme	Response	NAP Action	Amendment to draft NAP
Matters raised in relation to noise measurement: actual measured noise (single event, SEL, Lmax), annual averaged noise. Noise monitoring terminals (NMTs) Matters raised in relation to Priority Important Areas Verification of Noise Contour Maps. Matters raised relating to the adequacy of, and confidence in the aircraft noise maps presented in the draft Noise Action Plan.	that the identification of priorities at Dublin Airport be aligned with the NAO for the airport, relevant planning conditions, and any Regulatory Decision made under the Act of 2019. The NAO aims to reduce the harmful effects of aircraft noise in the medium to long term compared to the noise situation in 2019. Additionally, the NAO prioritises ensuring that the number of people exposed to noise levels above 65 dB Lden and 55 dB Lnight does not exceed the numbers exposed in 2019. Existing mitigation measures are also in place through planning consent conditions. Existing noise mitigation measures at Dublin Airport reported by the airport authority to be implemented unless and until updated, replaced or omitted through relevant processes. These measures include those introduced voluntarily by the airport, flight procedures and the introduction of quieter aircraft by manufacturers. New measures may be introduced in a regulatory decision by ANCA. Measures to manage aircraft noise will be considered through the process of aircraft noise regulation through the balanced approach. Any measures and / or mitigation proposed in a regulatory decision will be open to public consultation.	amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate. **Noise Action No. 3** Carry out a review of the Noise Abatement Objective for Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies.	

Theme	Response	NAP Action	Amendment to draft NAP
	Priority Important Areas for Fingal are addressed as part of the draft Noise Action Plan 2024-2028 – Dublin Agglomeration. The noise mapping body is the relevant airport authority, (daa), as set out in the Regulations. The Regulations prescribe the use of standardised annual averaged metrics for the presentation and assessment of aircraft noise. The Noise Action Plan describes the legal basis for the selection of noise metrics and the periods of time across which aircraft noise is averaged and presented. The Plan also details the methodology for the preparation and revision of noise maps. The Regulations require the airport authority to prepare the noise maps in a prescribed manner. Noise maps are prepared on a five-year cyclical basis for all major sources of environmental noise on a common basis across the European Union (the relevant year being 2021 for the current process). Supplementary maps for the most recent full year (2023) have also been included to further inform the Plan. The noise climate is further considered through the process of aircraft noise regulation where appropriate. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.		

Theme	Response	NAP Action	Amendment to draft NAP
	In addition to the actions in the Noise Action Plan, the plan includes a range of measures to ensure the noise management framework at the airport will be improved. **Area of Improvement No.2** Opportunities may exist to identify and implement improvements in noise abatement procedures in the AIP. **Area of Improvement No.3** Reduction of noise at source is an important objective. The promotion of quieter aircraft incentives, particularly at night, such as FlyQuiet programmes or environmental charges schemes should continue to be progressed. **Area of Improvement No.5** A review of the locations of noise monitors has been identified in the NAP as one of a range of measures in the Areas of Improvement during the duration of the plan to ensure they are closely aligned with airspace operations.		
The Noise Abatement Objective for Dublin Airport. Matters raised in relation to achievement of the	As part of the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the competent authority shall ensure, that the noise abatement objective is, as appropriate, defined, restated or amended, to ensure that the noise management	**Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of	In addition to Noise Action No. 2, Noise Action No. 3 has been added to the Noise Action Plan to address issues raised

Theme	Response	NAP Action	Amendment to draft NAP
NAO target outcomes and requests for amendments the NAO.	objectives remain relevant in the context of an evolving noise climate. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate. **Noise Action No. 3** Carry out a review of the Noise Abatement Objective for Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies.	through consultation on the draft Plan.
Health Impacts Matters raised in relation to the health impacts of aircraft noise, particularly sleep disturbance and annoyance. Reference to WHO Guidelines.	The assessment of harmful effects is incorporated into relevant legislation for the purposes of noise assessment. Annex III of Directive 2002/49/EC sets out methods for calculating the number of people highly annoyed and the number of people highly sleep disturbed due to aircraft noise exposure, using the dose-response relationships from WHO Environmental Noise Guidelines for the European Region 2018 (ENG18). Although the WHO Guidelines are not statutory limits the principles have been incorporated in the NAO for Dublin Airport and in the legislative framework for noise assessment.	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes. **Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as	In addition to Noise Action No. 1 and No. 2, Noise Action No. 3 has been added to the Noise Action Plan to address issues raised through consultation on the draft Plan.

Theme	Response	NAP Action	Amendment to draft NAP
	The noise abatement objective for Dublin Airport (NAO), and the process of aircraft noise assessment has regard for the evidence and guidance presented in the WHO Night Noise Guidelines for Europe 2009 (NNG), and WHO Environmental Noise Guidelines for the European Region 2018 (ENG18). The NNG recommendations aim to protect the public, including the most vulnerable groups such as children, chronically ill and elderly people. These guidelines specifically reference noise-related effects arising from aircraft noise exposure levels measured using the outdoor long-term noise exposure metrics Lnight and Lden. These guidelines were drafted by a guidance development group including noise and medical professionals. This evidence, with respect to the dose-response relationships linking aircraft noise exposure to harmful effects on health (namely annoyance and sleep disturbance) have been adopted in Annex III of Directive 2002/49/EC, which is to be used alongside Annex II of Directive 2002/49/EC with respect to preparation of noise exposure maps. The NAP has regard to harmful effects on all sectors of the population. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate. **Noise Action No. 3** Carry out a review of the Noise Abatement Objective for Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies.	

Theme	Response	NAP Action	Amendment to draft NAP
Operational Flight Paths, Public Consultation and Engagement Matters raised in relation to location of flight paths around Dublin Airport & the process of public consultation associated with airspace design.	Flight paths are designed by the airport authority in conjunction with the air navigation authority and are subject to safety regulation assessment. If a noise assessment indicates that new operating restriction measures may be required to address a noise problem at the airport, Fingal County Council (through the functions implemented by ANCA) will ensure that technical cooperation is established between the airport operators, aircraft operators and air navigation service providers to examine measures to mitigate noise. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes. **Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate.	No amendment required, as these issues have already been addressed in the actions outlined in the draft Noise Action Plan.
Planning and Compliance Matters raised in relation to compliance with planning conditions and use of runways. Matters raised in relation to other statutory planning and appeal processes.	Fingal County Council addresses and manages planning applications, compliance and enforcement matters in accordance with relevant legislative requirements and relevant policy documents including the Fingal Development Plan 2023-2029. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes.	No amendment to the draft Dublin Airport Noise Action Plan.

Theme	Response	NAP Action	Amendment to draft NAP
Land Use Planning Matters raised on aircraft noise impact in relation to airport noise zones in the Fingal Development Plan.	The Fingal Development Plan 2023-2029 provides for Noise Zones in the vicinity of Dublin Airport to allow for effective land use planning for development within these zones. The noise zoning system has been developed with the overarching objective to balance the potential impact of aircraft noise from the Airport. Objective DAO15 of the Fingal Development Plan 2023-2029 relates to the ongoing review of operation of Noise Zones. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	**Noise Action No. 4** Undertake an encroachment analysis to ensure that plans and objectives remain relevant and effective to ensure that land use planning is an effective component of the ICAO balanced approach at Dublin Airport.	Noise Action No. 4 has been added to the Noise Action Plan to address issues raised through consultation on the draft Plan.
Complaints Management Matters raised in relation to the Dublin Airport Complaints Management System.	Fingal County Council does not have a role in in relation to the Dublin Airport Complaints Management System. **In addition to the actions in the Noise Action Plan, the plan includes a range of measures to ensure the noise management framework at the airport will be improved.** **Area of Improvement No. 1** Opportunities may exist to further develop the flight reporting software (Webtrak) as delivered during the 2019-2023 plan to provide additional community information such as flight tracks. It is important to ensure that there is community self-service access to	**Not Applicable**	No amendment to the Draft Dublin Airport Noise Action Plan.

Theme	Response	NAP Action	Amendment to draft NAP
	good quality information relating to the noise climate around the airport and the factors that influence it. **Area of Improvement No. 4** The noise complaints management system is a valuable tool for communities to report aircraft noise concerns. The process of accepting, responding to and using the information provided through the complaints system should remain under ongoing review to identify and implement process enhancements where possible.		
Flight Times and Volumes Matters raised in relation to increased flight volumes and the nighttime flights.	Although Fingal County Council does not have a role in the scheduling of flights, there are planning conditions in place which govern airport passenger capacity and limits on night-time flights. The hours of night-time operation of the north runway are governed by planning conditions and proposals to amend some aspects of these conditions are currently under appeal to An Bord Pleanála. The final conditions will be decided by ABP. Operating restrictions may be imposed through the process of aircraft noise regulation. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes. **Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate.	No amendment to the Draft Dublin Airport Noise Action Plan.

Theme	Response	NAP Action	Amendment to draft NAP
Home insulation and property purchase measures Matters raised in relation to the need for aircraft noise home insulation measures and the purchase of properties.	There are two existing home insulation schemes in place at Dublin Airport, the Home Sound Insulation Programme (HSIP) and the Residential Noise Insulation Scheme (RNIS). A further insulation scheme has been proposed by ANCA in a Regulatory Decision. The RNIS is subject to review every two years and additional homes may become eligible through this process. Planning conditions provide for the voluntary purchase of dwellings within defined exposure levels. Additional measures may also be provided through the process of aircraft noise regulation through a regulatory decision. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	**Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate.	No amendment to the Draft Dublin Airport Noise Action Plan.
Environmental Assessments Matters raised in relation to the need for Appropriate Assessment & Strategic Environmental Assessment.	**Environmental Assessments** In regard to matters raised in the need for Appropriate Assessment, the NAP is not a framework for decisions which could impact changes to any identified Natura 2000 sites. The actions within the NAP do not lead to an increase in flights at Dublin Airport, or to routes	Not Applicable	No amendment to the Draft Dublin Airport Noise Action Plan.

Theme	Response	NAP Action	Amendment to draft NAP
	that are flown, and therefore the NAP could not cause changes in approach and departure profiles over the identified SPA and SACs along the Dublin Coast. The NAP does not provide a specific framework for development or propose specific measures that may inform a change in the airport's operation; rather it provides a strategy to develop an evidence base that may help to develop measures for noise emissions reduction. Such measures will though, be proposed through mechanisms other than the NAP. As a result, it does not directly affect a Natura 2000 site. The AA screening determines that the NAP does not set the framework for future development consent, nor does it directly affect a Natura 2000 site. Therefore, in alignment with the guidance, it is determined that the NAP will generate no potential for Likely Significant Effects. Consequently, a Stage 2 Appropriate Assessment is not required. As a result, there is no requirement for mandatory SEA.		
Dublin Airport Expansion Matters raised in both support and rejection of further development at	The matters raised under this theme relate to growth of the airport. All applications for change at the airport are considered for noise assessment.	**Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of	No amendment to the Draft Dublin Airport Noise Action Plan.

Theme	Response	NAP Action	Amendment to draft NAP
Dublin Airport and other locations.	Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under this theme.	the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate.	
Issues raised that are outside the scope of the NAP Matters raised such as: - Air pollution - Carbon emissions - Climate Change - Greenhouse gasses - PFAS - Capacity at other airports. - Economic Issues	The matters raised under this theme relate to issues which are beyond the scope of the Noise Action Plan as required under the Regulations. The legal and policy context of the NAP specifically focuses on the management and assessment of aircraft noise as applied at Dublin Airport. It is not within the scope of the NAP to provide recommendations on how legislation, guidance or policy should be amended.	Not within the scope of the Dublin Airport Noise Action Plan.	No amendment to the Draft Dublin Airport Noise Action Plan.

A6.2 Stakeholder Consultation Themes

A submission was received from daa as a statutory consultee the noise mapping body for Dublin Airport.

A summary of the themes and submission description is given in **Table A6-2.**

Table A6-2 – Summary of Stakeholder Consultation Theme

Theme	Response	NAP Action	Amendment to draft NAP
Airport authority for Dublin Airport (daa) Matters raised in relation to: • Identification and implementation of noise mitigation measures, clear roles for stakeholders; • the importance of land use planning to prevent encroachment supported by regular reviews of noise zones;	The list of noise mitigation measures at Dublin Airport as reported by the airport authority from the Annual Compliance Report 2022, has been replaced by the list reported in the Annual Compliance Report 2023. Fingal County Council has included actions in the Dublin Airport Noise Action Plan that address the issues raised under these themes.	**Noise Action No. 1** Implement all noise mitigation measures at Dublin Airport unless and until updated, replaced or omitted through relevant processes. **Noise Action No. 2** Carry out the process of Aircraft Noise Regulation at Dublin Airport in accordance with the relevant provisions of the Act of 2019, the Planning and Development Act 2000 (as amended) (the Act of 2000) and/or the Aircraft Noise Regulation as appropriate. **Noise Action No. 3** Carry out a review of the Noise Abatement Objective for	Noise Action No. 3 has been added to the Noise Action Plan to address issues raised through consultation on the draft Plan. Noise Action No. 4 has been added to the Noise Action Plan to address issues raised through consultation on the draft Plan.

Theme	Response	NAP Action	Amendment to draft NAP
• **relevant noise abatement objectives that balance population growth and housing requirements with airport operations;** • **Effective planning and development processes and home insulation and voluntary property schemes.**		Dublin Airport to support sustainable community and airport development in accordance with relevant plans and policies. **Noise Action No. 4** Undertake an encroachment analysis to ensure that relevant plans and objectives remain effective to ensure that land use planning is an effective component of the ICAO balanced approach at Dublin Airport.	
Errata:	Description of Table 1-1 has been corrected	Not applicable	Error corrected